A STUDY REGARDING THE ORGANIZATIONAL CLIMATE

PRESCRIBED BY THE PHILOSOPHY OF W. EDWARDS DEMING

by

ANTHONY JAMES POLITO

(Under the Direction of K. ROSCOE DAVIS)

ABSTRACT

The management philosophy of Dr. W. Edwards Deming is often credited as the catalyst for the Japanese "economic miracle." A review of the literature reveals very little empirical research regarding the Deming philosophy under rigorous, quantitative scientific methodology. Most of the literature relates either anecdotal evidence of success or restates the central precepts of the philosophy to a new audience or a specific industry. A set of propositions was formed on the basis of statements made by Deming in his two major books on management philosophy. The Work Environment Scale, an established, mature survey instrument that measures organizational climate along a number of dimensions, was sent to a population of subject matter experts (SMEs) in the Deming philosophy in order to statistically test these propositions. Additional propositions, comparing the Deming prescription work environment to the work environment of another quality prescription, the Malcolm Baldrige Award, were also tested. The results contribute knowledge regarding certain facets of the Deming organization, observations that may be conducive to the future building of theory. In addition, the survey results contribute to a quantitative profile of the Deming prescription that can be used in future empirical research and hypothesis testing. An annotated list of the Deming subject matter experts is appended.

INDEX WORDS: Deming, W. Edwards Deming, Quality, Work Environment Scale, Social Climate, Organizational Climate, Baldrige, WES

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for

My mother, my first

and most enduring

professor.

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"Writing is an adventure. To begin with, it is a toy and an amusement. Then it becomes a mistress, then it becomes a master, then it becomes a tyrant. The last phase is that just as you are about to be reconciled to your servitude, you kill the monster and fling him to the public."

— Winston Churchill

As I now kill and fling *my* dead monster to the public, it is with great pleasure that I first take advantage of the traditional invitation to acknowledge and thank those who have helped bring this work to completion.

There are many friends, family and professional colleagues who have influenced, supported and/or provided the foundation for this work and I hope they will all take great pleasure in this, the result of their generous efforts. No doubt this work is not perfect and so I accept the full responsibility for any imperfections. I am, however, quite grateful for the opportunity given here to share the credit for the wisdom contained in this work with the many individuals who in some way contributed to its completion being made possible.

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the committee members contributed their time and talent graciously to the effort of completing a doctoral dissertation, an effort too frequently unrewarded within the industry of higher education. As the work neared its completion, it seemed as if we had truly moved away from a task wandering in the wilderness and toward the process of working as colleagues to solve a mystery of common design.

Special thanks should also be given to two individuals with whom I shared the doctoral student experience, Dr. Kevin Watson and Mr. Rik Berry, who have by now developed the most patient and persevering listening skills in this industry. Two other colleagues, Dr. David Saiia and Dr. Maureen Boyd, provided critical support. Not only did Drs. Saiia and Boyd provide a summer home quite conducive to dissertation work, but they guided me toward and into my first true academic position as well. As it is well known that authorial food and shelter is highly correlated to successful dissertation completion ($r^2 \geq .98$), this contribution cannot be overvalued.

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I should also thank, though they are too numerous and diverse to name, the many inspiring teachers throughout my schooling as well as the many individuals who authored inspiring books that were a critical part of my education; in sum, they crafted the lens through which I see the world in which we all must live, and their crafting was toward improvement.

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INTRODUCTION

Introduction

This first chapter of this dissertation generally introduces the reader to the overall nature of this study.

The second section of this chapter presents a profile of W. Edwards Deming in order to introduce the neophyte reader to Deming as well as to demonstrate compelling cause for Deming and his philosophy to be researched.

The third section of this chapter briefly summarizes the background of research regarding the Deming prescription to date in order to further orient the reader as well as to demonstrate the clear need for academic and exploratory research into the Deming prescription.

The fourth section of this chapter notes the appropriate academic calls to research. That section is followed by a section that presents the two general research questions toward which this study offers conclusions.

The fifth section of this chapter discusses the importance of this research toward future academic work as well as toward practitioner applications. It is followed by a section that presents the reader with a brief overview of the organization of the balance of the dissertation.

The final section of this chapter summarizes the information presented in this chapter and directs the reader toward the introduction of next chapter, which presents the detailed review of the literature.

Profile of W. Edwards Deming

This section of the chapter presents a profile of W. Edwards Deming in order to introduce the neophyte reader to Deming as well as to demonstrate compelling cause for Deming and his philosophy to be researched.

W. Edwards Deming is regarded by many individuals as the most important and influential management philosopher since Fredrick Taylor, "the father of management." The following brief profile highlighting Deming's work and honors should not only orient the reader to the topic of this study but should serve to persuade the reader that Deming is a worthy, if not essential, topic for academic management research.

Dr. W. Edwards Deming is widely credited as the individual most influential in the economic recovery of post-war Japan as well as the rise of quality as a operations technique and a management philosophy during the 20th Century; many statements to that effect can be found in print, comments within (Bean, 1985; Dixon, 1987; Kusumoto, 1987; Lazzareschi, 1993; Milstein, 1992) are exemplars. The Deming perspective, in the words of one Deming scholar,

> "destroys every important notion of management, shows that the important things learned in business school are not only wrong but that they lead to inferior results, poor quality, and customer dissatisfaction."

Deming held a Ph.D. in mathematical physics from Yale University. His ideas found little support among American management in general during the first half of the 20th century. Deming found his audience when he was among the American operations

experts that tutored Japanese managers during Japan's reconstruction after World War II. In 1946, Deming joined the faculty of the School of Business at New York University (Stern), where he regularly lectured until 1992.

In 1980, a year in which the per capita gross national product in the United States, once first in the world, had fallen to seventh place, an NBC broadcast *If Japan can, why can't we?* highlighted Deming's teachings. Thereafter, Deming's advice was avidly sought in America; he consulted regularly at Ford, and at GM as well. In 1986, Deming authored *Out of the crisis* (Deming, 1986) to warn Western managers as to the causes and severity of the decline in their economy. In 1991, Deming developed within his final book, *The new economics for industry, government, education* (Deming, 1994), his System of Profound Knowledge, which he called

> "a comprehensive theory for management, providing the rationale by which every aspect of life may be improved."

The 1990s have seen a major proliferation of Deming organizations and study/user groups, though the full numbering is not truly known. As of this writing, there are at least a hundred such groups in the United States, two dozen in England, as well as in many other areas of the world, including Australia, Brazil, Canada, France, Indonesia, Madagascar, Norway, Russia, Sweden, Switzerland, and Taiwan. The most prominent American organization is The Deming Institute in Washington, District of Columbia; its stated mission is "to foster understanding of the Deming System of Profound Knowledge to advance commerce, prosperity and peace." The worldwide distribution rights for Deming's books and videotapes are held by MIT's Center for Advanced Educational Services. Bulgarian, Chinese, Dutch, French, Italian, Japanese, Portuguese, Russian, Serbian, Spanish and Turkish translations of Deming's books are currently available.

Dr. Deming was honored and respected worldwide. The Second Order Medal of the Sacred Treasure was bestowed on Deming by Emperor Hirohito for his contributions to Japan's economy. The main lobby of the Toyota headquarters building in Tokyo is dominated by three portraits, one of the company's founder, the second of its current board chairman and the third, and largest, of Dr. Deming. In 1983, Deming was elected to the National Academy of Engineering. In 1985, Deming began lecturing at Columbia University under the title of Distinguished Visiting Scholar. In 1986, he was inducted into the Science and Engineering Hall of Fame. Also in 1986, Deming received the National Medal of Technology from President Reagan "for ... his advocacy to corporations and nations of a general management philosophy that has resulted in improved product quality with consequent betterment of products available to users as well as more efficient corporate performance." Shortly thereafter, Deming received an award for his "Distinguished Career in Science" from the National Academy of Sciences.

There are several awards that carry Dr. Deming's name. In 1950, Japan's highest national award for quality, named the Deming Prize, was established by JUSE, the Japanese Union of Scientists and Engineers. The American Society of Quality has annually named an individual who significantly contributed to the Deming philosophy as a Deming Medallist since 1979. In 1995, the American Statistical Association established the Deming Lecturer Award in honor of Deming's accomplishments.

Dr. Deming was granted honorary advanced degrees by The University of Wyoming, Rivier College, The University of Maryland, Ohio State University, Clarkson College, The University of Miami, George Washington University, The University of

Colorado, Fordham University, The University of Alabama, Oregon State University, American University, The University of South Carolina, Yale and Harvard.

In the 1990s, Newt Gingrich lectured on the value of Deming methods, finding that they would be "one of the five pillars upon which American civilization would be renewed in the 21st century." *Workforce* magazine named Deming as one of the twenty-five visionaries who redefined the thinking, actions and capabilities of society during the last 75 years. The cover story of the April 22, 1991 edition of *U. S. News and World Report* gave even greater weight to Deming's significance when it discussed the "nine hidden turning points in human history;" the ninth turning point was Deming's fathering of the Japanese quality revolution, and called him "a turning point of business history made flesh." In 1994, Deming was included in *Fortune's* National Business Hall of Fame. Bill Clinton, in a July 1993 Chicago speech on the future of the American workplace, named a book about Dr. Deming and his philosophy as one of three, that, if read by every worker, would vastly improve the productivity of America. In November, 1999, *Fortune* stated that "together, Fredrick Taylor, Peter Drucker and W. Edwards Deming have had more influence on the conduct of business and the quality of life in the United States and abroad more than any CEO." On October 25 of that same year, the *Los Angeles Times* listed Dr. Deming as among the fifty people or groups who most influenced business in the 20th Century. Also in 1999, the American Management Association included in its list of "The 75 Best Management Decisions Ever Made" that of Toyota's acceptance of Deming's advice.

Background of Deming Research

This section of this chapter briefly summarizes the background of research regarding the Deming prescription to date in order to further orient the reader as well as to demonstrate the clear need for academic and exploratory research into the Deming prescription.

The previous section of this chapter demonstrated that the Deming management philosophy has been highly and widely regarded, and so a worthy topic, to some degree, of management research. It is surprising, then, to find that there is a virtual absence of rigorous academic study regarding the Deming prescription for management. The review of the literature for this study included approximately 150 articles, forty books, 100 article abstracts, fifteen dissertation abstracts, 100 newspaper articles, 100 newspaper article abstracts, as well as the entries within databases providing full coverage for well over 10,000 journals and trade magazines.

That search resulted in the location of no more than twenty works that represent rigorous, quantitative analytical attempts to build knowledge regarding the Deming philosophy via the scientific method, eight of those works being dissertations. A significant portion of the literature located during this literature review is best described as trade press cases informally anecdoting successful improvement through employment of the Deming prescription. Much of the balance of the literature located can be described as publications seeking to clarify and or exemplify some portion of the Deming prescription or publications seeking to restate the Deming prescription toward a niche audience, functional area or industry.

Calls to Research

This section of this chapter notes the appropriate academic calls to research.

The abundance of anecdotal support astride the absence of significant academic research regarding such a revered prescription in itself effects a compelling call to some type of research of the topic. Indeed, one call for research into the Deming prescription found in the literature is based on this exact argument:

> "Despite the apparent effect that the Deming management method has had on the practice of management around the world, there is little empirical research support for its effectiveness beyond anecdotal evidence. … Academic attention on the Deming management method has, in fact, been surprisingly sparse. … Other researchers are encouraged to critically examine the Deming management method approach to quality management." (Anderson, Rungtusanatham, & Schroeder, 1994)

Other statements in the literature that identify this gap between anecdotal success and rigorous research further contribute to a call for scientific study of the Deming prescription:

> "Despite the paucity of scientific evidence attesting to the effectiveness of W. Edwards Deming's quality management approach (see Deming, 1986, 1993), it has received considerable attention from manufacturing and service organizations around the world." (Rungtusanatham, Forza, Filippini, & Anderson, 1998)

> "There is also general agreement, however, that Deming's approach and related TQM methods lack an emphasis on careful analysis …" (Saunders & Saunders, 1994)

> "In parallel to this trend among practitioners [to adopt total quality management practices] … a plethora of prescriptive quality management literature has also emerged … each [guru] identifies a set of 'key practices' … [such as] Deming's Fourteen Points. While these claims are seldom accompanied by rigorous supporting evidence, they do have some degree of face validity. Similar anecdotal evidence and inferential evidence has been put forth by a variety of consultants, quality associations, and governmental agencies. The disappointing aspect of this debate is that after more than two decades of such claims, exceptionally

> little … rigorous empirical research has been conducted to verify them." (Dow, Samson, & Ford, 1999)
>
> "Despite the impact that Deming and his Fourteen Points have had on the practice of quality management, empirical support for the effectiveness of the Deming Management Method has not advanced beyond the presentation of anecdotal, case-study evidence." (Anderson, Rungtusanatham, Schroeder, & Devaraj, 1995)

Fred Luthans, in "Theory D and O. B. Mod.: Synergistic or opposite approaches to performance improvement?" (Luthans & Thompson, 1987) also specifically calls for research into the efficacy of the Deming prescription.

The Two General Research Questions

This section of the chapter presents the two general research questions toward which this study offers conclusions.

To this point, this chapter has demonstrated that the Deming prescription has been highly and widely regarded, and so a worthy topic, to some degree, of management research, that there is a virtual absence of rigorous academic study regarding that prescription, and that the abundance of anecdotal support versus the almost total absence of significant academic research regarding that prescription effects a compelling call for formal research into that prescription, a call that was echoed in the literature by a number of researchers. Given the situation that there were no active "streams" of Deming research to "extend," special consideration was given to the type and aim of this research, to the selection of two general research questions that guided the study and to the future value of the research to academics and practitioners.

The absence of mature theory regarding this topic begs the use of exploratory, empirical research. Such research yields knowledge useful toward the future building of theory, contributes realism to topic knowledge and generates appropriate questions for

future research. Further, empirical research often serves as the catalyst for theoretical research. For example, a recent rigorous empirical analysis that finds "clear evidence that the long-term performance of firms that implemented TQM is improved" (Easton & Jarrell, 1998) contributed demand for theoretical work in quality management.

It is for these very reasons that operations management researchers have made recent calls to increase the use of empirical research in the field of operations management. For example, within "Alternative research paradigms in operations," Jack Meredith calls for a broader spectrum of research methodologies in operations management research. He points out that in a review of articles published in the three top operations management journals that they were essentially void of field, expert panel and survey methodologies, and that these are the methods best suited to support fulfillment of needed research in quality management (Meredith, Raturi, Amoako-Gyampah, & Kaplan, 1989). The article "Empirical research methods of operations management" also encourages empirical research and points out that empirical data is important for longitudinal studies and theory-testing, topics generally ignored in operations management research (Flynn, Sakakibara, Schroeder, Bates, & Flynn, 1990).

It might seem that directly collecting data from companies claiming to practice the Deming prescription would be a logical first step in conducting empirical work to support theory-testing. There are many existing instruments that objectively measure organizational characteristics (e.g., the degree of stress being experienced by an organization's workers) and such instruments might be used to measure those characteristics within companies practicing the Deming prescription. This is not truly possible due, in part, to the fact that it may be difficult to correctly identify those

companies to include in the population of companies that practice the Deming prescription. Many aspects of the Deming prescription are far less objective and tangible than other operations management prescriptions (e.g., just-in-time, kanban) and so companies cannot be merely observed to determine whether they do or do not practice the Deming prescription. Further, it is quite possible that there are companies that will erroneously claim practice of the Deming prescription as well as companies that unknowingly practice the Deming prescription and/or practice other prescriptions with elements common with the Deming prescription. As a result, there does not at present exist a truly objective, non-anecdotal method for identifying companies practicing the Deming prescription. Therefore, a more objective method of describing the Deming prescription, and so to be able to identify the companies that practice it, can be seen as prerequisite to direct empirical study of Deming companies.

This study, then, is essentially guided by two questions that attempt to provide a more objective and measured understanding of certain dimensions of the Deming prescription, specifically those relating to an organization's work climate. Organizational work climate was selected as the focus of this study for two reasons. First, the degree and nature of many organizational work climate dimensions appear, upon initial inspection, to be strongly prescribed by Deming. Chapter 3, Propositions and Operationalizations, presents detailed discussion regarding a number of these dimensional prescriptions, arguments that form the basis for many of the propositions tested by this study. Second, mature, established instruments exist that measure various dimensions of organizational work climate in a reasonably objective manner. The two questions guiding this study, therefore, are:

1. What organizational work climate is prescribed by Deming?
2. What differences are there between the organizational work climate prescribed by the Deming prescription and that prescribed by other managerial philosophies?

These two guiding questions are disaggregated into a set of formal propositions within Chapter 3.

Importance of the Research

This section of the chapter discusses the importance of this research toward future academic work as well as toward practitioner applications.

The results of this investigation were expected to be meaningful regardless of the outcomes of the hypothesis testing, as a "true" ideal (or very good) work climate profile under the Deming prescription would be "in hand." The usefulness of that resulting profile toward the contribution of knowledge is manifold:

- The ideal (or very good) Deming work climate profile can be directly compared to the real work climate profile of other companies deemed "successful" or "unsuccessful" (e.g., the Fortune 500) in order to seek a degree of validation via scientific research for the Deming prescription.
- The ideal (or very good) Deming work climate profile can be directly compared to the ideal (or very good) work climate profile of other quality and management prescriptions. For example, there has been recent debate between advocates of the Deming philosophy and the Goldratt philosophy as to the degree of their coincidence; some argue there is a lack of coincidence, others, such as the authors of *Deming and Goldratt* (Lepore

& Cohen, 1999), base their position on the assumption of similarity. It is this specific type of usefulness that inspired the committee to involve the Malcolm Baldrige National Quality Award (MBNQA or "Baldrige" or "Baldy") prescription in this study.

- Gaps discovered between a real work climate where the Deming prescription is advocated and the ideal (or very good) Deming work climate profiles will suggest areas for action.
- Gaps discovered between the ideal (or very good) Deming work climate profile and the work climate "expected" by management planning to implement the Deming prescription can be used to align management expectations and facilitate implementation decisions such as the allocation of resources.
- Future academic research can disqualify companies anecdoting their practice of the Deming prescription by measuring their actual work climate. At present, since a claim to "be a Deming company" can neither be affirmed nor falsified on a scientific basis, studies of, or comparisons of, Deming companies cannot be effectively carried out.
- Subject matter experts (SMEs) may well agree to participate in similar surveys based on their experience with the creation of this profile. Such further surveys would increase the empirical profile of the Deming prescription, increasing the ability to affirm a company's claim that they follow the prescription. There are very similar instruments that measure

more specific environments (e.g., health care, education) where application of the Deming prescription is even less understood.

The reader should note all of the research applications described above can be successfully completed without the existence of formal theory.

Overview of Organization of the Dissertation

This section of the chapter presents the reader with a brief overview of the organization of the balance of the dissertation.

Chapter 2 reviews in detail the existing literature regarding the philosophy of W. Edwards Deming. The scope, method and limitations of the literature review is briefly described, three informal categories of Deming literature—explanatory literature, anecdotal literature and knowledge transfer literature—are informally defined, each of those three categories was described and examples of the literature found within each are presented and then the academic Deming literature that was located during the literature review is described and discussed.

Chapter 3 presents the twenty specific propositions that were tested in this study as well as the developmental arguments upon which they were formed. Martin's "garbage can" model of research, a model which bore strong influence upon the aim and design of this study, is described and its influence explained, the seven Deming prescription versus normative value propositions that were given support from within Deming's seminal works on management philosophy are developed and presented, the three Deming prescription versus normative value propositions that were included in this study, without equivalent rational development from Deming's seminal works on management philosophy, at the request of the committee are presented. Finally, the ten Deming

prescription versus Baldrige prescription propositions that were included in this study without rational development at the request of the committee are presented.

Chapter 4 presents the detailed information regarding the methodology that was used to analyze the data collected during this study and used to test the propositions formed in the preceding chapter. The primary survey instrument is described in detail, information supporting the reliability and validity of the instrument is presented and cited, the sources and methods of data collection is described, the various statistical tests that were applied to Propositions 1 through 20 are detailed, and the specific data analysis techniques employed in the analysis of the Deming SME open response questions are described.

Chapter 5 presents the analysis of the data collected toward this study. The response rate information is presented, the results of the specific hypothesis tests associated with the study's twenty propositions are discussed, tabled and charted. The responses from the Deming SMEs regarding the study's five open response questions are listed, aggregated and/or codified, and where appropriate, informal conclusions are drawn and the data was tabled and/or charted.

Chapter 6 employs the data analysis, as well as the specific conclusions that fall from the data, as the foundation for the formation of the study's final general conclusions and associated discussions. The chapter conducts certain discussion prerequisite to forming the general conclusions of this study, presents and discusses, in order of relative strength, the primary, secondary and tertiary general conclusions of this study reached through interpretation of the outcomes resulting from the formal and informal analysis of the data, discusses the general and most significant limitations and assumptions regarding

this study and then discusses the implications of the general conclusions of this study and suggests areas for future research.

The reader may also benefit from a brief chronological listing of the major developmental phases of this study, and so such listing is presented below:

1. Initial interest developed in Deming philosophy
2. Committed to Deming philosophy as topic of research
3. Familiarization with, and understanding of, Deming philosophy developed through more extensive readings, Deming conference attendance, participation on Deming Internet discussion lists as well as study of existing Deming websites.
4. Completed Deming philosophy literature review. Determined the lack of active streams of research.
5. Rationalize causes for lack of active streams of research. Rationalization includes the lack of operationalization of Deming philosophy.
6. Invocation of Martin's Garbage Can Model of Research, which inspires recognition of effective operationalization methods as a key resource toward building a research foundation in Deming philosophy.
7. Extensive review of mature, established survey instruments (which offer good operationalization) for reasonable match with elements of Deming philosophy as familiarized and understood.
8. Work Environment Scale identified as an instrument that measures constructs that reasonably match elements of Deming philosophy.
9. WES instrument constructs "drive" selection of constructs to be propositioned.
10. Deming's seminal works were scrutinized in order to form "direction" (e.g., greater than, less than) of each proposition. For those constructs not given direction in Deming's works, neutral propositions were formed.
11. Deming subject matter experts (SMEs) were identified to act as survey participants.
12. Additional propositions were formed to compare the Deming SME responses with Baldrige SMEs responses.

13. Methodology, test statistics, etc. were finalized.

14. Data collection and data analysis were completed. Conclusions were drawn.

Summary

This final section of the chapter summarizes the information presented within this chapter and directs the reader toward the introduction of next chapter, which presents the detailed review of the literature.

This chapter introduced the reader to the general nature of this study by profiling W. Edwards Deming, summarizing the background of research regarding the Deming prescription, noting the academic calls to research the Deming prescription, discussing the importance of this research toward future academic work and practitioner application and presenting the reader with a brief overview of the organization of balance of the dissertation. The following chapter reviews in detail the existing literature regarding the philosophy of W. Edwards Deming.

CHAPTER 2

THE REVIEW OF THE RELATED LITERATURE

Introduction

This chapter reviews in detail the existing literature regarding the philosophy of W. Edwards Deming. The following section of the chapter briefly describes the scope, method and limitations of the literature review.

The next section of the chapter presents the four informal categories of Deming literature—academic literature, explanatory literature, anecdotal literature and knowledge transfer literature—that were located during the literature. In the following three sections, the categories of explanatory literature, anecdotal literature and knowledge transfer literature are described and examples of the literature found within each are presented. The final major section of the chapter discusses and details the academic Deming literature that was located during the literature review.

Scope and Method of the Literature Review

This section of the chapter briefly describes the scope, method and limitations regarding the review of the Deming philosophy literature conducted as part of this study.

A review of the literature relating to the Deming perspective was conducted. Approximately 150 articles, forty books, 100 article abstracts, fifteen dissertation abstracts, 100 newspaper articles and 100 newspaper article abstracts regarding the Deming philosophy were reviewed. Articles relating to technical and quantitative aspects

of Deming methods (e.g., statistical process control, sampling procedures), were generally excluded from the search.

The associated search included a number of large databases including the Social Sciences Citation Index, The Science Citation Index Expanded, The Arts & Humanities Citation Index, Current Contents, ERIC and the UMI ABI/Inform Index. These databases provide full coverage for well over 10,000 journals as well as a number of trade magazines and selected coverage for several thousand other titles. Approximately 700 citations were located and considered for inclusion in the literature review. To contrast the thoroughness of this search, consider that the *Business Periodical Index* listed only twelve articles on W. Edwards Deming from 1980, when he first came to the attention of American management, through 1987 (Gartner & Naughton, 1988).

Categories of Deming Literature

This section of the chapter presents the informal categories of Deming literature that were located during the review of the literature.

During the review of the literature regarding Deming and his prescription for management, only a very few instances of academic literature, i.e., studies that were based upon rational investigation and scientific method as expected under the prevailing social science paradigm, were found. A large amount of Deming literature, however, was located. Rather than being academic in nature, that literature can best be described as belonging to one of three non-academic categories: explanatory literature, anecdotal literature or knowledge transfer literature. In the following sections of this chapter, each of these four categories are described and examples of the literature found within them are presented.

Explanatory Deming Literature

This section of the chapter describes the nature of the category of explanatory Deming literature and presents examples of the literature found within it.

Explanatory publications seek to clarify and/or exemplify Deming's prescription, or some portion of it. Examples of such explanatory publications include:

- performance measurement and appraisal within "The performance appraisal process: Deming's deadly disease" (Moss & Moen, 1989), "You cannot improve my performance by measuring it!" (Crow, 1996), "Traditional performance appraisal systems: The Deming challenge" (Elmuti, Kathawala, & Wayland, 1992) and "Performance evaluation: A deadly disease" (Aluri & Reichel, 1994)
- control charts and variation within "Product defects and productivity" (Gitlow & Hertz, 1983)
- the PDSA cycle within "Deming's real legacy: An easier way to manage knowledge" (Mooney, 1996)
- average total cost of inspection within "The (k1, k2) game" (Burke, Davis, & Kaminsky, 1993) and "Probability distributions for the Deming cost models" (Kaminsky & Haberle, 1995)
- the Fourteen Points for Management within "The Deming view of a business" (Roehm & Castellano, 1997), "Deming's Fourteen Points for management: Framework for success" (Neave, 1987) and "Revisiting Deming's Fourteen Points in light of Japanese business practices" (Yoshida, 1996)
- merit pay within "Incentivize me, please" (Linden, 1991)

- management accounting within "The Deming philosophy: A new paradigm for management accounting systems" (Castellano, Roehm, & Hughes, 1995) and "Deming's message for management accountants" (Johnson, 1992a)
- sole sourcing within "Deming's Point Four: A study" (Anonymous, 1988) and "Implementing Deming's Fourth Point" (Windham, 1995)
- the driving out of fear in the workplace within "Fear and learning in the workplace" (Briksin, 1996)
- Deming's Point Twelve within "Removing barriers to pride in workmanship" (Brown, 1994)
- systems thinking within "Appreciation for a system: From fragmentation to integration" (Carlisle, 1998) and "A framework for the systemic control of organizations." (Blackstone, Gardiner, & Gardiner, 1997)
- Theory of Profound Knowledge within "Profound knowledge: Application of a major Deming principle" (Anjard, 1995), "The role of profound knowledge in the continual improvement of quality" (Anderson, Dooley, & Misterek, 1991), and "Understanding and applying Deming's primary concept of profound knowledge" (Anjard, 1996)

Explanatory discussions of a more general nature were also found. Exemplar articles included "Getting back to Deming" (Ranney, 1996), "Prophet with honour" (Johnstone, 1990), "The Deming management method: A bedrock philosophy comes home" (Walton, 1990b), "Deming management philosophy: Does it work in the US as well as in Japan?" (Yoshida, 1989), "The route to total quality management: Part one" (McDonnell, 1994), "Dr. Deming's traveling quality show" (Lorinc, 1990), "Ed Deming

wants big changes, and he wants them fast" (Dobyns, 1990), and "Dr. Deming: Management today does not know what its job is" (Stevens, 1994).

Anecdotal Deming Literature

This section of the chapter describes the nature of the category of anecdotal Deming literature and presents examples of the literature found within it.

Anecdotal publications related a case as evidence of improvement in outcomes after implementation of Deming's prescriptions. Such publications included:

- the Spartanburg, South Carolina Chamber of Commerce (Barrier, 1993)
- Brazosport Memorial Hospital in Lake Jackson, Texas (Lynn & Osborn, 1991)
- a business course at Georgetown University (Gartner, 1993)
- the library at Samford University, Birmingham, Alabama (Fitch, 1993)
- the development of quality auditing at Ford Motor's Central Laboratory (Terjimanian & Kelly, 1996)
- Surfsoft, Inc of Capitola, California (Ballon, 1998)
- UPS (Quigley, 1992)
- The CPR process at the University of Alabama–Birmingham Medical Center (Battito, Boyd, & Day, 1996)
- Windsor Export Supply (Baker & Artinian, 1985)
- Portage Lakes, Ohio vocational schools (Christ, 1996)
- Zytec, Incorporated of Redwood Falls, Minnesota (Altany, 1992)
- Muhlenberg College administration (Mihaly, 1995)
- Orent Graphics of Omaha, Nebraska, (Anonymous, 1998)
- the city government of Madison, Wisconsin (Sensenbrenner, 1991)

- the Total Quality Leadership program within the Department of the Navy (Kidder & Ryan, 1996)

A large number of the newspaper articles located in the search were also anecdotal in nature. In that these anecdotal publications involve case study methodology, they do employ scientific method. Case study, however, is a methodology that tends to maximize realism at the expense of the generalizablity and precision of results (see McGrath, 1981), and so does not provide for the precise testing and conclusions found under other, more common methodologies.

A number of historically popular and introductory books about the Deming philosophy (and persona) were also primarily explanatory and/or anecdotal in nature, including *Dr. Deming: The American who taught the Japanese about quality* (Aguayo, 1990), *Thinking about quality: Progress, wisdom, and Deming philosophy* (Dobyns & Crawford-Mason, 1994), *The man who discovered quality: How W. Edwards Deming brought the quality revolution to America: The stories of Ford, Xerox, and GM* (Gabor, 1990), *The Deming guide to quality and competitive position* (Gitlow & Gitlow, 1987), *The world of W. Edwards Deming* (Kilian, 1988), *Four days with Dr. Deming: A strategy for modern methods of management* (Latzko, Deming, & Saunders, 1995), *The keys to excellence: The story of the Deming philosophy* (Mann, 1985) *The Best of Deming*[1] (McCoy, 1996), *The Deming dimension* (Neave, 1990), *The Deming route to quality and productivity: Road maps and roadblocks* (Scherkenbach, 1986), *Deming's road to continual improvement* (Scherkenbach, 1991), *Deming's profound changes:*

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[1] A selection of representative Deming quotations edited and approved by Deming shortly before his passing.

When will the sleeping giant awaken? (Delavigne, Robertson, & Gluckman, 1994), *Deming: The way we knew him* (Voehl, 1995), *The Deming management method* (Walton, 1986) and *Deming management at work* (Walton, 1990a).

Knowledge Transfer Deming Literature

This section of the chapter describes the nature of the category of knowledge transfer Deming literature and presents examples of the literature found within it.

Knowledge transfer publications restated or translated Deming's prescription, or some portion of it, toward a target audience, functional area or industry. Education was, by far, the most frequent target of knowledge transfer, with articles such as "Total quality management in higher education: Applying Deming's Fourteen Points" (Masters & Leiker, 1992), "Total quality management of teaching and learning" (Chizmar, 1994), "Quality in education according to the teachings of Deming and Feuerstein" (Tribus, 1996b), "The educational consequences of W. Edwards Deming" (Holt, 1993c), "The reconciliation of W. Edwards Deming and John Dewey: An exploration of similarities in motivation theory" (Towns, 1996), "The red bead experiment for educators" (Turner, 1998), "Applying the Deming corporate philosophy to restructuring" (Blankenstein, 1993), "The Deming approach to education: A comparative study of the USA and Japan" (Yoshida, 1994), "Deming's quality: Our last but best hope" (Schenkat, 1993), "TQM transforms the classroom" (Peak, 1995), "Quality implementation in transition: A framework for specialists and administrators" (Wald & Repetto, 1995), "The application of Deming's theory of total quality management to achieve continuous improvements in education" (Stensaasen, 1995), "Deming on education—a view from the seminar" (Holt, 1993a), "Evaluating faculty based on student opinions: Problems, implications and

recommendations from Deming's theory of management perspective" (Martin, 1998), "Will joy in work be helped or hindered by value-added indicators? Applying Deming to education" (Fitz-Gibbon, 1997), and "Dr. Deming and the improvement of schooling: No instant pudding" (Holt, 1993b). Books that transferred the Deming philosophy to education included *Using Deming to improve quality in colleges and universities* (Cornesky, 1990)*, The school for quality learning: Managing the school and classroom the Deming way* (Crawford, Bodine, & Hoglund, 1993), *Improving student learning: Applying Deming's quality principles in classroom*s (Jenkins, 1997), *The new philosophy for K-12 education: A Deming framework for transforming America's schools* (Leonard, 1996), *Applying the Deming method to higher education: for more effective human resource management* (Miller, 1991), *Quality education: Applying the philosophy of Dr. W. Edwards Deming to transform the educational system* (Rinehart, 1993), *Teams in education: Creating an integrated approach* (Arcaro, 1995) and *Total quality education: Profiles of schools that demonstrate the power of Deming's management principles* (Schmoker & Wilson, 1993).

Other audiences and industries targeted by knowledge transfer publications included government and the public sector (Levin, 1996; White & Wolf, 1995), service industries (Akande, 1992; Butterfield, 1991; Rienzo, 1993; Rosander, 1991), modular manufacturing (Schroer & Ziemke, 1992), clinical diagnosis (Pfadt & Wheeler, 1995), parenting (Guenther, 1997), community life (Anonymous, 1996), commercial loan decisions (Gupta, Roehm, & Castellano, 1994), libraries (Mackey & Mackey, 1992), equipment inspection (Campbell, 1996), educational technology services (Richie, 1994), industrial engineering (Castle, 1989), construction safety management (Sommerkamp,

1994), physicians and health care (Caldwell, 1995; Dees & Garcia, 1995; McCarthy, Ward, & Young, 1994; Teichholz, 1993), software development (Pittman & Russell, 1998; Yilmaz & Chatterjee, 1997; Zultner, 1988) and fund raising (Nelson, 1998).

Many of the remaining knowledge transfer publications fell into such categories as book reviews, letters to the editors and so on. A number of those articles attempted to unite, compare or contrast the Deming perspective with the perspective of other prominent individuals such Fredrick Taylor (Knouse, Carson, & Carson, 1993), Herbert Simon (Little, 1994), Michael Hammer (Kleiner, 1995; Kleiner & Hertweck, 1996), John Dewey (Towns, 1996), Henry James (Towns, 1997), B. F. Skinner (Mawhinney, 1992; Saunders et al., 1994), Neely Gardner[2] (Wolf, 1992), Harry Braverman[3] (Schiff & Goldfield, 1994), William Glasser (Glasser, 1994) and Gregory Bateson (Johnson, 1997).

In addition to the three major categories noted above, some articles are best described as remembrances and/or tributes to Deming and his legacy (e.g., (Anderson, 1994; Anonymous, 1994a, b; Austin, 1994; Boardman, 1994; Boyd, 1994; Clauson, 1996; Heller, 1994; Lee, 1994a; McKenna, 1995; McManus, 1994; Tetzeli, 1993; Tribus, 1996a)). Also, a number of articles were, in one aspect or another, contrarian in nature (e.g., (Carson & Carson, 1993; Duncan & Van Matre, 1990; Golomski, 1996; Graber, Breisch, & Breisch, 1992; Hopkins, 1995; Lee, 1994b; Noguchi, 1995; Sherman, 1995; Spencer, 1994; Tsutsui, 1996)).

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[2] Gardner is a former faculty member of the School of Public Administration at the University of Southern California known for his "Action Training and Research" approach.

[3] Braverman, is the author of *Labor and monopoly capital*, 1974.

Academic Deming Literature

This section of the chapter details the academic work that was located during the review of the Deming literature.

The literature search resulted in the location of twenty writings that represent rigorous, quantitative analytical attempts to build knowledge regarding the Deming philosophy via the scientific method. Only one "stream" of research in major academic management journals was located. A 1994 *Academy of Management Review* article presents research that proposes a theoretical model based on constructs resulting from a Delphi study involving seven experts who "had been involved professionally, and, in some cases, personally with Deming." (Anderson et al., 1994). The Anderson model contains seven constructs and eight paths: (1) visionary leadership effects, (2) internal/external cooperation, (3) learning, internal/external cooperation and learning effect, (4) process management, process management effects, (5) continuous improvement, (6) employee fulfillment and continuous improvement and employee fulfillment effect and (7) customer satisfaction. A 1995 *Decision Sciences* article describes a testing of the model using path analysis on survey data collected from forty-one U.S. manufacturing plants. Statistical significance is found for six of the eight paths (Anderson et al., 1995). A 1997 dissertation hypothesized that the causal factors in that model would correlate with the outcomes expected under the Deming philosophy; only minor support was found (Kromkowski, 1997). A 1998 article in the *Journal of Operations Management* replicates the 1995 study, this time analyzing data from forty-four Italian manufacturing plants; five of the eight paths found support (Rungtusanatham et al., 1998). While the work of Anderson is not directly related to the

propositions formed in this study, it does represent the single stream of work on Deming within major academic management journals, and so merits notation.

Other researchers investigated various aspects of the Deming philosophy. A group of managers and subordinates were surveyed regarding their beliefs about performance appraisals; support was found for the Deming perspective (Carson, Cardy, & Dobbins, 1991). Two departments of an organization were surveyed regarding their implementation of interdepartmental cooperation according to the Deming prescription; the respondents perceived positive improvements (Collard, 1993). Researchers developed a "Company Quality Profile" instrument based on Deming's Fourteen Points, then piloted the instrument at a high-technology consumer products factory (Motwani, Sower, & Roosenfeldt, 1993). A longitudinal field study investigated the perceived changes in quality-of-work life and productivity after implementation of Deming methods using the Michigan Organizational Assessment Package; the results indicate positive impact on productivity (Elmuti & Kathawala, 1994). Two economists constructed an economic model based on agency theory that finds validity for Deming's Point Four advocacy of single suppliers (Richardson & Roumasset, 1995). A recent article posits, but does not test, certain relationships between existing leadership styles and the Deming philosophy (Sosik & Dionne, 1997).

Eight of the twenty writings located were dissertations. One dissertation developed an fifty-item, Likert-style scale instrument that measures implementation of Deming's Fourteen Points. The instrument was assessed by the author for reliability and validity (Tamimi, 1993). The author later published the instrument along with results of an associated survey (Tamimi & Gershon, 1995). Similar work was performed in an

earlier dissertation. A similar type of instrument was developed, assessed for validity, and used to survey for data used for the building of a unpublished model (McCullough, 1988). Another dissertation work prepared a "Deming Advocacy Questionnaire" and employed it to determine what type of individual advocates Demingism, the types being defined as those that fall from the Myers-Briggs Type Indicator (Gleckner, 1994). A 1993 dissertation developed an instrument to measure Deming perspective characteristics in individuals and used it to survey a number of American Society of Quality managers. Cluster analysis determined that the managers tended to be either Deming managers, non-Deming managers, or "not sure" managers (McNary, 1993). Another dissertation analyzed the holistic nature of Deming's Fourteen Points. The work found no holistic adherence to Deming's Fourteen Points within any of the six organizations studied, each of which had inconsistent quality outcomes. As a result, it could not be concluded that holistic adherence is requisite to positive quality outcomes (Long, 1994).

Two dissertations involved educational research. One dissertation surveyed 1,100 Wisconsin principals to test the hypothesis that their positive behaviors and attitudes regarding the Deming philosophy positively correlate with student achievement; the results indicated no correlation (Sohn, 1998). Another dissertation surveyed North Dakota public school superintendents and determined that the majority favor implementation of Deming practices as presented in the instrument and that there was no system size effect (Holmes & William, 1997).

Summary

In summary, the review of the literature finds an almost total absence of rigorous academic study regarding the Deming prescription. The major implication resulting from

the literature review is, therefore, that the abundance of anecdotal support versus the almost total absence of significant academic research regarding that prescription effects a compelling call for formal research into that prescription. The secondary implication resulting from the literature review is that, given that there are no active "streams" of Deming research to "extend," special consideration should be given, and was given, toward the type and aim of this research and toward the propositions that were the basis of this study, so that it would provide an active foundation for future academic research into the Deming philosophy.

This chapter reviewed in detail the existing literature regarding the philosophy of W. Edwards Deming. The scope, method and limitations of the literature review was briefly described, three informal categories of Deming literature—explanatory literature, anecdotal literature and knowledge transfer literature—were informally defined, each of those three categories was described and examples of the literature found within each were presented and then the academic Deming literature that was located during the literature review was described and discussed. The following chapter details the twenty specific propositions that were tested in this study as well as the developmental arguments upon which they were formed.

CHAPTER 3

PROPOSTIONS AND OPERATIONALIZATIONS

Introduction

This chapter presents the twenty specific propositions that were tested in this study as well as the developmental arguments upon which they were formed. The following section describes Martin's "garbage can" model of research, a model which bore strong influence upon the aim and design of this study.

The next seven sections present seven Deming prescription versus normative value propositions—one proposition each regarding the constructs of work pressure, coworker cohesion, supervisor support, autonomy, innovation, involvement and task orientation—that were given support from within Deming's seminal works on management philosophy.

The eighth, ninth, and tenth sections present three Deming prescription versus normative value propositions—one proposition presented in each section regarding the constructs of clarity, managerial control and physical comfort—that were included in this study, without equivalent rational development from Deming's seminal works on management philosophy, at the request of the committee.

The eleventh section presents ten Deming prescription versus Baldrige prescription propositions—one proposition for each of the ten aforementioned

constructs—that were included in this study without rational development at the request of the committee.

The Garbage Can Model of Research

This section of the chapter describes Martin's "garbage can" model of research, a model which bore strong influence upon the aim and design of this study. First the model is described, then its influence upon the conceptualization of this study is discussed.

In part, these propositions were arrived at by employing a descriptive and pragmatic "garbage can" model of the research process as discussed in an article by Martin (Martin, 1982). The "garbage can" model of the research process is briefly described below.

The traditional "rational" research model contains four sequential steps: problem and hypothesis formulation, selection and execution of methodology, analysis and interpretation of results, and confirmation/negation of hypothesis. This model is reflected in the headings of a typical article: literature survey, hypothesis, methods, results, and discussion. The researcher reviews the literature to identify an important and unresolved problem and from that problem deduces an appropriate hypothesis for resolution. The nature of the problem is then used to rationally choose the best research method. The researcher then collects and analyzes the data, and uses the results to confirm or revise theory regarding the problem.

However, as most researchers are acutely aware, the "rational" approach represents a theoretical, not a descriptive, model. March's organizational garbage can model presumes organizational problems, decision participants, choice opportunities, and solutions to exist in a concurrent space—garbage can—that are driven by complexity

(Cohen, March, & Olsen, 1972). His organizational model implies a more descriptive model for the process of conducting research within a research organization. Unlike the sequential nature of the rational research process, Martin maintains that research variables, such as theoretical problems for hypothesis, methodological choice and resources available to the researcher can solicit one another during the decision process. The rational model implies that resources simply enable the research process; the garbage can model recognizes that resource availability influences theoretical problem selection as well as restricts the selection of methodological choice. The rational model implies that problem determines methodological choice; the garbage can model recognizes that methodological resource availability may override theoretical considerations, or that theoretical problems remain unselected due to methodological difficulties. The garbage can model also relaxes the rational model assumption that results are always unknown until the research process is completed. Such relaxation allows the results to be used as a starting point for research, influencing appropriate methodological choice, appropriate investigation of resource availability, and appropriate formation of hypotheses.

Martin's model influenced the conceptualization and proposal of this study by suggesting that available methodology can solicit specific propositions. Given the lack of a well-established stream of Deming philosophy research to serve as a foundation for "extended" research, a mature, established instrument—an instrument that could well measure constructs likely to be part of Deming prescription content—was sought out and ultimately identified. That instrument, in turn, solicited, after the confirmation of rational support within Deming's seminal works on management philosophy, the specific propositions that formed the basis of this study.

Development of P1: Degree of Work Pressure

This section of the chapter presents the first proposition of this study, regarding the degree of work pressure prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy.

The first specific research question relates to the degree of work pressure expected under the Deming prescription. The construct "work pressure" is operationalized as the degree to which high work demands and time pressure greatly dominate the job milieu.

Deming greatly de-emphasizes a number of traditional measures and methods such as quotas that effect urgency and pressure upon the factory floor in search of higher efficiency. By "quota," Deming means "measured day work … rates, or ... work standards." (Deming, 1986) Among his Fourteen Points is the admonishment to "Eliminate work standards (quotas) on the factory floor. Substitute leadership." (Deming, 1986)

Deming objected to the use of quotas for a number of reasons. Quotas direct attention to outcomes instead of process improvement. Deming states:

> "… focus on outcomes ... must be abolished." (Deming, 1986)

> "Quotas are an example of measures of productivity [that] do not lead to improvement in productivity." (Deming, 1986)

> "... measurements of productivity are like accident statistics. They tell you that there is a problem, but they don't do anything about it. This book is an attempt to improve productivity, not just to measure it." (Deming, 1986)

Deming does not believe a company can be "successful on visible figures alone" (Aguayo, 1990; Deming, 1986). In place of focus on numerical outcomes, Deming advocates increases in productivity through focus on processes, not outcomes. For

example, he states that “the boost in quality and productivity all along the line that comes from success in improvement of quality at any station upstream” is “a figure that is unknown or unknowable” (Deming, 1986). Pressure to meet quotas effect undesirable actions and costs within the organization. “A quota ... is a fortress against improvement of quality and productivity. I have yet to see a quota that includes any trace of a system by which to help anyone to do a better job. A quota is totally incompatible with never-ending improvement” (Deming, 1986).

Schonberger and Knod (Schonberger & Knod, 1997) briefly note other examples of undesirable actions effected by pressure to meet quotas such as end-of-period push and channel-stuffing. Deming states that pressure to meet quotas creates an “inability to serve the best interests of the company” (Deming, 1986).

Deming also believes that quotas increase global costs:

> “The intent of application of a work standard is noble: predict costs; establish a ceiling on costs. The actual effect is to double the cost of the operation and to stifle pride of workmanship. There are more engineers engaged in construction of work standards, and people counting production, than there are people engaged in actual production.” (Deming, 1986)

Also, he states that the “cost of warranty is largely chargeable to [engineering’s] rush to production ...” (Deming, 1986). According to Deming, “the push for production robs [designers] of the chance to go into the production area to learn the problems created by the designs they construct” (Deming, 1986).

Further, quotas can generate fear on the job, and Deming finds fear on the factory floor to be inappropriate. “Drive out fear, so that everyone may work effectively for the company” (Deming, 1986). Deming advocates the removal of fear in that it prevents appropriate risk-taking. Workers must not be fearful of committing errors towards

learning and/or improvement. “We can no longer tolerate ... people on the job that do not know what the job is and are afraid to ask” (Deming, 1986). “[They] ... could accomplish important improvements ... if they could work without fear of taking a risk” (Deming, 1986). Another productivity loss from fear is inability to serve the best interests of the company through necessity to satisfy specified rules, or the necessity to satisfy, at all costs, a quota of production (Deming, 1986). Deming gives an example of a manager of a grocery store with a quota for shrinkage; the manager “knows fifty-five ... ways to meet his allowance ... all of which hurt the business” (Deming, 1994). Deming recommends process improvement instead of fear to increase productivity; he notes that you can “beat horses and they will run faster—for a while” (Deming, 1986).

In addition, quotas lead to nonproductive “distortion and faking” (Deming, 1994). Ironically, they also lead to a loss of productivity when “people are able to meet their quotas in six hours. They then have two hours for TV, cards, reading” (Deming, 1994).

Deming views visual admonishments pressuring workers to perform also to be inappropriate:

> “Eliminate slogans, exhortations and targets for the work force asking for zero defects and new levels of productivity [as] such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force.” (Deming, 1986)

The resulting adversarial relationships, in turn, effect lower productivity. Recollections of Ben Hamper, a General Motors production line worker (Hamper, 1991) provide a typical exemplification. Other traditional methods that are typically used to create urgency of work are denounced as well. Deming labeled “incentive pay, pay for performance” as among the “forces of destruction” (Deming, 1994).

These statements, as well as other statements made by Deming, clearly advocate a relaxation of a number of Tayloristic approaches that typically effect work urgency and pressure on the production floor. This advocacy supports P1 as the proposition associated with this first specific research question.

P1: Deming methods prescribe a less-than-average degree of work pressure.

Development of P2: Degree of Coworker Cohesion

This section of the chapter presents the second proposition of this study, regarding the degree of coworker cohesion prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy.

The second specific research question relates to the degree of coworker cohesion expected under the Deming prescription. The construct "coworker cohesion" is operationalized as how much employees are friendly and supportive of one another.

The Deming prescription recommends that employees should be highly supportive of one another to improve performance. Deming argues his position from two perspectives. First, in contrast to the division of labor concept, Deming advocates that employees should function in team mannerisms due to the significance of interaction effects on performance outcomes:

> "Suppose that the symbols A, B, C, etc., represent the separate abilities of the people in a company. ... The full capability of the people in the company, working together may be expressed as:
>
> individuals (A + B + C + D + ...)
> interactions + (AB) + (AC) + (AD) + ...
> + (BC) + (BD) + ...
> + (CD) + ...
> + (ABC) + (ABD) + (BCD) + ...
> + (ABCD) + ...

> Parentheses denote interaction between people, helping or hurting each other in pairs, triplets, etc., in teams, platforms, chimneys, divisions, departments. An interaction may be negative, zero or positive." (Deming, 1994)
>
> "Let *x* be the contribution of some individual, (*yx*) the effect of the system on his performance … suppose that we have some number for his apparent performance, such as eight ... Then $x + (yx) = 8$ . ... People ignore the other term, (*yx*), which is predominant." (Deming, 1994)

Several other tables within *The new economics for industry, government, education* (Deming, 1994) are dedicated to illustrating that action within one area of the company may have a negative interaction with other areas of the company effecting a net negative effect on the entire company. Deming also provides anecdotal evidence; for example, he witnesses a "company ... going down the tubes" since "each staff area was suboptimizing its own work, but not working as a team for the company." (Deming, 1986). Deming also argues for a "compensating" worker interaction effect; that "teamwork requires one to compensate with his strength someone else's weakness, for everyone to sharpen each other's wits with questions." (Deming, 1986).

Deming believes that teamwork and peer cooperation and support is needed to ensure positive interaction effects in various situations. Deming's Point Nine, to "break down barriers between departments" calls for teamwork "to foresee problems of production and in use that may be encountered with the product or service." (Deming, 1986). The tables noted above (Deming, 1994) argue that departments working together, "including areas that take a loss for the benefit of the whole company" will lead to "heavy gain for the company as a whole." Deming believes that there is a high degree of interdependence in business, and that "the greater the interdependence between

components, the greater the need for communication and cooperation between them." (Deming, 1986).

Deming also frames the interaction effect in the terms "divided responsibility" and "joint responsibility." His statement that "when responsibility is divided, no one is responsible" (Deming, 1994) argues directly against division of labor, argues for peer supportive behavior. Deming uses an example of a worker and his supervisor each assuming the other will check the tally of hours on a timecard and the division of operator and inspector to exemplify this interaction effect (Deming, 1994).

Deming's second argument for peer cohesion stems from his belief that workers must function as part of a system with a shared mission for long-term organizational success. This shared mission is described as a "constancy of purpose" (Deming, 1986) or "the aim of the system" (Deming, 1994). Deming's Point One within his Fourteen Points is to require "constancy of purpose towards improvement of product and service ..." (Deming, 1986). Such improvement can only be achieved through cohesive, team effort. Deming states that "there is no substitute for teamwork ... to bring consistency of effort" (Deming, 1986). Deming notes an example where "ninety-two per cent of critical parts for three and four years ahead are now in development by teams composed of the chosen supplier, design engineer, purchasing, manufacturing, sales. ... everybody working together with a common aim" (Deming, 1986). Deming also expects that employees must be mutually supportive in making the transition to his recommended style of management; his Fourteen Points call for "everybody in the company to work to accomplish the transformation. The transformation is everybody's job" (Deming, 1986). Deming views production with a "systems perspective." One of Deming's four branches

of Profound Knowledge is "appreciation for a system" (Deming, 1994), and he frequently refers to his "production as a system" diagram (Deming, 1986; 1994). Deming views the concepts of system and aim as overlapping: "... is [your organization] a system? In other words, is there an aim?" (Deming, 1994) Deming clearly sees workers as part of that system; he states "suppose we post names on [the diagram]: you work here, John works there" (Deming, 1994). Working together as a system towards constancy of purpose employs peer cohesion and teamwork; Deming states that "teams composed of people in design, engineering, production, and sales ... accomplish important improvements in product …" (Deming, 1986).

Deming believes that strictly interpreted division of labor ignores highly significant worker interactions, and that workers must cooperate in order to function as a system with a common aim. Perhaps his most direct statement to his perspective regarding peer cohesiveness is that when "people in the company do not work together as a system," it is "mismanagement" (Deming, 1994).

From these statements, as well as other statements made by Deming, it appears that Deming expects significant coworker cohesion, and so supports the formation of P2, the second proposition associated with this second specific research question.

P2: Deming methods prescribe a higher-than-average degree of coworker cohesion.

Development of P3: Degree of Supervisor Support

This section of the chapter presents the third proposition of this study, regarding the degree of supervisor support prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy.

The third specific research question relates to the degree of supervisor support expected under the Deming prescription. The construct "supervisor support" is operationalized as the extent to which management is supportive of its employees and encourages employees to be supportive of one another.

According to Aguayo (Aguayo, 1990), Deming has always substituted the word leadership for supervision; in *Out of the crisis*, Deming directly states that "the job of management is not supervision, but leadership" (Deming, 1986). Deming delineates such traditional supervision, much of which "could be described as supervision by ordinal numerics and percentages" (Deming, 1986) from leadership, the aim of which "should be to help people ... to do a better job" (Deming, 1986). This "help" takes both the form of high support of employees and encouraging supportive behaviors amongst employees.

Deming expects management to be highly supportive of its employees in general. He views a manager of people as "coach and council, not a judge;" (Deming, 1994) as "a colleague, counseling and leading his people on a day-to-day basis" (Deming, 1986). In describing other behaviors appropriate for a manager of people towards those people he supervises, Deming employs numerous supportive phrases such as conveying meaning; helping to see; explaining; teaching; creating interest, challenge, and joy; and optimizing worker hopes and abilities (Deming, 1994). Deming calls for other various supportive managerial behaviors. He asks managers to understand the needs of employees; "the most important act that a manager can take is to understand what it is that is important to an individual. ... it is so vital that managers spend time to listen to an employee to understand [what] he is looking for ..." (Deming, 1994). A manager is expected to nurture labor; "good management helps to nurture and preserve ... positive innate attributes of

people" such as "a natural inclination to learn" and "the right to enjoy his work" (Deming, 1994). A manager is expected to facilitate the education of his employees; he "encourages his people to study. He provides ... advancement of learning. He encourages continued education in college or university" (Deming, 1994). Deming's Fourteen Points for Management call not only for management to "institute a vigorous program of education" but "self-improvement" as well (Deming, 1986). Other of Deming's Fourteen Points clearly instruct towards managerial behaviors to directly support employees, e.g., "drive out fear, so that everyone may work effectively for the company," "institute training on the job," "eliminate slogans, exhortations ... for the work force ...[that] only create adversarial relationships," "remove barriers that rob the hourly worker of his right to pride of workmanship," and so on (Deming, 1986). In general, Deming wishes "to soften the adversarial relationship between production worker and supervisor" (Deming, 1986).

Deming also expects management to encourage supportive behaviors amongst its employees. The Deming perspective requires teamwork behaviors of workers, as noted above. Deming expects the supportive behaviors of workers to be effected through the efforts of management, as such system interactions are the responsibility of management. This posture is reflected in a number of Deming's statements:

> "Management of dependence and interdependence between people, groups, divisions ... is helpful." (Deming, 1994)
>
> "Management has the job of trying to help all people involved with inventory to work together on a give-and-take basis." (Deming, 1986)
>
> "[Management should] break down barriers between departments [so that] people in research, design, sales and production must work as a team." (Deming, 1986)

> "[A manager of people] helps his people to see themselves as components in a system, to work in cooperation with preceding stages and with following stages ..." (Deming, 1994)
>
> "... the company was going down the tubes. Why? Each staff area was suboptimizing its own work, but not working as a team for the company. It was the president's job to coordinate the talents of these men for the good of the company." (Deming, 1986)
>
> "Resolution of conflicts, and removal of barriers to cooperation, are responsibilities of management." (Deming, 1994)
>
> "Management of a system therefore requires knowledge of the interrelationships between all ... of the people that manage it." (Deming, 1994)

Aguayo also interprets the Deming perspective as requiring management to foster supportive behaviors among labor: "But in the Deming view ... it is a leader's job to foster ... teamwork" (Aguayo, 1990).

Therefore Deming's own words strongly suggest that, under his prescription, management is expected to be both highly supportive of employees as well as encouraging employees to be supportive of one another. Deming's words support the formation of P3 as the proposition associated with the third specific research question.

P3: Deming methods prescribe a higher-than-average degree of supervisor support.

Development of P4: Degree of Autonomy

This section of the chapter presents the fourth proposition of this study, regarding the degree of autonomy prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy.

The fourth specific research question relates to the degree of autonomy expected under the Deming prescription. The construct "autonomy" is operationalized as how

much employees are encouraged to be self-sufficient and to make their own decisions. This differs from the construct "coworker cohesion," which is operationalized as how much employees are friendly and supportive of one another. An autonomous worker may make his own decision, then, through coworker cohesion, find other employees are supportive of that decision.

The Deming prescriptions advocates a much higher degree of self-sufficient, decision-making employees than found under classic principles. Several statements by Deming to this effect include:

> "[A manager of people]creates an environment that encourages freedom and innovation." (Deming, 1994)
>
> "The components [of a system] need not all be clearly defined and documented; people may merely do what needs to be done." (Deming, 1994)
>
> "Leaders must be empowered and directed to inform upper management concerning conditions that need correction." (Deming, 1986)

In addition, Deming frequently describes workers as unable to be responsible for quality but "can only try to do their jobs" (Deming, 1994) under conditions where workers have little autonomy to alter the system within which they work.

Deming found autonomous workers preferable for a number of reasons. Deming clearly advocates the continual improvement of product and service (Deming, 1986). Continual improvement requires a higher degree of autonomy than offered under classic division of labor. Workers must be free to initiate change, to determine their own "best way." For example, workers must have sufficient autonomy to investigate and determine root causes of undesirable effects; Deming describes the need for such investigation throughout his works; an example is found within *Out of the crisis* (Deming, 1986).

Further, part of the continual improvement process is the removal of waste. Deming states:

> "the greatest waste in America is failure to use the abilities of people." (Deming, 1986)
>
> "Improvement of the process includes better allocation of human effort. It includes ... [giving] everyone, including production workers, a chance to ... contribute the best of their talents It means removal of barriers to pride of workmanship." (Deming, 1986)
>
> "One only need listen to a tape of a meeting with production workers to learn about their frustration and the contribution that they are eager to make." (Deming, 1986)
>
> "Improvement includes selection of people, their placement, their training, to give everyone, including production workers, a chance to advance their learning and contribute the best of their talents." (Deming, 1986)

Here, the removal of waste of human resources calls for the application of autonomy to the work force. Deming's Fourteen Points also include an advisement to "drive out fear, so that everyone may work effectively for the company" (Deming, 1986). One of the ways that fear prevents effectiveness is through its removal of autonomy. Deming cites examples: "If I did what is best for the company, long term, I'd have to shut down production ... I would be out of a job;" "I am afraid to put forth an idea;" "I would like to understand better ... procedures, but I don't dare to ask about them" (Deming, 1986). Deming notes that the loss in productivity due to fear must be removed; "we can no longer tolerate ... people on the job that do not know what the job is and are afraid to ask" (Deming, 1986). Deming's stance for elimination of quotas also argues for an autonomous work force; quota requirements inhibit self-direction in the interest of the company. Deming notes this complementary relationship; "one way to move away from quotas is to introduce ... a self-directed work force—anybody does anything that needs to

be done" (Deming, 1994). The grocery store manager, aforementioned under Development of P1, illustrates how a quota inhibits beneficial decision-making. Deming provides other examples as well; e.g., a bank loan officer, who in meeting his lending quota, waded the bank into trouble with bad loans (Deming, 1994). A parallel example offered regarding MBO quotas is purchasing agents taking advantage of 10% discount "... and in so doing raise the cost of manufacture and impair quality" (Deming, 1994). Deming also believes that reward systems tied to quotas, numerical goals and the like do more harm than good, that intrinsic motivation develops self-efficacy, makes work meaningful, and so workers will choose to make truly needed improvements (Deming, 1994).

The Tayloristic perspective, in requiring little autonomy, so requires little education of workers; in his classic pig-iron example, Taylor found the "work to be so crude and elementary in its nature that ... it would be possible to train an intelligent gorilla so as to become a more efficient pig-iron handler than any man ..." (Taylor, 1911). In contrast, Deming calls for worker education, e.g., within his Fourteen Points that require "a vigorous program of education and self-improvement" (Deming, 1986). Deming prefers that a worker "engage his mind as well as his labor" (Deming, 1994). Such engagement requires greater autonomy.

Deming's statements imply a prescription in favor of a self-directed, decision-making work force and thus support the formation of P4 regarding the fourth specific research question.

P4: Deming methods prescribe a higher-than-average degree of autonomy.

Development of P5: Degree of Innovation

This section of the chapter presents the fifth proposition of this study, regarding the degree of innovation prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy.

The fifth specific research question relates to the degree of innovation expected under the Deming prescription. The construct "innovation" is operationalized as the emphasis on variety, change, and new approaches.

Deming's first point for management is to "create constancy of purpose toward improvement of product and service;" his fifth point for management is to "improve constantly and forever the system of production and service." (Deming, 1986). The philosophy of continual improvement advocated in these two points requires continual change and innovation. Deming states this relationship more explicitly:

> "establishment of constancy of purpose means acceptance of obligations [to] ... innovate ... new service and new product ... new materials ... method of production; possible changes in equipment for production ... new skills required ... training and retraining of personnel ..." (Deming, 1986).

Other statements by Deming emphasize a requirement for an environment of change and innovation:

> "It is good to introduce, by innovation, a new product ... it is necessary to innovate, to predict the needs of the customer ... He that innovates and is lucky will take the market." (Deming, 1994)

> "[A manager of people] creates an environment that encourages freedom and innovation." (Deming, 1994)

> "The first step in the transformation is to learn how to change." (Deming, 1986)

> "Innovation [is] the foundation of the future ..." (Deming, 1986)

> "The management of a company, seized with determination to change ..." (Deming, 1986)

Deming notes the requirement for continual improvement, and so change, in various areas of the organization including engineering (Deming, 1986), testing methods (Deming, 1986), software maintenance (Deming, 1986), the distribution of quality characteristics (Deming, 1986), vendor relationships, (Deming, 1986) as well as "management's responsibilities for improvement at every stage" (Deming, 1986).

Other key elements of Deming's perspective support a structured approach towards change and innovation. Deming's PDSA cycle for continuous improvement is a framework for change, where the first step is to "plan a change or a test, aimed at improvement" (Deming, 1994), and the final step is to "Act. Adopt the change or abandon it" (Deming, 1994). Deming advocates statistical process control and run/control charting so as to indicate a requirement for change towards improvement; to Deming, a process charted to be in control "indicated that any substantial improvement must come from a change in the system" (Deming, 1986). Further, using charting and statistical process control to identify in-control processes also removes "unstable chaos, the noise of which would mask the effect of any attempt to bring improvement. With statistical control achieved, engineers and chemists became innovative, creative" (Deming, 1986).

Deming's educational points for management, e.g., "institute training on the job" (Deming, 1986) and "institute a vigorous program of education and self-improvement" (Deming, 1986) are required, in part, to support change and innovation, since it is needed to effect long-term constancy of purpose towards continual improvement. Again, "constancy of purpose means acceptance of obligations [to] ... innovate ... allocate resources for long-term planning. Plans for the future call for ... new skills ... training and

retraining of personnel ...” (Deming, 1986). Deming notes elsewhere the importance of the interrelationships of change, education, and the aim of future improvement:

> “Long term commitment to new learning and new philosophy is required.” (Deming, 1986)
>
> “Preparation for the future includes lifelong learning for employees.” (Deming, 1994)
>
> “A better outlook is of course to embrace new knowledge because it might help us do a better job.” (Deming, 1986)
>
> “Efforts for improvement ... are in most companies ... fragmented, with ... no integrated system for continual improvement. Everyone, regardless of his job needs a chance to learn and develop. In a climate of fragmentation, people go off in different directions, unaware of what other people are doing. They have no chance to work to the best advantage of the company nor with themselves.” (Deming, 1986)
>
> “... engineers and chemists, aiming to improve the process, may introduce change.” (Deming, 1986)
>
> “The purchasing department must change its focus ... This means education in purchasing.” (Deming, 1986)

Deming clearly states a requirement for an environment of variety and change, as well as the value of new and different ideas and approaches, primarily towards the central aim of continual improvement. Deming’s statements support the formation of P5 regarding the fifth specific research question:

P5: Deming methods prescribe a higher-than-average degree of innovation.

Development of P6: Degree of Involvement

This section of the chapter presents the sixth proposition of this study, regarding the degree of involvement prescribed by Deming, after developing rational support for that proposition from Deming’s seminal works on management philosophy.

The sixth specific research question relates to the degree of involvement expected under the Deming prescription. The construct "involvement" is operationalized as the extent to which employees are concerned about and committed to their jobs.

While Tayloristic management principles do not generally acknowledge the need for employee involvement, such is required under the Deming perspective. Deming expects employees to be highly involved in, concerned about, and committed to, their work; "[A manager of people] tries to create for everybody interest and challenge" (Deming, 1994). Deming chided traditional managerial thinking for its "greatest ... failure to use the abilities of people" (Deming, 1986). *Out of the crisis* (Deming, 1986) documents numerous observations of situations where companies would have gained from facilitating involvement of its workers; one set of such examples can be found at pages 79 through 83.

Deming generally prefers intrinsically motivated behaviors towards quality, productivity, and improvement; "the present style of reward, and their effects ... build into [an individual] extrinsic motivation. We must preserve the power of intrinsic motivation ... that people are born with" (Deming, 1994). Deming employs intrinsic motivators such as pride to replace other control mechanisms. For example, he advocates "management in authority ... take pride in their adoption of the new philosophy ..." (Deming, 1986) as opposed to ensuring the adoption through bureaucratic or "scientific management" control.

Deming requires substantial involvement in the form of pride. Deming's Point Twelve requires that management "remove barriers that rob the hourly worker of his right to pride of workmanship," that management "remove barriers that rob people in

management and in engineering of their right to pride of workmanship." (Deming, 1986). Deming believes that facilitating such pride will lead to significant gains; examples include his statements that "[improvement] means removal of barriers to pride of workmanship ..." (Deming, 1986) and that "quality to the production worker means that his performance satisfies him, provides to him pride of workmanship" (Deming, 1986). He also believes that lack of ability to take such pride leads to significant losses; for example "... robbing people of their right to pride of workmanship would add a deplorable amount to Dr. Feigenbaum's estimate [that 15 to 40 percent of manufacturing cost is waste]" (Deming, 1986).

In parallel with his posture regarding "pride of workmanship," Deming also argues for the facilitation of involvement in the form of "joy in work:"

> "[A worker] may now engage his mind as well as his labor ... He may now take joy in his work." (Deming, 1994)
>
> "There are other aims for [a system], such as joy in work." (Deming, 1994)
>
> "Some people go where they can get more money. ... He stays here because ... he takes joy in his work." (Deming, 1994)
>
> "The transformation will release the power of human resource contained in intrinsic motivation. ... There will be joy in work." (Deming, 1994)
>
> "Joy on the job comes not so much from the result, the product, but from contribution to a system in which everybody wins." (Deming, 1994)

Deming also calls for employee involvement through commitment. He expects that "every employee must be committed to the transformation" (Deming, 1986) and he notes the positive outcome where "improvement of quality became at once, with total commitment: companywide—all plants, management, engineers, production workers, suppliers, everybody. Embracing every activity in

production and service …" (Deming, 1986). Deming states that "long term commitment to new learning and new philosophy is required" (Deming, 1986).

Deming additionally describes his requirement for employee involvement in the forms of effort, devotion, satisfaction, understanding and help:

> "Best efforts are essential." (Deming, 1986)
>
> "There is a need for consistency of effort." (Deming, 1986)
>
> "[When] everyone in the organization performs with devotion, [it is referred to as an] aid that can boost efficiency." (Deming, 1986)
>
> "... on the problems that rob the production worker of the possibility of carrying out his work with satisfaction." (Deming, 1986)
>
> "... people in the company must understand the Fourteen Points, the deadly diseases, the obstacles ... management is helpless otherwise." (Deming, 1986)
>
> "Older salesman now help beginners. ... They now help each other. They all help people in the warehouse to avoid scratches and breakage. ... Result: sales go up month after month." (Deming, 1994)

In addition, Deming's points for management that require "people ... work as a team," that they have "constancy of purpose" and "a vigorous program of education and self-improvement" can clearly be interpreted to contain the expectation for a high degree of worker involvement, even more so for Deming's Point defining "the transformation" to a new philosophy of management as "everyone's job."

Involvement in the form of challenge is expected of management as well. Managers must "commit themselves for life to quality and productivity" (Deming, 1986), "must awaken to the challenge [of adopting the new philosophy]" (Deming, 1986).

From quotations such as these, it appears that the Deming perspective expects a level of employee work involvement well above that of merely directed labor typical

under classic principles of scientific management, and so they support the formation of P6, the proposition related to the sixth specific research question:

P6: Deming methods prescribe a higher-than-average degree of involvement.

Development of P7: Degree of Task Orientation

This section of the chapter presents the seventh proposition of this study, regarding the degree of task orientation prescribed by Deming, after developing rational support for that proposition from Deming's seminal works on management philosophy. The seventh specific research question relates to the degree of task orientation expected under the Deming prescription. The construct "task orientation" is operationalized as the emphasis on good planning, efficiency, and getting the job done. Certain aspects of task orientation are prescribed by Deming, while other, more traditional, aspects are avoided.

Deming advocates an extremely high degree of planning by both employees and managers. The planning required by Deming has more in common with the scientific method than with traditional business planning. Deming requires managers and workers to have an explanatory theory from which they should generate their plans, rather than to rely solely on past experience as the basis for action; as "experience teaches nothing." Deming continually reemphasized the need for this type of planning:

> "Present practice: Reactive ... Better practice: Theory of management required ... Do some long term planning." (Deming, 1994)

> "Failure of management to plan for the future and to foresee problems has brought about waste of manpower, of materials, and of machine time." (Deming, 1986)

> "The presentation [of great ideas]must describe a plan of action." (Deming, 1994)

> "If you can improve productivity, or sales, or quality, or anything else by (e.g.) 5 per cent next year without a rational plan for improvement, then why were you not doing it last year? ... And if one can accomplish improvement of 3 per cent with no plan, why not 6 per cent? Moreover, it was numbers only; no plan for all-out effort to minimize total cost." (Deming, 1986)

> "[A leader] has a plan, step by step, and can explain it in simple terms." (Deming, 1994)

> "... the quality desired starts with the intent, which is fixed by management. The intent must be translated into plans, specs, tests ... all of which are management's responsibility." (Deming, 1986)

> "Goals are necessary for you and for me, but numerical goals set for other people, without a road map to reach the goal, have effects opposite to the effects sought." (Deming, 1986)

> "A group, a team, should have an aim, a job, a goal." (Deming, 1986)

> "Management that faces seriously [these] questions will perceive the need of an overall integrated plan. Where do you hope to be five years from now? How may you reach this goal? By what method?" (Deming, 1986)

> "The great advantage of the Kanban system (delivery just in time) is the discipline behind it—processes in control; quality, quantity and regularity predictable." (Deming, 1986)

> "A man in the Postal Service told me that his organization intends to improve productivity 3 per cent next year. Enquiry about the plan or method for this accomplishment brought forth the usual answer: no plan—they were simply going to improve." (Deming, 1986)

A high degree of planning is also central to key Deming principles such as the Deming cycle for continuous improvement, "constancy of purpose" as well as the seven deadly diseases:

> "The PDSA Cycle ... for improvement of a product or a process. Step 1: PLAN ... to plan a change or a test, aimed at improvement ... is the foundation of the whole cycle." (Deming, 1994)

> "Point 1: Create constancy of purpose ... Constancy of purpose means acceptance of obligations [to] ... allocate resources for long-term planning.

> Plans for the future call for ... new skills ... training and retraining of personnel ...” (Deming, 1986)
>
> “Enumeration of the deadly diseases: 1. Lack of constancy of purpose to plan product and service.” (Deming, 1986)
>
> “The crippling disease: lack of constancy of purpose.” (Deming, 1986).

Deming offers further action plans for his own ideas; enumerated steps are found in *Out of the crisis* (Deming, 1986) at pages 86−90.

In addition to advocating a high degree of planning, Deming demonstrates his orientation towards task through his interest in the elimination of wasted time and resources. Deming finds and criticizes waste he finds in companies that do not practice his philosophy. He states that “the present style of management is the biggest producer of waste, causing huge losses ... The aim of this chapter is to identify the most important sources of loss (waste), and to offer suggestions for better practice” (Deming, 1994) and that “the production worker in America is under handicaps that are taking a terrific toll in quality and productivity.” (Deming, 1986). He concurs with Feigenbaum’s estimate that “from fifteen to forty per cent of the manufacturer’s costs of almost any American product that you buy today is for waste embedded in it—waste of human effort, waste of machine time ...” (Deming, 1986). He criticizes the “failure of management to plan for the future and to foresee problems has brought about waste of manpower, materials, and of machine time;” (Deming, 1986) and the “greatest waste in America ... failure to use the abilities of people” (Deming, 1986). Deming chides a subway where “mechanics in a huge repair shop spent three-quarters of their time waiting in line to get parts” (Deming, 1986).

Deming states that continual improvement of quality will reduce that waste, that "improvement of quality transfers waste of man hours and of machine time into the manufacture of good product and better service" (Deming, 1986) and that "downstream [from management's plan], there will be continual reduction of waste and continual improvement in quality" (Deming, 1986).

Though Deming prescribes a high degree of planning and waste reduction, he does not advocate a high degree of task orientation in such forms as meeting quotas and maximizing the direct laboring upon product. Deming clearly advocates productivity, but not in the usual sense of "working hard" or "staying busy" in comparison to work standards: "It is a common supposition that quality and productivity can be achieved by putting on the screws ... A new book explains how to 'Motivate your people to work at top speed!' Beat horses, and the will run faster—for a while." (Deming, 1986) Rather, Deming expects management focus on improvement of processes instead of focus on outcomes: "Measures of productivity do not improve productivity" (Deming, 1986); "Paper profits do not make bread: improvement to quality and productivity do" (Deming, 1986);[4] "Eliminate quotas; substitute leadership" (Deming, 1986). Other reasons (as stated above) for the lack of emphasis on quotas include their increasing of global costs, their generation of fear that detracts from effectiveness, and their contribution to nonproductive "distortion and faking," i.e., Taylor's soldiering. (Taylor, 1911)

To Deming, efficiency is not a sufficient condition for success: "It is a mistake to suppose that efficient production of product and service can with certainty keep an

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[4] Deming's perspective is reminiscent of that of Confucius, as expressed within *The Analects*: "The wise man understands equity; the small man understands only profit."

organization solvent and ahead of competition. It is possible and in fact fairly easy for an organization to go downhill and out of business ... employing ... every other aid that can boost efficiency" (Deming, 1986); "a plant was recognized for efficiency ... written up and filmed. ... Why did the plant close? ... It was turning out a product that had lost the market. ... All [the bank's] operations could go off without blemish, while the bank closes ... their bad loans." (Deming, 1994).

Deming emphasizes hard work, efficiency, and task completion as outcomes that result from appropriate aims, (e.g., joy in work, removal of fear, teamwork, elimination of ranking) rather than as appropriate aims in themselves:

> "The job of management is to replace work standards by knowledgeable and intelligent leadership. ... Wherever [this has been done], quality and productivity have gone up substantially." (Deming, 1986)
>
> "[Establishment of operational definitions of acceptable work (or clear definition of process)] is an example of gain in productivity accomplished by a change in the system." (Deming, 1986)
>
> "Monies spent ... are ineffective unless inhibitors to good work are removed (i.e., remove barriers that rob the hourly worker of his right to pride of workmanship; remove barriers that rob people in management ... of their right to pride in workmanship)." (Deming, 1986)
>
> "There is no substitute for teamwork and good leaders of teams to bring consistency of effort, along with knowledge." (Deming, 1986)
>
> "The so-called merit system introduces conflict between people. Emphasis goes to achievement of rank, merit, not on the work." (Deming, 1994)
>
> "Yet somehow or other the company was going down the tube. Why? ... Each ... area was suboptimizing its own work, but not working as a team for the company. It was the ... president's job to coordinate." (Deming, 1986)

Deming's point for management regarding the removal of fear (Deming, 1986) is one recommended managerial action that will effect an outcome of increased efficiency;

one of the many related examples offered by Deming describes a failing drive shaft: " 'That bearing is about to go out and it will ruin the shaft along with it ... if we do not take care of it now.' ... The foreman, for fear of his job, could not protect the best interests of the company. He is judged by numbers only, not for avoiding shutdowns. ... Before they get the load out, the bearing freezes ... four days lost to get a new shaft from Baltimore and replace it" (Deming, 1986). In advocating a work stoppage to replace the shaft, Deming is promoting a long-term efficiency at the expense of "time on task."

Further, Deming does not offer support for devotion to task in the form of "best efforts" without qualification. While Deming believes that "best efforts are essential" (Deming, 1986), "best efforts are not sufficient" (Deming, 1986). Deming points out that "people charging this way and that way without guidance of principles, can do a lot of damage. Think of the chaos that would come if everyone did his best, not knowing what to do" (Deming, 1986). He states that "best efforts and hard work, not guided by new knowledge, they only dig deeper the pit that we are in" (Deming, 1994). As proof, Deming notes that "the prevailing system of management has been created by best efforts, without [that new] knowledge" (Deming, 1994). Deming advises finding new approaches rather than maximizing effort under current approaches; to "work smarter, not harder" (Deming, 1986).

With regard to the Deming perspective, task orientation is evidenced by good planning, minimal "time-off-task," "getting the job done" and overall efficiency. Deming advocates a high degree of planning, both in employees and managers. In addition, Deming prescribes a central philosophy of continual improvement, which in turn, captures productivity, discipline and efficiency through elimination of wasted time, labor

and resources. However, Deming does not advocate a high degree of task orientation in such forms as meeting quotas and maximizing the direct laboring upon product. Deming views efficiency not as an aim, but as the outcome of appropriate aims. Further, he qualifies his advocacy of workers applying their "best efforts."

This posture supports the formation of P7, related to the seventh specific research question.

P7: Deming methods prescribe an average degree of task orientation.

Development of P8: Degree of Clarity

This section of the chapter presents the eighth proposition of this study, regarding the degree of clarity prescribed by Deming, that was included without equivalent rational development from Deming's seminal works on management philosophy at the request of the committee.

The eighth specific research question relates to the degree of clarity expected under the Deming prescription. The construct "clarity" is operationalized as whether employees know what to expect in their daily routine and how explicitly rules and policies are communicated. Evidence from Deming's two major works that might be used to support formation of an associated proposition was not nearly as strong as with P1 through P7. However, since the survey instrument that will be used measures the degree of clarity, the committee has requested that the associated data be analyzed and so an associated proposition will be formed. Again, as no argument was developed regarding the proposition; the neutral (i.e., average degree) proposition was the most appropriate:

P8: Deming methods prescribe an average degree of clarity.

Development of P9: Degree of Managerial Control

This section of the chapter presents the eighth proposition of this study, regarding the degree of managerial control prescribed by Deming, that was included without equivalent rational development from Deming's seminal works on management philosophy at the request of the committee.

The ninth specific research question relates to the degree of managerial control expected under the Deming prescription. The construct "managerial control" is operationalized as how much management uses rules and procedures to keep employees under control. Evidence from Deming's two major works that might be used to support formation of an associated proposition was not nearly as strong as with P1 through P7. However, since the survey instrument that will be used measures the degree of managerial control, the committee has requested that the associated data be analyzed and so an associated proposition will be formed. Given that no persuasive argument was developed regarding the degree of managerial control expected under the Deming prescription, the neutral (i.e., average degree) proposition was the most appropriate:

P9: Deming methods prescribe an average degree of managerial control.

Development of P10: Degree of Physical Comfort

This section of the chapter presents the tenth proposition of this study, regarding the degree of physical control prescribed by Deming, that was included without equivalent rational development from Deming's seminal works on management philosophy at the request of the committee.

The tenth specific research question relates to the degree of physical comfort expected under the Deming prescription. The construct "physical comfort" is operationalized as the extent to which the physical surroundings contribute to a pleasant work environment. Evidence from Deming's two major works that might be used to support formation of an associated proposition was not nearly as strong as with P1 through P7. Only one relevant quotation was located:

> "Filth and vandalism raise the cost of living and, as any psychologist can aver, lead to slovenly work and to dissatisfaction with life and the workplace." (Deming, 1986)

However, since the survey instrument that will be used measures the degree of physical comfort, the committee has requested that the associated data be analyzed and so an associated proposition will be formed. Given that no persuasive argument was developed regarding the degree of physical comfort expected under the Deming prescription, the neutral (i.e., average degree) proposition was the most appropriate:

P10: Deming methods prescribe an average degree of physical comfort.

Development of P11 through P20: Deming versus Baldrige

The next section presents ten Deming prescription versus Baldrige prescription propositions—one proposition for each of the ten aforementioned constructs—that were included in this study without rational development at the request of the committee.

One concept presented in Chapter 1, that the ideal (or very good) Deming work climate profile that results from this study could be compared to the ideal (or very good) work climate prescribed by other quality and management philosophers, so as to better understand their similarities and differences, was a concept that captured the interest of the committee. Accordingly, the committee requested that Malcolm Baldrige National

Quality Award subject matter experts (SMEs) be surveyed and that the subscale differences be tested for significant differences. A discussion as to whether there is congruence of the Deming and Baldrige prescriptions has arisen in the literature before; a discussion by Jim Evans (Evans, 1996) is one notable example. Each year, approximately nine MBNQA judges are appointed by the Secretary of Commerce, and approximately 350 examiners are competitively appointed to review the applications of organizations applying for the Malcolm Baldrige Award. Of these, approximately seventy are appointed as senior examiners. These senior examiners, then, almost certainly represent the population of those who are most expert in the current Baldrige prescription. Further, such examiners historically contribute significantly to information transfer activities and were therefore expected to be cooperative as research subjects. Accordingly, these senior examiners were surveyed as Baldrige experts for the purpose of this study.

Ten appropriate propositions were formed. Given that no persuasive argument was developed regarding differences between the Deming prescription and the Malcolm Baldrige Award prescription, the neutral (i.e., no significant difference) proposition was the most appropriate.

P11: There is no significant difference between the degree of work pressure under the Deming prescription and the degree of work pressure under the Baldrige prescription.

P12: There is no significant difference between the degree of coworker cohesion under the Deming prescription and the degree of coworker cohesion under the Baldrige prescription.

P13: There is no significant difference between the degree of supervisor support under the Deming prescription and the degree of supervisor support under the Baldrige prescription.

P14: There is no significant difference between the degree of autonomy under the Deming prescription and the degree autonomy of under the Baldrige prescription.

P15: There is no significant difference between the degree of innovations under the Deming prescription and the degree of innovation under the Baldrige prescription.

P16: There is no significant difference between the degree of involvement under the Deming prescription and the degree of involvement under the Baldrige prescription.

P17: There is no significant difference between the degree of task orientation under the Deming prescription and the degree of task orientation under the Baldrige prescription.

P18: There is no significant difference between the degree of clarity under the Deming prescription and the degree of clarity under the Baldrige prescription.

P19: There is no significant difference between the degree of managerial control under the Deming prescription and the degree of under of managerial control the Baldrige prescription.

P20: There is no significant difference between the degree of physical comfort under the Deming prescription and the degree of physical comfort under the Baldrige prescription.

Summary

This chapter presented the twenty specific propositions that were tested in this study as well as the developmental arguments upon which they were formed. Martin's "garbage can" model of research, a model which bore strong influence upon the aim and design of this study, was described and its influence explained, the seven Deming prescription versus normative value propositions that were given support from within Deming's seminal works on management philosophy were developed and presented, the three Deming prescription versus normative value propositions that were included in this study, without equivalent rational development from Deming's seminal works on management philosophy, at the request of the committee were presented and the ten Deming prescription versus Baldrige prescription propositions that were included in this study without rational development at the request of the committee were also presented.

The following chapter presents the methodology that was used to analyze the data collected during this study and used to test the propositions formed above within this chapter.

CHAPTER 4

METHODOLOGY

Introduction

This chapter presents detailed information regarding the methodology that was used to analyze the data collected during this study and used to test the propositions formed in the preceding chapter.

The first section of this chapter describes the primary survey instrument that was used in the study. First, the section briefly describes the instrument in general terms. Next, the biographical information and academic credentials of the instrument's primary author are discussed. The section ends with a detailed description of the structure of the instrument as well as its theoretical basis.

The second section of this chapter discusses the reliability of the primary survey instrument. Reliability is briefly defined, then two generally accepted methods for gauging reliability are explained and the literature that supports the reliability of the survey instrument under those two measures is cited.

The third section of this chapter discusses the validity of the primary survey instrument. Validity is briefly defined then each of the three major types of validity are discussed in further detail and the literature that supports the validity of the survey instrument under each of the three types of validity is cited.

The fourth section of this chapter discusses the sources and methods of data collection. A general description of the surveyed population is given, followed by a general discussion regarding how the surveying process was conducted.

The fifth section of the chapter describes the statistical tests that were applied to seek significant difference between the Deming work environment profile and the work environment profile of the normative values, i.e., the differences explored through Propositions 1 through 10. Two tests were conducted for each of the ten propositions. One test was based upon the generally accepted "difference of two means" test; the other test was based upon the "one standard deviation" test recommended for the instrument within the literature. First, this section of the chapter discusses the general nature and appropriateness of the generally accepted "difference of two means" test. Next, each proposition is listed along with the appropriate null hypothesis, alternative hypothesis and critical value used to test that proposition under the generally accepted "difference of two means" test. Next, the nature and appropriateness of the "one standard deviation" test for use with Work Environment Scale data is described and cited, then each proposition is listed along with the appropriate null hypothesis and alternative hypothesis used to test that proposition under the "one standard deviation" test.

The sixth section of this chapter describes the specific statistical tests that were applied to seek significant difference between the Deming work environment profile and the Baldrige work environment profile, i.e., the differences explored through Propositions 11 through 20. Two tests were conducted for each of the ten propositions. Again, one test was based upon the generally accepted "difference of two means" test; the other test was based upon the "one standard deviation" test recommended for the instrument within the

literature. First, this section of the chapter discusses the general nature and appropriateness of the generally accepted "difference of two means" test. Next, each proposition is listed along with the appropriate null hypothesis, alternative hypothesis and critical value used to test that proposition under the generally accepted "difference of two means" test. Next, the nature and appropriateness of the "one standard deviation" test for use with Work Environment Scale data is described and cited, then each proposition is listed along with the appropriate null hypothesis and alternative hypothesis used to test that proposition under the "one standard deviation" test.

The final section of this chapter that presents methodology discusses the specific data analysis techniques employed in the analysis of the Deming SME open response questions that were included with the primary survey instrument at the request of the committee. Each open response question is listed, and is then followed by a brief description of the methodology of data analysis employed for that question.

The Survey Instrument

This section of the chapter describes the primary survey instrument that was used in the study. First, the instrument is briefly described in general terms. Next, the biographical information and academic credentials of the instrument's primary author are discussed. The section ends with a detailed description of the structure of the instrument as well as its theoretical basis.

The instrument used was the Work Environment Scale (WES), developed by Dr. Rudolf H. Moos. The purpose of the WES is to measure the organizational degree of each of the constructs whose degrees form the set of propositions of this study. For example, Proposition 1 is "Deming methods prescribe a less-than-average degree of work

pressure;" the WES measures the degree of work pressure in an organization. The same is the case for the other propositions that were the basis of this study.

The WES has been used hundreds of times as a central instrument in published academic works and dissertations, implying that the instrument is generally acceptable for use in research. For example, according to Vaux, the WES has been extensively used to describe and compare work settings (Vaux, 1992). According to Vaux, "the theoretical underpinnings of the instrument … have worn well" (Vaux, 1992). In addition, the WES is reliable and valid; it was developed with due concern for psychometrics (Vaux, 1992). The WES is also administratively advantageous to this study. It is designed for self-administration and it is brief, no more than fifteen to twenty minutes in length (Moses, 1994). As it is written at a reading and comprehension level equivalent to that of popular magazines and local newspapers, it is suitable for a broad range of individuals (Moses, 1994; Vaux, 1992).

Dr. Moos, the primary author of the instrument, received his Ph.D. in 1960, as well as his B.A. degree with honors in 1956, from the University of California, Berkeley. He also holds a diploma in clinical psychology from the American Board of Professional Psychology and is a recipient of the Hofheimer Award for Research of the American Psychiatric Association. Dr. Moos has been on faculty of the Department of Psychiatry and Behavioral Sciences at Stanford University since 1962 and is the Director of Stanford's Postdoctoral Research Training Program. He is also the Director of the Social Ecology Laboratory as Chief of Psychiatric Research at the Veterans Administration Medical Center, Palo Alto, California. Dr. Moos has authored one dozen books and nearly three hundred professional writings during his career (Moses, 1994).

The WES "provides a method for quantification and objective definition of important behavioral variables that affect job performance and that have been shown to relate significantly to work output and employee efficiency" (Moses, 1994). The WES consists of ninety short, declarative statements to which the subject responds "true" or "false." The ninety statements correspond to ten subscales of nine questions, each subscale measuring an exclusive behavioral construct upon which the two sets of ten propositions in this study are formed.[5] Each question is scored one when the respondent makes the high degree selection, zero when the respondent makes the low degree selection. The total score for a particular construct is then derived by adding the scores for the nine questions associated with a particular construct. Accordingly, the entire WES instrument generates a value between zero and nine for each of the ten constructs that it measures.

These ten subscales assess three underlying dimensions: (1) relationships, (2) personal growth and (3) system maintenance/change. Those three dimensions and their interactions define the organizational system within the theoretical framework upon which Dr. Moos relies. The WES is grounded in theory, specifically derived from the work of Henry Murray (Moses, 1994); Murray described behavioral outcomes as a consequence of the interaction of the needs of the individual and the dictates of the environment (see Murray, 1959). Figure 1 illustrates and clarifies the relationship between the dimensions, subscales and questions contained within the WES.

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[5] The reader may, therefore, interpret the words "subscale" and "construct" as synonyms within the context of this study.

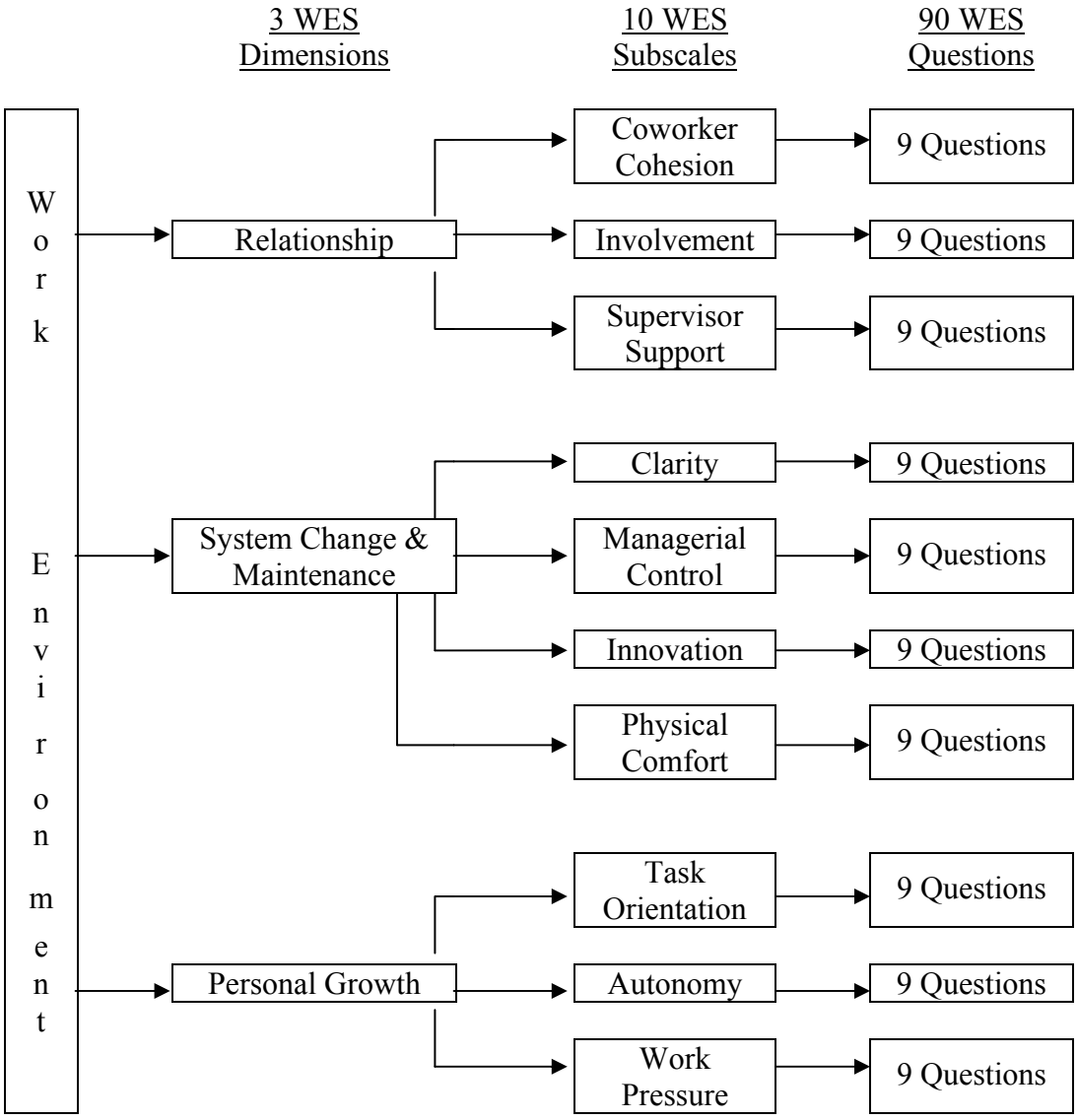

Figure 1: WES Dimensions, Subscales and Questions

Reliability

This section of the chapter discusses the reliability of the primary survey instrument. Reliability is briefly defined, then two generally accepted methods for gauging reliability are explained and the literature that supports the reliability of the survey instrument under those two measures is cited.

"In the abstract, reliability is a matter of whether a particular technique, applied repeatedly to the same object, would yield the same result each time" (Babbie, 1995). There are a number of useful techniques available to gauge the reliability of an instrument; several have already been used to establish reliability for the Work Environment Scale.

Internal consistency is a method that estimates the reliabilities that would be obtained from all possible ways of subdividing an instrument (Nunnally & Ator, 1972), each of which can be thought of as approximation of an alternate form of the instrument (Nunnally et al., 1972). Cronbach's alpha (Cronbach, 1951) is one objective measure of this characteristic; in a sample of 1,045 subjects, all of the subscale alphas as well as the mean alpha value for the Work Environment Scale fell within acceptable psychometric limits (Moos, 1994b; Moses, 1994).

Test-retest is another appropriate measure of reliability (Babbie, 1995; Nunnally et al., 1972). Test-retest measures stability reliability, the reliability of the instrument over time. The Work Environment Scale was administered with a one-month intertest interval with resulting "moderately high" reliability values (Moos, 1994b; Moses, 1994). Longitudinal studies have provided data for stability over periods from 1 to 10 years; finding that the instrument is quite stable over 1 year and is moderately stable over the

long term (Moos, 1994b). These stability values are "within acceptable limits for practical application" (Moos, 1994b).

Validity

This section of the chapter discusses the validity of the primary survey instrument. Validity is briefly defined then each of the three major types of validity are discussed in further detail and the literature that supports the validity of the survey instrument under each of the three types of validity is cited.

"Validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under construction" (Babbie, 1995). A common intuitive definition of a valid instrument is that is measuring just what it is supposed to measure (Alreck & Settle, 1995; Carmines & Zeller, 1979; De Vaus, 1995; Kerlinger, 1986). Researchers stress that validity cannot be truly measured (Babbie, 1995; De Vaus, 1995). Nevertheless, the issue of validity is typically addressed by the researcher in some fashion. Discussions of validity often address three major types of validity: construct validity, criterion validity, and content validity (Carmines et al., 1979; De Vaus, 1995).

Construct validity refers to the extent to which the instrument outcomes can be adequately explained in terms of the of underlying theory and constructs; Kerlinger states that "one must try to validate the theory behind the test" (Kerlinger, 1986). According to Vaux, "a great many studies bear on the construct validity of the Work Environment Scale; that is, yield findings that to a greater or lesser degree conform to the theoretical predictions" (Vaux, 1992). Vaux presents several illustrative studies; Moos offers many more examples in a lengthy discussion (Moos, 1994b) that "support the construct … validity of the scale" (Moos, 1994b). For example, Moos cites a study by Weyer and

Hodapp (Weyer & Hodapp, 1978) that compares the German version of the Work Environment Scale with a scale that measures work pressure and dissatisfaction, providing evidence of construct validity (Moos, 1994b). Moos also states elsewhere that his Social Climate instruments in general show good construct validity (Moos, 1994a).

Researchers are faced with a persistent and inevitable "trade-off" between reliability and validity; (Babbie, 1995) Moos notes that the WES, intended to measure broad concepts, was developed with sacrifice of reliability in order to preserve construct validity (Moos, 1994b). In addition, each of three studies (Constable, 1983; Flood, 1987; Yarne, 1983) have factor analyzed the Work Environment Scale and it "loaded" onto three factors, as would be expected. Construct validation requires convergence and discriminability (Kerlinger, 1986); due to the fact that the Work Environment Scale is a unique instrument, no explicit tests of convergent or discriminant validity have been conducted (Vaux, 1992).

Criterion validation is determined by comparing the outcomes of the instrument to other variables. i.e., criteria (Kerlinger, 1986). The two types of criterion-related validity generally discussed are concurrent validity and predictive validity. The following discussion of criterion validity by De Vaus is an example of concurrent validity:

> "Using this approach we would compare how people answered our new questions to measure a concept, with existing, well-accepted measures of the concept. If people's answers on both the new and the established measure are highly correlated this is taken to mean the new measure is valid." (De Vaus, 1995)

The following discussion of criterion validity by Babbie is an example of predictive ability:

> "For example, the validity of the college board [exam]is shown in its ability to predict the college success of students. The validity of a written

> driver's test is determined, in this sense, by the relationship between the scores people get on the test and how well they drive." (Babbie, 1995)

Though the predictive ability of the Work Environment Scale is not germane to this study, it is true that preliminary evidence shows that the instrument may have significant predictive validity (Moses, 1994). In addition, approximately sixty studies by various researchers in a variety of settings "support the … concurrent and predictive validity of the scale" (Moos, 1994b).

There is a recent appeal in the literature for operations management researchers to give greater attention to the issue of content validity (Rungtusanatham, 1998). Content validity refers to the extent to which content is representative of the construct under measure. (Kerlinger, 1986). This type of validity is not usually "tested" but is "ensured" by proper planning and procedures used during test construction and item selection as well as using reasonable criteria for retaining items in the instrument that properly represent the intended construct (Nunnally & Bernstein, 1994). A detailed discussion of the planning, development and item selection for the Work Environment Scale (Moos, 1994b) lends content validity to the instrument. Moos also states elsewhere that content validity was built into his Social Climate instruments from the outset by carefully defining constructs,[6] preparing items to fit the construct definitions and selecting items according to empirical analysis (Moos, 1994a). The three aforementioned studies performing factor analysis also strengthen the argument for content validity. Again, the reader is reminded that content validation, in the final analysis, is basically judgmental (Kerlinger, 1986).

Data Collection

This section of the chapter discusses the sources and methods of data collection. A general description of the surveyed population is given, followed by a general discussion regarding how the surveying process was conducted.

Fifty-three individuals were selected to function as Deming philosophy subject matter experts (SMEs) for this survey. These individuals were selected on the basis that they had relatively extensive professional contact with Dr. Deming, published on the topic of the Deming philosophy, remain centrally active in the Deming community, and/or are credited by name by Dr. Deming in his written works. These fifty-three individuals clearly represent a high percentage of the entire population of Deming subject matter experts (SMEs) in the context intended by the researcher. Appendix A lists each individual expert surveyed and details their proximity to Deming and his philosophy as evidence of their qualification as Deming subject matter experts.

Due to the researcher's extensive prior personal contacts with the specific experts being surveyed and with the Deming community in general, an acceptable response rate from the experts was expected. Regardless, in order to positively effect the response rate a number of actions were taken. At least one attempt was made to contact each subject by telephone prior to the mailing of the survey in order to increase the response rate. It was explained in the cover letter that each individual received with the survey letter that they were part of a very carefully selected and very small group of individuals being surveyed and so each response was critical in order for the study to be successful. A second request

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[6] As reflected in the operational definitions noted at the beginning of each prepositional development.

letter and a ”double-mailing” of the survey was sent to non-respondents. Further, the cover letter was sent on departmental letterhead to imply sponsorship and authenticity. Dillman (Dillman, 1978) gives support toward the use of all these tactics in order to increase response rate. Dillman was also consulted in a broader, more general sense for expertise in conducting this mail survey. Further, surveys were sent with stamped return postage (as opposed to “postage to be paid” mailings), a second request letter and “double mailing” was sent to non-respondents and cover letters were sent on university letterhead due to the fact that significance was found for each of those factors in a meta-analysis of the factors typically used to induce response in mail surveys (Fox, Crask, & Kim, 1989). It was possible to survey respondents directly by telephone if needed, as Work Environment Scale proctors are allowed to read test items to, and mark responses for, respondents who are unable to read the test instrument for various reasons (Moses, 1994); however the need to do so did not arise during the data collection. Further, an informal evaluation of Deming SME response bias was conducted in order to determine their primary reason for non-response through the examination of the information given by a number of Deming SMEs who chose to explain why they did not participate.

In order to test the propositions that compared the Deming prescription work environment with that of the Baldrige work environment prescription, the population of 2000 Baldrige senior examiners, seen to represent the best possible population of Baldrige SMEs in the context of this study, were also surveyed, employing the same specific survey tactics as discussed above in the context of the Deming SME survey process.

Data Analysis Techniques, P1 through P10

This section of the chapter describes the statistical tests that were applied to seek significant difference between the Deming work environment profile and the work environment profile of the normative values, i.e., the differences explored through Propositions 1 through 10. Two tests were conducted for each of the ten propositions. One test was based upon the generally accepted "difference of two means" test; the other test was based upon the "one standard deviation" test recommended for the instrument within the literature. First, this section of the chapter discusses the general nature and appropriateness of the generally accepted "difference of two means" test. Next, each proposition is listed along with the appropriate null hypothesis, alternative hypothesis and critical value used to test that proposition under the generally accepted "difference of two means" test. Next, the nature and appropriateness of the "one standard deviation" test for use with Work Environment Scale data is described and cited, then each proposition is listed along with the appropriate null hypothesis and alternative hypothesis used to test that proposition under the "one standard deviation" test.

The generally accepted "difference of two means" test, as described by Anderson, Sweeney and Williams (Anderson, Sweeney, & Williams, 1987) for example, was used to statistically test for support of the set of propositions P1 through P10. Since the sample sizes involved are greater than 30, a *z*-test was used in place of a *t*-test. Further, the assumption regarding the normality of the underlying distributions required under a *t*-test (Anderson et al., 1987) was avoided using a *z*-test. The test statistic was:

$$z = \frac{(\bar{x}_{de} - \bar{x}_{ns}) - (\mu_{de} - \mu_{ns})}{\sqrt{(s^2_{de} / n_{de}) + (s^2_{ns} / n_{ns})}}$$

where $\bar{x}_{de}$ is the subscale mean of Deming expert responses, s^2_{de} is the subscale variation of Deming expert responses, n_{de} is the number of Deming expert responses, $\bar{x}_{ns}$ is the subscale mean of the Work Environment Scale normative sample, s^2_{ns} is the subscale variation of the Work Environment Scale normative sample, and n_{ns} is the sample size of the Work Environment Scale normative sample. In that data was to be collected from virtually the entire population of Deming subject matter experts, sample size n was not planned. Table 1 displays the Work Environment Scale normative subscale means and variances:

Table 1: WES Subscale Normative Means and Variances

WES Subscale	$\bar{x}_{ns}$	s^2_{ns}
Involvement	5.71	$(1.14)^2$
Coworker Cohesion	5.52	$(0.91)^2$
Supervisor Support	5.18	$(0.97)^2$
Autonomy	5.47	$(0.76)^2$
Task Orientation	5.86	$(1.06)^2$
Work Pressure	5.31	$(1.02)^2$
Clarity	4.91	$(0.87)^2$
Managerial Control	5.26	$(0.96)^2$
Innovation	4.09	$(1.12)^2$
Physical Comfort	4.24	$(1.10)^2$

The source of the Work Environment Scale normative means and standard deviations is the associated *Work Environment Scale manual* (Moos, 1994b), published by the author of the instrument to support its users. The phrase "normative sample mean" refers to the average of the responses obtained from the 8,146 people belonging to 116 work groups originally sampled by the developers of the instrument. "Subscale" refers to one of the constructs being measured, such as "autonomy." So, for example, the "normative sample mean for the autonomy subscale" refers to the average of the

autonomy responses obtained from the 8,146 people originally sampled by the developers of the instrument.

Normative data is based upon 3,267 employees in general work groups and 4,879 employees in health care work groups. The general work groups include employees from the retail food industry, office managers and clerical workers, employees of radio stations, varied groups of employees in education and over 800 people who were case controls in two studies and were drawn randomly from specified census tracts in the San Francisco area. The health care work groups comprise employees from outpatient medical and psychiatric clinics, patient care personnel in hospital settings, personnel not involved in patient care (such as janitors, maintenance workers and office clerks), and administrative and supervisory personnel from community mental health centers, children's residential treatment centers, state mental hospitals, Department of Veteran Affairs medical centers, university-affiliated medical and dental schools, long-term care facilities and intensive care and general medical hospital units.

In each case, H_0, the null hypothesis was $\mu_{de} - \mu_{ns} = 0$. However H_1, the alternate hypothesis, varied according to which of the propositions was being tested; i.e., it was either a "one-tailed" or "two-tailed" test. The appropriate *z*-value for p = .05 was used as the critical value.

Based on the preceding discussion, the following specific tests were conducted to test the hypotheses:

P1, Deming methods prescribe a less-than-average degree of work pressure, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} < 0$, a "one-tailed" test, with p = .05,

and so the critical value z = -1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P2, Deming methods prescribe a higher-than-average degree of coworker cohesion, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} > 0$, a "one-tailed" test, with p = .05, and so the critical value z = +1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P3, Deming methods prescribe a higher-than-average degree of supervisor support, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} > 0$, a "one-tailed" test, with p = .05, and so the critical value z = +1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P4, Deming methods prescribe a higher-than-average degree of autonomy, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} > 0$, a "one-tailed" test, with p = .05, and so the critical value z = +1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P5, Deming methods prescribe a higher-than-average degree of innovation, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} > 0$, a "one-tailed" test, with p = .05, and so the critical value z = +1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P6, Deming methods prescribe a higher-than-average degree of involvement, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} > 0$, a "one-tailed" test, with p = .05, and so the critical value z = +1.645. The proposition found support if evidence was found to reject H_0 in favor of H_1.

P7, Deming methods prescribe an average degree of task orientation, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P8, Deming methods prescribe an average degree of clarity, as operationalized in Chapter 3, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P9, Deming methods prescribe an average degree of managerial control, as operationalized in Chapter 3, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P10, Deming methods prescribe an average degree of physical comfort, as operationalized in Chapter 3, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{ns} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

In addition to the traditional statistical *z*-test as described above, significant difference was also tested at values exceeding one standard deviation, as this is the significance test recommended by both the instrument authors and by the evaluative literature, for example:

> "Work Environment Scale profile elevations typically are interpreted as significant at approximately 1 standard deviation above the approximate normative mean. Profile elevation differences of this magnitude between groups compared on the same form of the WES generally are interpreted as relevant. … WES users would be well advised to interpret differences

> on the order of a standard deviation or more as clinically relevant." (Moses, 1994)

Beyond the mere recommendation of the literature, there was sufficient rationale to supplement the traditional *z*-test with the "one standard deviation" hypothesis test. The WES normative values are based upon a large sample size drawn from the full population of work environments. So the traditional *z*-test, in this situation, is more so testing to see if a specific work environment significantly differs from the entire population of known work environments, and this is indeed a test we would almost certainly expect to fail. The WES normative values support this perspective. The WES normative means tend to fall near 4.5–5.5 and the WES normative standard deviations tend to fall near 1.0. Therefore, for the traditional *z*-test to find significance against the null hypothesis, the sample mean would have to fall approximately below 1.0 or above 8.0. Given that a sample mean is derived from a "zero-to-nine" scale, in order for the traditional *z*-test to find significance, almost all of the nine responses on the instrument, from almost all of the respondents, would have to be toward the same extreme. Accordingly, significance for the traditional *z*-test was expected to be highly unlikely. Therefore, the traditional *z*-test was supplemented with the "one standard deviation" hypothesis test toward finding significant difference, as recommended within the literature. Additional discussion contrasting the traditional *z*-test and the "one standard deviation" hypothesis test can be found in Chapter 6, just prior to the presentation of the general conclusions of this study.

Based on that recommendation, the following specific tests, employing the previously tabled WES normative means and variances, were also conducted to test the hypotheses. The null hypotheses and alternative hypotheses that were used to test each

proposition are stated below; in each case, the alternative hypothesis supports the proposition.

P1, Deming methods prescribe a less-than-average degree of work pressure, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} - s_{ns}$ and H_1: $\bar{x}_{de} < \bar{x}_{ns} - s_{ns}$.

P2, Deming methods prescribe a higher-than-average degree of coworker cohesion, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} + s_{ns}$ and H_1: $\bar{x}_{de} > \bar{x}_{ns} + s_{ns}$.

P3, Deming methods prescribe a higher-than-average degree of supervisor support, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} + s_{ns}$ and H_1: $\bar{x}_{de} > \bar{x}_{ns} + s_{ns}$.

P4, Deming methods prescribe a higher-than-average degree of autonomy, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} + s_{ns}$ and H_1: $\bar{x}_{de} > \bar{x}_{ns} + s_{ns}$.

P5, Deming methods prescribe a higher-than-average degree of innovation, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} + s_{ns}$ and H_1: $\bar{x}_{de} > \bar{x}_{ns} + s_{ns}$.

P6, Deming methods prescribe a higher-than-average degree of involvement, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns} + s_{ns}$ and H_1: $\bar{x}_{de} > \bar{x}_{ns} + s_{ns}$.

P7, Deming methods prescribe an average degree of task orientation, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns}$ and H_1: $\bar{x}_{ns} - s_{ns} < \bar{x}_{de} < \bar{x}_{ns} + s_{ns}$.

P8, Deming methods prescribe an average degree of clarity, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns}$ and H_1: $\bar{x}_{ns} - s_{ns} < \bar{x}_{de} < \bar{x}_{ns} + s_{ns}$.

P9, Deming methods prescribe an average degree of managerial control, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns}$ and H_1: $\bar{x}_{ns} - s_{ns} < \bar{x}_{de} < \bar{x}_{ns} + s_{ns}$.

P10, Deming methods prescribe an average degree of physical comfort, was tested using H_0: $\bar{x}_{de} = \bar{x}_{ns}$ and H_1: $\bar{x}_{ns} - s_{ns} < \bar{x}_{de} < \bar{x}_{ns} + s_{ns}$.

Data Analysis Techniques, P11 through P20

This section of the chapter describes the specific statistical tests that were applied to seek significant difference between the Deming work environment profile and the Baldrige work environment profile, i.e., the differences explored through Propositions 11 through 20. Two tests were conducted for each of the ten propositions. Again, one test was based upon the generally accepted "difference of two means" test; the other test was based upon the "one standard deviation" test recommended for the instrument within the literature. First, this section of the chapter discusses the general nature and appropriateness of the generally accepted "difference of two means" test. Next, each proposition is listed along with the appropriate null hypothesis, alternative hypothesis and critical value used to test that proposition under the generally accepted "difference of two means" test. Next, the nature and appropriateness of the "one standard deviation" test for use with Work Environment Scale data is described and cited, then each proposition is listed along with the appropriate null hypothesis and alternative hypothesis used to test that proposition under the "one standard deviation" test.

The generally accepted "difference of two means" test, as, for example, described by Anderson, Sweeney and Williams (Anderson et al., 1987), was again appropriate and was used to statistically test for support of the set of propositions P11 through P20. The test statistic was:

$$z = \frac{(\bar{x}_{de} - \bar{x}_{be}) - (\mu_{de} - \mu_{be})}{\sqrt{(s^2_{de} / n_{de}) + (s^2_{be} / n_{be})}}$$

where $\bar{x}_{de}$ is the subscale mean of Deming expert responses, s^2_{de} is the subscale variation of Deming expert responses, n_{de} is the number of Deming expert responses, $\bar{x}_{be}$ is the

subscale mean of the Baldrige expert responses, s^2_{be} is the subscale variation of Baldrige expert responses, and n_{be} is the number of Baldrige expert responses.

In each case, H_0, the null hypothesis was $\mu_{de} - \mu_{be} = 0$ and H_1, the alternate hypothesis, was a "two-tailed" test. The appropriate *z*-value for p = .05 was used as the critical value. On this basis, the following specific tests were conducted to test the hypotheses:

P11, there is no significant difference between the degree of work pressure under the Deming prescription and the degree of work pressure under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P12, there is no significant difference between the degree of coworker cohesion under the Deming prescription and the degree of coworker cohesion under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P13, there is no significant difference between the degree of supervisor support under the Deming prescription and the degree of supervisor support under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P14, there is no significant difference between the degree of autonomy under the Deming prescription and the degree autonomy of under the Baldrige prescription, was

tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P15, there is no significant difference between the degree of innovation under the Deming prescription and the degree of innovation under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P16, there is no significant difference between the degree of involvement under the Deming prescription and the degree of involvement under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P17, there is no significant difference between the degree of task orientation under the Deming prescription and the degree of task orientation under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P18, there is no significant difference between the degree of clarity under the Deming prescription and the degree of clarity under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P19, there is no significant difference between the degree of managerial control under the Deming prescription and the degree of under of managerial control the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P20, there is no significant difference between the degree of physical comfort under the Deming prescription and the degree of physical comfort under the Baldrige prescription, was tested using the alternate hypothesis H_1: $\mu_{de} - \mu_{be} \neq 0$, a "two-tailed" test, with p = .05, and so the critical values $z = \pm 1.96$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

Again, in addition to the traditional statistical *z*-test as described above, significant difference was also tested at values exceeding one standard deviation, in accordance with the recommendation found in the literature:

> "Work Environment Scale … profile elevation differences of [1 standard deviation] between groups compared on the same form of the WES generally are interpreted as relevant. … WES users would be well advised to interpret differences on the order of a standard deviation or more as clinically relevant." (Moses, 1994)

Based on that recommendation, the following specific tests were also conducted to test the hypotheses. In each case, H_0, the null hypothesis, is $| \bar{x}_{de} - \bar{x}_{be} | \leq s_{pooled}$, where s_{pooled} is the pooled standard deviation, calculated as displayed in the denominator of the preceding *z* statistic.

P11, there is no significant difference between the degree of work pressure under the Deming prescription and the degree of work pressure under the Baldrige

prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P12, there is no significant difference between the degree of coworker cohesion under the Deming prescription and the degree of coworker cohesion under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P13, there is no significant difference between the degree of supervisor support under the Deming prescription and the degree of supervisor support under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P14, there is no significant difference between the degree of autonomy under the Deming prescription and the degree autonomy of under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P15, there is no significant difference between the degree of innovation under the Deming prescription and the degree of innovation under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P16, there is no significant difference between the degree of involvement under the Deming prescription and the degree of involvement under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P17, there is no significant difference between the degree of task orientation under the Deming prescription and the degree of task orientation under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P18, there is no significant difference between the degree of clarity under the Deming prescription and the degree of clarity under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed H_0 in favor of H_1.

P19, there is no significant difference between the degree of managerial control under the Deming prescription and the degree of under of managerial control the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

P20, there is no significant difference between the degree of physical comfort under the Deming prescription and the degree of physical comfort under the Baldrige prescription, was tested using the alternate hypothesis H_1: $| \bar{x}_{de} - \bar{x}_{be} | > s_{pooled}$. The proposition found support if evidence failed to reject H_0 in favor of H_1.

Data Analysis Techniques, Open Response Questions

This section of the chapter discusses the specific data analysis techniques employed in the analysis of the Deming SME open response questions that were included with the primary survey instrument at the request of the committee. Each open response question is listed, and is then followed by a brief description of the methodology of data analysis employed for that question. As the five questions were open-ended and

subjective in nature, there were no formal hypothesis tests planned for these questions. Rather, an informal, *post hoc* analysis was intended and so executed.

Open Response Question 1: What are the top three reasons effecting failure of Deming prescription in cases where it has failed? The responses were informally coded and the frequency of codings listed. An informal conclusion was then drawn based upon that coding frequency and was followed by a Pareto charting of all unduplicated codings.

Open Response Question 2: What are the three biggest problems encountered in implementing the Deming prescription? The responses were informally coded and the frequency of codings listed. An informal conclusion was then drawn based upon that coding frequency and was followed by a Pareto charting of the five most frequent codings.

Open Response Question 3: What percentage of the Deming philosophy do you believe is addressed by the preceding survey instrument? The responses were aggregated; i.e., the mean, standard deviation were calculated and the maximum and minimum values were identified. An informal conclusion was then drawn based upon that mean and variance. Finally, the data was bar charted into 10% frequency buckets in order to visualize the variance.

Open Response Question 4: Which of the questions in the preceding survey instrument (the Work Environment Scale) must be answered true for a Deming company? The responses were aggregated; i.e., they were tabled according to how many questions were selected by each of the Deming experts, then an informal conclusion was drawn based upon the frequency observed in the table. Next, the data was reaggregated

according to which questions were most frequently selected by the Deming SMEs, then an informal conclusion was drawn based upon the frequency observed in that table..

Open Response Question 5: What are the expected outcomes of traditional measures under the Deming philosophy? It appeared from the sense of their responses that many of the respondents misread or misunderstood the intended nature of the question. Due to this misinterpretation of the question, coding of the data would not have been purposeful and, accordingly, there were neither conclusions drawn nor data tabled or charted.

Summary

This chapter presented detailed information regarding the methodology that was used to analyze the data collected during this study and used to test the propositions formed in the preceding chapter. The primary survey instrument was described in detail, information supporting the reliability and validity of the instrument was presented and cited, the sources and methods of data collection were described, the various statistical tests that were applied to Propositions 1 through 20 were detailed, and the specific data analysis techniques employed in the analysis of the Deming SME open response questions was described. The following chapter discusses the results of the data analysis conducted according to the methodology just presented.

CHAPTER 5

DATA ANALYSIS

Introduction

This chapter contains the results of the analysis of the data collected toward this study. The section of this chapter that immediately follows reports, discusses and tables the basic response rate information for both the Deming and Baldrige SMEs.

The second section of this chapter tables the aggregated data and summary statistics resulting from the useable Deming subject matter expert (SME) Work Environment Scale responses. It is followed by a section that reports the results of the hypothesis tests associated with Propositions 1 through 10, the propositions that compare the Deming work environment prescription to the normative work environment values.

The third section of this chapter tables the aggregated data and summary statistics resulting from the useable Baldrige subject matter expert (SME) Work Environment Scale responses. It is followed by a section that reports the results of the hypothesis tests associated with Propositions 11 through 20, the propositions that compare the Deming prescription work environment values to the Baldrige prescription work environment values.

The fourth section of the chapter that presents summary-level tabling and charting of the data resulting from the Work Environment Scale responses by displaying the results of all the hypothesis tests in a single table, then employs radar charts to illustrate

the work environment profiles associated with the Deming prescription, the Baldrige prescription and the given normative values.

The final section of this chapter that presents data analysis presents and analyzes the results of the open response questions given to the Deming experts surveyed. For each question, a full listing of the responses is given, followed by an aggregation and/or codification of the responses, then, where appropriate, informal conclusions are drawn and the data is tabled and/or charted.

Response Rate and Bias

This section of the chapter reports the basic survey response rate information. The response rate, as well as reasons for non-response, for the Deming SMEs is discussed, then tabled. Next, the issue of Deming SME non-response bias is addressed. The section ends with a discussion of the Baldrige SME response rate.

Through the reading of Deming literature as well as through general participation in the Deming, fifty-five possible Deming SMEs were identified. Upon further inspection, two of these individuals were excluded as not truly being qualified as Deming SMEs. Thus, a total of fifty-three Deming SMEs were ultimately identified for the purposes of this survey. Of those individuals identified, two individuals disqualified themselves in pre-contact as not being Deming subject matter experts, one individual declined participation during pre-contact and three individuals could not be located. Of those remaining forty-seven individuals who were mailed the survey, twenty-nine individuals completed and returned all or part of the survey, which translates into a 61.7% overall survey response rate. Table 2 below illustrates the type of participation of the fifty-three Deming SMEs as described above:

Table 2: Type of Participation by the Fifty-three Identified Deming SMEs

Completed surveys, all or in part	29
Declined, health reasons	1
Declined, returned materials without explanation	1
Declined, with explanation of theoretical objections	5
No response	11
Subtotal, surveys mailed	47
Declined in pre-contact	1
Disqualified self as Deming expert in pre-contact	2
Could not be located for contact	3
Total Deming SMEs initially identified	53

Of the 29 individuals who completed all or part of the survey, one individual chose to only return the open response portion of the survey and five individuals returned the WES instrument with only those questions completed which they interpreted as relevant. Therefore, 23 usable Work Environment Scale responses were returned. This translates into a 48.9% Work Environment Scale response rate.

Of the 29 individuals who completed all or part of the survey, two individuals returned the Work Environment Scale portion of the survey along with a message that the open response section would arrive at a later date, however neither individual ever returned any open responses. Therefore, 27 sets of usable open response questions were returned. This translates into a 57.4% open response questions response rate.

Seven of the eighteen individuals who were mailed the survey but did not complete and return any part of it volunteered varying degrees of explanation as to why they did not complete and return it. One individual declined on the basis of poor health (an issue well known in the Deming community). Another individual returned the survey materials with a short note merely offering his "apologies for not being able to take part in the Deming survey." The other five individuals declined to participate based upon their

theoretical methodological objections and/or their belief that the survey instrument was not appropriate for study of the Deming philosophy. Given these seven responses, as compared to the two individuals who responded that they were not Deming experts, the likelihood of non-response bias was presumed to be low.

A total of 67 Baldrige experts, specifically the population of 2000 Malcolm Baldrige National Quality Award senior examiners, were identified for the purposes of this survey. Of those 67 Baldrige experts who were mailed the survey, 29 completed and returned all or part of the survey, which translates into a 43.3% overall survey response rate. One Baldrige expert only partially completed the instrument, with the omissions left unexplained. Therefore, 28 usable Work Environment Scale responses were returned from the Baldrige experts surveyed.

Aggregated Data & Statistics, Deming SME WES Responses

This section of the chapter tables the aggregated data and summary statistics resulting from the useable Deming subject matter expert Work Environment Scale responses.

Tables 3, 4 and 5 aggregate and present the basic summary statistics that resulted from the responses of the twenty-three Deming expert responses within the Work Environment Scale. The information is presented below in three separate tables in order to effect appropriate size and clarity. The abbreviations used in the columnar headings for the subscales are I for involvement, CC for Coworker Cohesion, SS for supervisor support, A for autonomy, TO for task orientation, WP for work pressure, C for clarity, Ctl for managerial control, Inn for innovation and Com for physical comfort.

Table 3: Deming SMEs' WES Aggregated Data & and Summary Statistics, Part 1

Subscale	I	CC	SS	A	TO
Units' Digit of Question Number	-1	-2	-3	-4	-5
Questions 1−10	22	22	22	23	22
Questions 11−20	19	21	18	14	20
Questions 21−30	21	20	21	18	17
Questions 31−40	21	20	20	17	19
Questions 41−50	21	21	22	17	20
Questions 51−60	21	19	16	16	15
Questions 61−70	20	20	22	22	21
Questions 71−80	21	17	17	18	22
Questions 81−90	22	23	21	20	22
Number of "High Degree" Responses	188	183	179	165	188
Total Number of Responses	207	207	207	207	207
Percentage of "High Degree" Responses	90.8%	88.4%	86.5%	79.7%	90.8%
Mean	8.174	7.957	7.783	7.174	8.174
Standard Deviation	0.928	1.732	2.315	2.872	0.928

Table 4: Deming SMEs' WES Aggregated Data & and Summary Statistics, Part 2

Subscale	WP	C	Ctl	Inn	Com
Units' Digit of Question Number	-6	-7	-8	-9	-0
Questions 1−10	3	20	7	19	17
Questions 11−20	5	19	10	19	22
Questions 21−30	4	16	11	21	20
Questions 31−40	15	18	3	19	13
Questions 41−50	18	20	18	17	19
Questions 51−60	3	20	1	21	17
Questions 61−70	19	21	11	21	21
Questions 71−80	14	21	9	20	16
Questions 81−90	3	19	4	14	19
Number of "High Degree" Responses	84	174	74	171	164
Total Number of Responses	207	207	207	207	207
Percentage of "High Degree" Responses	40.6%	84.1%	35.7%	82.6%	79.2%
Mean	3.652	7.565	3.217	7.435	7.130
Standard Deviation	6.982	1.581	5.167	2.291	2.774

Table 5: Deming SME Subscale Means and Variances

WES Subscale	$\bar{x}_{de}$	s^2_{de}
Involvement	8.174	$(0.928)^2$
Coworker Cohesion	7.957	$(1.732)^2$
Supervisor Support	7.783	$(2.315)^2$
Autonomy	7.174	$(2.872)^2$
Task Orientation	7.739	$(2.438)^2$
Work Pressure	3.652	$(6.982)^2$
Clarity	7.565	$(1.581)^2$
Managerial Control	3.217	$(5.167)^2$
Innovation	7.435	$(2.291)^2$
Physical Comfort	7.130	$(2.774)^2$

Tests of Hypotheses: P1 through P10

This section of the chapter reports the results of the hypothesis tests associated with Propositions 1 through 10, the propositions that compare the Deming work environment prescription to the normative work environment values.

Proposition 1: Deming methods prescribe a less-than-average degree of work pressure. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1 , when $p \leq .05$. The *z*-value resulting from the test was -0.237. Accordingly, the work pressure *p*-value of .406 under the *z*-test did not support the proposition, nor did it suggest much support for the null hypothesis. The "one standard deviation" test, however, did support the proposition.

The Deming SMEs responses did generate a high variance for the work pressure subscale; examination of the responses to the individual questions, however, suggested the Deming SMEs strongly concurred regarding the subscale; they generally regarded the same individual questions as being appropriate—or inappropriate—toward the Deming prescription.

Proposition 2: Deming methods prescribe a higher-than-average degree of coworker cohesion. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1, when $p \leq .05$. The *z*-value resulting from the test was 1.405. Accordingly, the coworker cohesion *p*-value of .080 under the *z*-test did not support the proposition, however it came very close to doing so. The "one standard deviation" test also supported the proposition.

Proposition 3: Deming methods prescribe a higher-than-average degree of supervisor support. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1, when $p \leq .05$. The *z*-value resulting from the test was 1.123. Accordingly, the supervisor support *p*-value of .131 under the *z*-test did not support the proposition, however it was far more supportive of the proposition than it was of the null hypothesis. The "one standard deviation" test also supported the proposition.

Proposition 4: Deming methods prescribe a higher-than-average degree of autonomy. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1, when $p \leq .05$. The *z*-value resulting from the test was 0.593. Accordingly, the autonomy *p*-value of .277 under the *z*-test did not support the proposition, nor did it suggest much support for the null hypothesis. The "one standard deviation" test, however, did support the proposition.

Proposition 5: Deming methods prescribe a higher-than-average degree of innovation. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1, when $p \leq .05$. The *z*-value resulting from the test was 1.458. Accordingly, the innovation *p*-value of .072 under the *z*-test did not support the

proposition, however it came very close to doing so. The "one standard deviation" test also supported the proposition.

Proposition 6: Deming methods prescribe a higher-than-average degree of involvement. Under the *z*-test, the proposition found support if evidence was found to reject H_0 in favor of H_1, when $p \leq .05$. The *z*-value resulting from the test was 2.638. Accordingly, the involvement *p*-value of .004 under the *z*-test provided an extremely high degree of support for the proposition. In fact, this was the strongest statistical significance found during this study, hence the conclusion that Deming methods prescribe that employees be highly concerned about and committed to their jobs, more so than is typical, is one of the major conclusions of this study. The "one standard deviation" test, of course, also supported the proposition.

Proposition 7: Deming methods prescribe an average degree of task orientation. Under the *z*-test, the proposition found support if evidence failed to reject H_0 in favor of H_1, when $p \geq .05$. The *z*-value resulting from the test was 0.770. Accordingly, the task orientation *p*-value of .441 under the *z*-test did not reject H_0 in favor of H_1, and it did suggest some degree of support for the null hypothesis. The "one standard deviation" test, however, clearly rejected the proposition, and in so doing, found that Deming methods prescribe a higher-than-average degree of task orientation.

Proposition 8: Deming methods prescribe an average degree of clarity.

Under the *z*-test, the proposition found support if evidence failed to reject H_0 in favor of H_1, when $p \geq .05$. The *z*-value resulting from the test was 1.677. Accordingly, the clarity *p*-value of .094 under the *z*-test did not reject H_0 in favor of H_1, however it came very close to doing so, and so it does not suggest much support for the null hypothesis.

The "one standard deviation" test, however, clearly rejected the proposition, and in so doing, found that Deming methods prescribe a higher-than-average degree of clarity.

Proposition 9: Deming methods prescribe an average degree of managerial control. Under the *z*-test, the proposition found support if evidence failed to reject H_0 in favor of H_1, when $p \geq .05$. The *z*-value resulting from the test was -0.395. Accordingly, the managerial control *p*-value of .693 under the *z*-test did not reject H_0 in favor of H_1, and it did suggest a reasonable degree of support for the null hypothesis. The "one standard deviation" test, however, clearly rejected the proposition, and in so doing, found that Deming methods prescribe a less-than-average degree of managerial control.

The Deming SMEs responses did generate a high variance for the managerial control subscale; examination of the responses to the individual questions, however, did not suggest they strongly concurred regarding the subscale.

Proposition 10: Deming methods prescribe an average degree of physical comfort. Under the *z*-test, the proposition found support if evidence failed to reject H_0 in favor of H_1, when $p \geq .05$. The *z*-value resulting from the test was 1.041. Accordingly, the physical comfort *p*-value of .298 under the *z*-test did not reject H_0 in favor of H_1, and it does not suggest much support for the null hypothesis. The "one standard deviation" test, however, clearly rejected the proposition, and in so doing, found that Deming methods prescribe a higher-than-average degree of physical comfort.

Aggregated Data & Statistics, Baldrige SME WES Responses

This section of the chapter tables the aggregated data and summary statistics resulting from the useable Baldrige subject matter expert Work Environment Scale responses.

Table 6: Baldrige SMEs' WES Aggregated Data & and Summary Statistics, Part 1

Subscale	I	CC	SS	A	TO
Units' Digit of Question Number	-1	-2	-3	-4	-5
Questions 1−10	25	24	26	26	28
Questions 11−20	26	24	26	17	23
Questions 21−30	26	28	24	27	24
Questions 31−40	27	23	26	26	21
Questions 41−50	28	26	27	25	26
Questions 51−60	25	24	16	21	21
Questions 61−70	25	22	28	24	26
Questions 71−80	25	24	22	26	24
Questions 81−90	25	26	24	23	26
Number of "High Degree" Responses	232	221	219	215	219
Total Number of Responses	252	252	252	252	252
Percentage of "High Degree" Responses	92.1%	87.7%	86.9%	85.3%	86.9%
Mean	8.286	7.893	7.821	7.679	7.821
Standard Deviation	1.093	1.810	3.606	3.180	2.398

Table 7: Baldrige SMEs' WES Aggregated Data & and Summary Statistics, Part 2

Subscale	WP	C	Ctl	Inn	Com
Units' Digit of Question Number	-6	-7	-8	-9	-0
Questions 1−10	12	21	9	21	23
Questions 11−20	12	23	20	23	26
Questions 21−30	7	22	12	22	27
Questions 31−40	22	21	3	24	17
Questions 41−50	26	23	21	20	23
Questions 51−60	4	26	1	24	23
Questions 61−70	24	25	7	23	27
Questions 71−80	22	26	6	22	25
Questions 81−90	8	20	7	13	27
Number of "High Degree" Responses	137	207	86	192	218
Total Number of Responses	252	252	252	252	252
Percentage of "High Degree" Responses	54.4%	82.1%	34.1%	76.2%	86.5%
Mean	4.893	7.393	3.071	6.857	7.786
Standard Deviation	8.303	2.236	6.966	3.391	3.232

Table 8: Baldrige SME Subscale Means and Variances

WES Subscale	$\bar{x}_{be}$	s^2_{be}
Involvement	8.286	$(1.093)^2$
Coworker Cohesion	7.893	$(1.810)^2$
Supervisor Support	7.821	$(3.606)^2$
Autonomy	7.679	$(3.180)^2$
Task Orientation	7.821	$(2.398)^2$
Work Pressure	4.893	$(8.303)^2$
Clarity	7.393	$(2.236)^2$
Managerial Control	3.071	$(6.966)^2$
Innovation	6.857	$(3.391)^2$
Physical Comfort	7.786	$(3.232)^2$

Tables 6, 7 and 8 aggregate and present the basic summary statistics that resulted from the responses of the 28 Baldrige expert responses within the Work Environment Scale. Again, the information is presented above in three separate tables in order to effect appropriate size and clarity. The subscale abbreviations used in the Table 6 and 7 columnar headings are, as with Tables 3 and 4, I for involvement, CC for Coworker Cohesion, SS for supervisor support, A for autonomy, TO for task orientation, WP for work pressure, C for clarity, Ctl for managerial control, Inn for innovation and Com for physical comfort.

Tests of Hypotheses: P11 through P20

This section of the chapter reports the results of the hypothesis tests associated with Propositions 11 through 20, the propositions that compare the Deming prescription work environment values to the Baldrige prescription work environment values.

Proposition 11: There is no significant difference between the degree of work pressure under the Deming prescription and the degree of work pressure under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the

proposition. The *z*-value resulting from the test was -0.114. Accordingly, the work pressure *p*-value of .909 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

The Baldrige SME work pressure responses, as with the Deming SME work pressure responses, generated a high variance for the work pressure subscale; examination of the responses to the individual questions suggested the Baldrige SMEs strongly concurred regarding the subscale; they generally regarded the same individual questions as being appropriate—or inappropriate—toward the Baldrige prescription.

Proposition 12: There is no significant difference between the degree of coworker cohesion under the Deming prescription and the degree of coworker cohesion under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was 0.025. Accordingly, the coworker cohesion *p*-value of .980 under the *z*-test not only did not reject the null hypothesis but, in fact, offered an extremely high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 13: There is no significant difference between the degree of supervisor support under the Deming prescription and the degree of supervisor support under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was -0.009. Accordingly, the supervisor support *p*-value of .993 under the *z*-test not only did not reject the null hypothesis but, in

fact, offered an extremely high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 14: There is no significant difference between the degree of autonomy under the Deming prescription and the degree autonomy of under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was –0.118. Accordingly, the autonomy *p*-value of .906 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 15: There is no significant difference between the degree of innovation under the Deming prescription and the degree of innovation under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was 0.141. Accordingly, the innovation pressure *p*-value of .888 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 16: There is no significant difference between the degree of involvement under the Deming prescription and the degree of involvement under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was -0.078. Accordingly, the involvement

pressure *p*-value of .938 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a very high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 17: There is no significant difference between the degree of task orientation under the Deming prescription and the degree of task orientation under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was -0.024. Accordingly, the task orientation pressure *p*-value of .981 under the *z*-test not only did not reject the null hypothesis but, in fact, offered an extremely high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 18: There is no significant difference between the degree of clarity under the Deming prescription and the degree of clarity under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, the closer the *p*-value is to 1.00, therefore the more support it offers for the proposition. The *z*-value resulting from the test was 0.063. Accordingly, the clarity *p*-value of .950 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a very high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 19: There is no significant difference between the degree of managerial control under the Deming prescription and the degree of under of managerial control the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was 0.017.

Accordingly, the managerial control *p*-value of .987 under the *z*-test not only did not reject the null hypothesis but, in fact, offered an extremely high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Proposition 20: There is no significant difference between the degree of physical comfort under the Deming prescription and the degree of physical comfort under the Baldrige prescription. Under the *z*-test, this proposition equivocates to the null hypothesis, therefore the closer the *p*-value is to 1.00, the more support it offers for the proposition. The *z*-value resulting from the test was -0.154. Accordingly, the physical comfort *p*-value of .878 under the *z*-test not only did not reject the null hypothesis but, in fact, offered a high degree of support for the proposition. The "one standard deviation" test also supported the proposition.

Summary Tabling/Charting of Deming & Baldrige WES Results

This section of the chapter presents summary-level tabling and charting of the data resulting from the Work Environment Scale responses. First, the results of all the hypothesis tests are displayed in a single table, then radar charts are employed to illustrate the work environment profiles associated with the Deming prescription, the Baldrige prescription and the given normative values.

The relevant statistics and hypothesis test results are presented below in a single table, Table 9. The mean responses from the Deming and Baldrige SMEs, form numeric "profiles" illustrated above as Figures 2, 3, and 4 in the form of radar charts toward ease of comparison. Figure 3 illustrates the results of Propositions 1 through 10. Figure 4

Table 9: Statistics & Hypothesis Test Results, Propositions 1 through 20

		x_{de}	x_{ns} or x_{be}	z	z*	p value	Support z-test	Support 1 s.d.
Deming vs. Average Propositions								
1	Work Pressure, <	3.652	5.310	-0.237	-1.645	0.406		Support
2	Coworker Cohesion, >	7.957	5.520	1.405	+1.645	0.080		Support
3	Supervisor Support, >	7.783	5.180	1.123	+1.645	0.131		Support
4	Autonomy, >	7.174	5.470	0.593	+1.645	0.277		Support
5	Innovation, >	7.435	4.090	1.458	+1.645	0.072		Support
6	Involvement, >	8.174	5.710	2.638	+1.645	0.004	Support	Support
7	Task Orientation, =	7.739	5.860	0.770	±1.960	0.441		Reject, >
8	Clarity, =	7.565	4.910	1.677	±1.960	0.094		Reject, >
9	Managerial Control, =	3.217	5.260	-0.395	±1.960	0.693		Reject, <
10	Physical Comfort, =	7.130	4.240	1.041	±1.960	0.298		Reject, >
Deming vs. Baldrige Propositions								
11	Work Pressure, =	3.652	4.893	-0.114	±1.960	0.909	Support	Support
12	Coworker Cohesion, =	7.957	7.893	0.025	±1.960	0.980	Support	Support
13	Supervisor Support, =	7.783	7.821	-0.009	±1.960	0.993	Support	Support
14	Autonomy, =	7.174	7.679	-0.118	±1.960	0.906	Support	Support
15	Innovation, =	7.435	6.857	0.141	±1.960	0.888	Support	Support
16	Involvement, =	8.174	8.286	-0.078	±1.960	0.938	Support	Support
17	Task Orientation, =	7.739	7.821	-0.024	±1.960	0.981	Support	Support
18	Clarity, =	7.565	7.393	0.063	±1.960	0.950	Support	Support
19	Managerial Control, =	3.217	3.071	0.017	±1.960	0.987	Support	Support
20	Physical Comfort, =	7.130	7.786	-0.154	±1.960	0.878	Support	Support

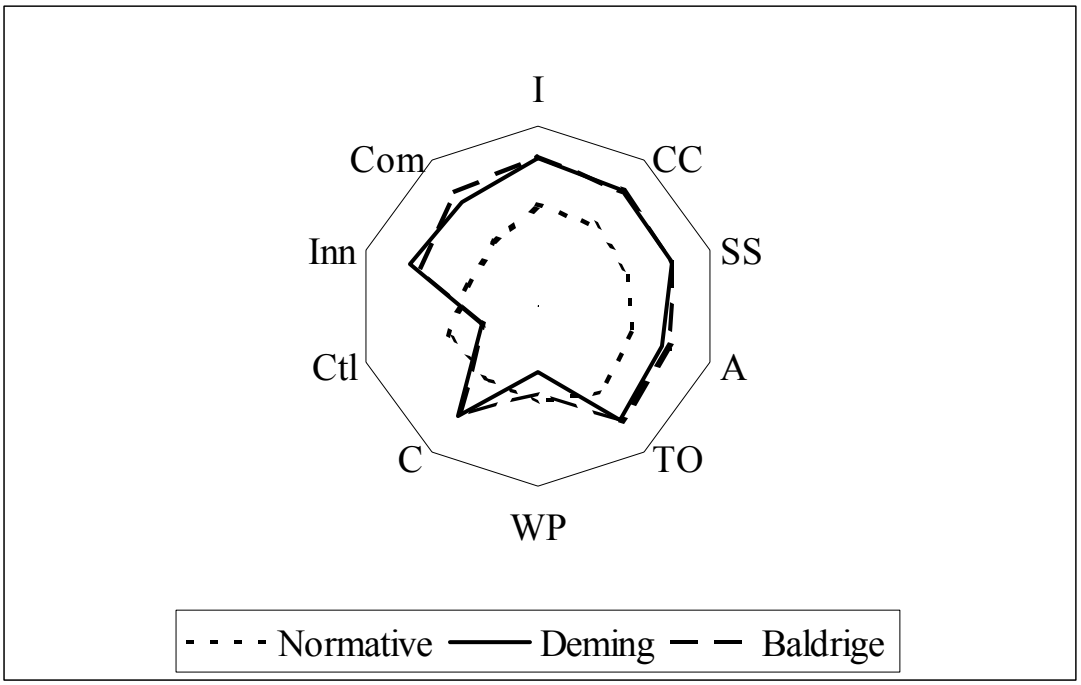

Figure 2: Radar Charting of WES Profiles, Deming, Baldrige & Normative

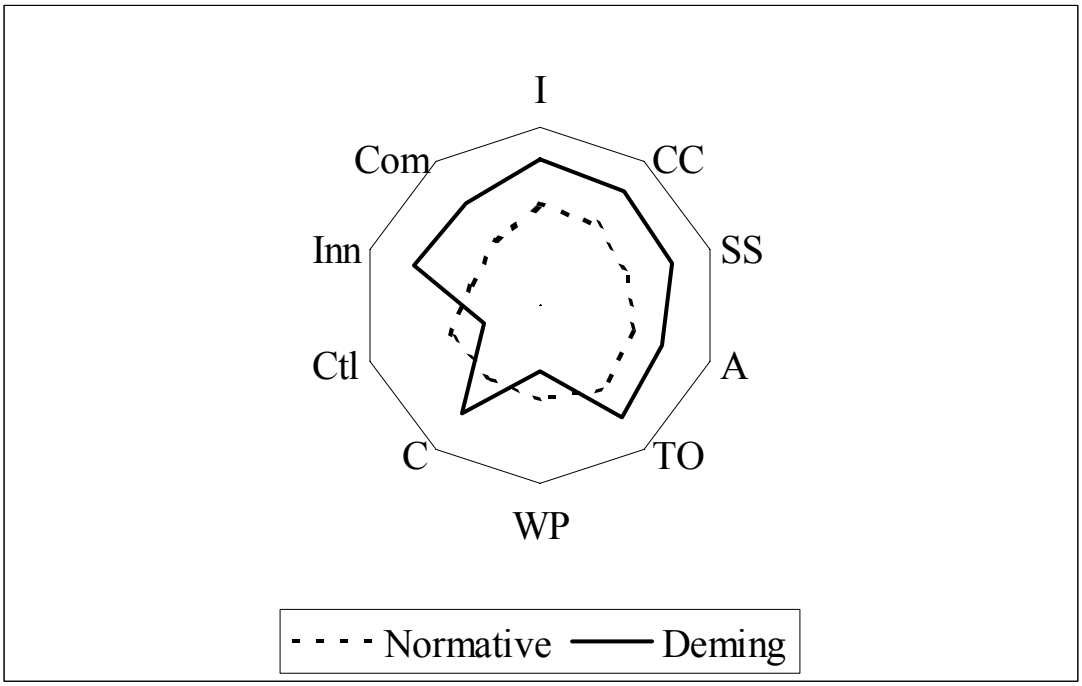

Figure 3: Radar Charting of WES Profiles, Deming vs. Normative

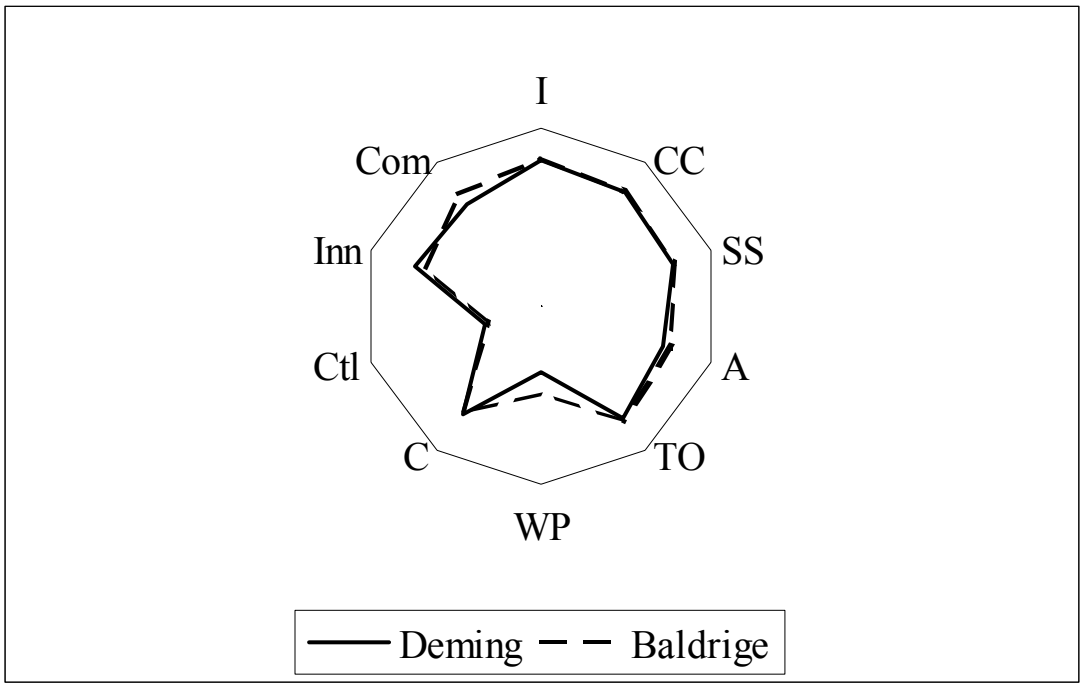

Figure 4: Radar Charting of WES Profiles, Deming vs. Baldrige

illustrates the results of Propositions 11 through 20. (Dr. Robert J. Vokurka, Texas A&M University at Corpus Christi, is gratefully acknowledged herein for his suggestion to employ radar charts toward ease of understanding.)

Results of Open Response Questions

This section of the chapter presents and analyzes the results of the open response questions given to the Deming experts surveyed. For each question, a full listing of the responses is given, followed by an aggregation and/or codification of the responses, then, where appropriate, informal conclusions are drawn and the data is tabled and/or charted.

Open Response Question 1: What are the top three reasons effecting failure of Deming prescription in cases where it has failed?

Full Listing of the Responses

Respondent 3

Lack of support by top management are 1, 2, and 3.

Respondent 4

1. The transformation was implemented without a plan of action. Every department of division tried to do it their way. The organization saw this as a haphazard approach.
2. Top management was fully committed, but they never were able to get middle management commitment.
3. Management failed to get input from workers.

Respondent 5

1. Lack of constancy of purpose by top management. And/or Board of Directors.
2. Naively expecting too much, too soon (no commitment to a long-term plan).
3. Failure to actually change (improve) the system.

Respondent 7

1. Lack of commitment at the top.
2. Inexperience or a poorly trained leader/consultant.
3. Poor execution.

Respondent 8

1. Managers do not understand that the "Deming Prescription" is first a new way of thinking.
2. Managers believe they have nothing new to learn.
3. Managers are unwilling to change their behavior, try to delegate quality.

Respondent 9

1. Misunderstanding of Deming's philosophy or the organization's misunderstanding of its problems or potential.
2. Management not consciously knowing what it presently believes about how much to manage a purposeful social system and therefore is unable to change these beliefs.
3. Management tries to copy others; Deming's principles are universal but each application is unique.

Respondent 10

1. Lack of commitment by top management.
2. Management not understanding what is expected of them.
3. Lack of knowledge within organization.

Respondent 11

I don't know what "Deming prescription" is. I never heard him use that term and I have never heard any of the people who were closest to him use that term. If you are speaking of examples of organizations that claimed they were practicing Deming's Fourteen Points or Deming's philosophy

and then turned away from that claimed practice, then I can comment on that. Here are three factors that may have had an influence, although I don't know if they're the "top three" or why it is required that the "reasons" be ranked:

1. Lack of understanding of the Fourteen Points and the System of Profound knowledge, including lack of understanding of variation and of systems.
2. Actions by management inconsistent with the Systems of Profound Knowledge.
3. A culture that worships adversarial competition and individualism.

Respondent 12

1. Lack of knowledge by consultants.
2. Philosophy is at variance with the Education system.
3. CEO and top management.

Respondent 13

1. Not taking the time to fully understand what Deming is saying.
2. Lack of following through by top management.
3. No clear customer focus.

Respondent 15

I'm not sure what you mean by the Deming "prescription." Deming mostly avoided prescribing actions—one of the main reasons many had difficulty knowing what to do. It is necessary to synthesize the principles of Deming's philosophy with subject matter.

Respondent 17

1. Lack of understanding and support from top management.
2. Lack of commitment to ongoing training, so that (eventually) all people in the organization work off a solid foundation of theory.
3. Difficulty in appreciation and knowing how to change the cultural elements of an organization to align with the practice of Deming's approach.

Respondent 18

There was never a prescription. The closest to this was his Fourteen Points for management (1981). Later, they were replaced with a more fundamental theory-system of profound knowledge (1989).

Respondent 19

1. Lack of Leadership with Profound Knowledge.
2. Think Deming=TQM, which they have done.
3. Think they already have the answers (not open to learning and change).

Respondent 20

This could be answered three ways. It could refer to the predictions of general theory, to my observation of the way it has worked when applied by others, or to my own personal experience. Because it is so important, I will answer it in each of the three ways.

First, General Theory. A good starting point is "Diseases and Obstacles" in Chapter 3 of "Out of the Crisis," but of course the whole book, and

"The New Economics," are essential. The most important single thing, so obvious and necessary that it is not stressed in Chapter 3, is intelligent commitment by top management. Slavish copying of examples is not enough. So the top three reasons, in this sense, are, from page 98 onwards of "Out of the Crisis:"

1. Lack of constancy of purpose.
2. Emphasis on Short Term Profits.
3. Merit rating, or pay for performance.

Second, my observations of the attempts by others. This may be different from what you will hear from others, because my experience is mainly in the UK. Deming himself did not consider obstacles due to failures by consultants. He spoke only of the problems when the Deming Philosophy is properly applied. But it rarely is. I expect (in fact I am sure, though not from direct observation) that this problem is common everywhere. In many cases consultants have developed "watered down" versions of the Deming Philosophy, which are less in conflict with traditional management assumptions and practices. The whole "TQM" bandwagon, now fortunately dying out, is an example. Deming stigmatized such consultants as "hacks," and often seemed to imply that their ignorance was willful. I feel this is too severe. I believe that these popularized versions are in most cases adopted by consultants in good faith. In fact, until I had worked closely with him, and with his associates such as Joyce Orsini, or Gipsie Ranney, I thought the watered down versions were the Deming

Philosophy. They are dangerously persuasive. I have heard consultants say that what they offer is either "What Deming really meant" or "An advance on Deming" or "What he would have said if he had lived longer" or "This is the real world: Deming only taught theory." Another is "Deming doesn't tell us what to do." I once heard someone say this to Deming's face, at a 4-day seminar. He exploded: "You've not been listening!!" But people were listening. What he said was (and remains) so foreign to their way of thinking that they couldn't hear it. No wonder they produced "improved" versions of the Deming Philosophy. Unfortunately these perverted versions, however well intentioned, do not work. By that I mean that they may produce some improvement, but they will not produce the total transformation that Deming intended. They are much easier to introduce than the Deming Philosophy. They are usually based on mechanical rules, and start with the shop floor, rather than with top management. They also involve costly training courses, which are good business for consultants. But they still do not work. They lack foundation in fundamental theory. In many cases there are good short-term results, because these consultants concentrate on problem solving, and on visible figures. But they do not tackle the source of the problems, and the effects, though exciting at first, soon fade. Deming describes this in "The New Economics" page 37 of the Second Edition. He describes the difference between the 3% of potential improvement that comes from working on the "visible processes that produce figures," and compares this with the far

greater possible improvement - the 97% that comes from working on the "invisible" processes and the whole system. To be fair, many consultants are driven to working on the 3% because it is all that management will let them work do. So from this point of view, the top three reasons for failure are:

1. Adoption of watered-down versions of the Deming Philosophy, such as TQM.
2. Advice from hacks, rather than masters.
3. Concentration, due to management resistance or failure to understand, on the least important, but most visible, kinds of improvement.

Third, my own experience. Where things have gone wrong, it has been due to interference from a higher level. For example, I have started working with a manager who did control the local system, and the results were just beginning to appear. It takes time - Deming warns not to expect real results for about five years. Then, as a result of a take-over, or a downturn in the market, a higher level of management (in a different country, in both cases) made changes which destroyed the good work that had just begun to show results. In one case the overseas group claimed to be a Deming organization, though "my" UK manager could see little sign of it. In another case I met a difficulty (before I was so well known) that the manager of a UK subsidiary did not understand that I could advise on all of management, not just statistics. He turned to another consultant for

that (of the type described in part 2). Naturally I could not continue, as there would have been different messages from the two sources. And it would have been unprofessional to contradict what the other consultant was saying, however misguided I think it was. I dropped the consultancy, and the company soon discovered that the other consultant's approach did not produce lasting results. So the manager went ahead without outside help, and has now (about 15 years later) done almost all the things I advised at the time, but which he was not then ready to accept. But this, while a failure in the sense that I did not get through to him what I could offer, was not a failure for the company. Working without outside help, the results are outstanding, and the overseas directors are beginning to learn from the success of the UK subsidiary. I like to imagine that I could have got them ahead faster, but perhaps not. It takes time, and everyone has to find their own way. So, perhaps because I will not accept a client who is not, in my view serious about transformation, I have met only one cause of failure: Interference from a higher level - usually overseas.

Respondent 21

1. Lack of management interest in change.
2. Lack of leadership in a personal transformation.
3. Lack of leadership in a company transformation. The Deming prescription instills at least anxiety if not fear in managers who perceive themselves as successful with the methods that they use today. If they change, will they still be as successful as they were

in the past? For those who start but do not finish, the problem can be that their firms was sold to someone not in a Deming mold. Alternatively, they tried to start in one area such as constancy of purpose, prepare some form of statement and see that nothing happened; mostly the lack of action is due to their failing to sell the process to those working for them.

Respondent 22

1. Mobility of Management.
2. Change in market.
3. Restructuring/reorganization.

Respondent 23

1. Lack of management commitment
2. Inconsistency of purpose or aim
3. Undue focus on short-term results, especially profits. (In America, everyone wants the quick fix.)

Respondent 24

1. Failure of those attempting to "implement" it to understand that it is a long-term effort—years long—and that it will affect every aspect of the organization and every person in it.
2. Failure of those attempting to "implement" it to understand it at all!
3. Tendency of sr. mgmt to interpret Deming's teachings as a series of tools to be used to improve processes.

Respondent 25

The only reason I have ever observed or heard of is a failure of top management to commit to the program

Respondent 26

1. Lack of constancy of purpose by senior management.
2. Implementation of tools before theory is well understood.
3. Forgetting that continuous improvement is a way of leading, not a management technique.

Respondent 30

1. People "at the top" want all the power. Cannot have all the power if Deming's theories are implemented.
2. People talk continuous improvement, but ranking is the real evaluation.
3. Content with *status quo*.

Respondent 32

Deming laid them out in his Deadly Diseases and Obstacles:

1. Treating Quality as a fad.
2. Failure to manage people: ranking and awarding credit without a causal link.
3. Destruction of loyalty and trust (e.g. the "new" employment contract).

Respondent 33

1. Lack of systemic view.
2. Viewing necessary changes as prescriptive/programmatic as opposed to as a new way of thinking.
3. Institutional memory—shifting from a Theory X style to an approach that values people (including their minds) is hard to do when people remember how they were treated in the past. Some people say "trust must be earned"—but re-earning trust is much more difficult when it has been lost!

Respondent 34

1. Failure to take the time to understand the theory, in order to act appropriately.
2. Cannot be installed; requires a change in the way people think.
3. Is not a quick fix—takes time to implement.

Respondent 38

1. There is no foundation for the theories exposed.
2. There is no adaptation to the history and culture of organization.
3. Weak strategic planning of the process

Respondent 40

There is no Deming prescription. However I believe the biggest reason for failure of Deming's philosophy is lack of commitment of organizational leaders.

Response Tabulation, Analysis and Conclusions

The above responses were informally coded, resulting in a certain degree of evidence upon which at least one informal conclusion was drawn. From the answers provided by the 27 respondents, 71 responses were coded. By far, the most common response was failure of senior management or leadership. Failure of senior management and leadership accounted for seventeen of the 71 coded responses, approximately 24% of the total coded responses. In fact ten of the 27 individuals responded that failure of senior management and leadership was the leading cause of Deming prescription failure, and three of the individuals cited it as the sole cause. The most common failure attributed to senior management and leadership was a lack of commitment or constancy of purpose. Thirteen other coded responses attributed failure to "management" for various reasons, but did not specifically make reference to senior management. This data certainly offers a certain degree of informal evidence to conclude that Deming prescription failure is most often due to management, most frequently the lack of commitment by senior management. This conclusion is in general alignment with the existing management literature that finds various organizational models and outcomes are ultimately requisite upon the posture of senior management. This conclusion is also in general alignment with Dr. Deming's known posture toward the criticality of senior management support.

Five other major codings emerged from the responses: inadequate understanding of Demingism (nine responses), lack of long-term focus and/or short-term thinking (six responses), poor or partial implementation (five responses), lack of a good Deming consultant (three responses) and organizational culture/philosophy that conflicted with Demingism (three responses). There were fifteen other unduplicated responses that were

coded as “miscellaneous.” The results of the aforementioned coding, disregarding the miscellaneous responses, are Pareto charted in the Figure 5 below:

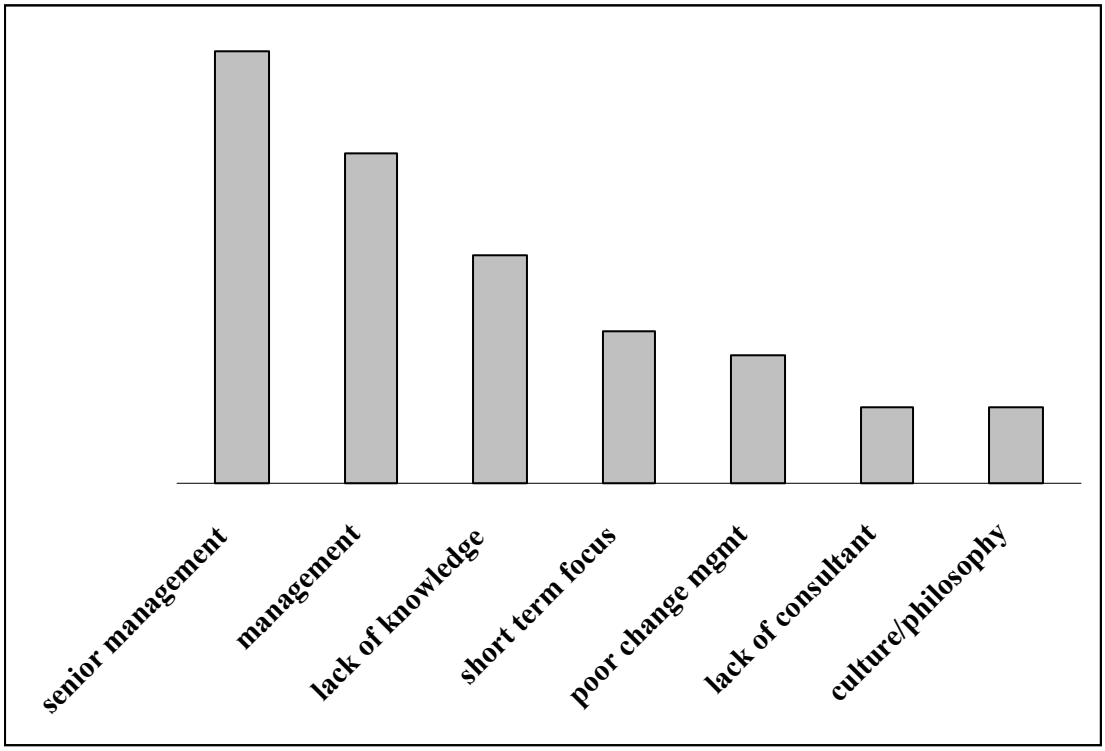

Figure 5: Pareto Charting of Open Response Question 1

Open Response Question 2: What are the three biggest problems encountered in implementing the Deming prescription?

Full Listing of the Responses

Respondent 3

Lack of support by top management.

Respondent 4

1. Management recognized that the success of the business depended on implementing their strategic plan. The problem was that they didn't see the Deming transformation as a management model to use to achieve this plan.
2. The Deming transformation became something else for management to do. It was an add-on assignment. Consequently there was no time for performing the transformation. That is why I wrote my book.
3. Management tries to change the entire organizational culture based on Deming's principles before starting to put these principles into practice. The end result was two years would go by before any tangible benefits were derived from the transformation. The CFO would then say, "Why are we spending all this money?" Top management would panic and start looking for quick fixes.

Respondent 5

1. Executives unwilling to give up old ways and being threatened by management ideas they do not understand well enough to be comfortable with.
2. Difficulty of effectively teaching Deming's principles using traditional teaching methods.
3. Profound organizational change takes more time and effort than most organizations are willing to give.

Respondent 7

1. Depends on whether you are a consultant or a manager. For a consultant working with the existing culture requires gradualism.
2. Having top management understand how radically different they need to become.
3. Dealing with regression.

Respondent 8

1. Convincing managers of the personal and job benefits derived from adopting the new philosophy.
2. Persuading managers to take a long-term perspective on organization improvement despite pressure to maintain quality.
3. People's mobility to grasp the profound implications of the systems view.

Respondent 9

1. Management is unable to face their illusion that control is possible and then learn how to manage.
2. Management is unable to face/understand the dynamic nature of a purposeful social system.
3. Management is unable to learn how to transform fear, mistrust, and anger into a positive force and reverse the system's thrust toward entropy.

Respondent 10

1. Failure of top management to model.

2. Lack of training for people with profound knowledge.

3. Production focus.

Respondent 11

See comments in response to question 1.

Respondent 12

1. Knowledge. See above response [to question 1].

Respondent 13

1. Lack of involvement by top management.

2. Lack of focus to the implementation process.

3. No real plan for the transformation of the organization. Knowledge relevant to the application.

Respondent 15

1. Some of the concepts (such as abolishing pay for performance) are based on such deep rooted (unconscious) assumptions, they are hard to overcome.

2. The search for “instant pudding.”

3. Many adults have difficulty thinking in ‘formal operational’ terms.

Respondent 17

1. Desire for “quick fixes” (instant pudding).

2. Gaining appreciation for the unknown and unknowledgeable aspects of the systems.

3. Calming those who feel the Deming approach will “stifle innovation.”

Respondent 18

1. Blaming people for faults of the system.
2. Not understanding Deming's theory for management.
3. Not recognizing that "the most important measures are unknown and unknowable."

Respondent 19

1. Fear in the organizations (the environment).
2. Lack of knowledge.
3. Lack of leadership (old style management is in place).

Respondent 20

Here I am replying entirely from my own experience, though the "Diseases and Obstacles" still apply.

1. Strangeness. The Deming Management Philosophy is quite unlike anything else that a manager has experienced. What is more, it is quite different, in most cases, from what the manager has been told about the Deming Philosophy. (See Question 1, part 2). Almost everything that Deming taught defies "Common Sense." It contradicts the assumptions of the culture we live in, and the very experience of the manager in the past. That may sound extreme, but as Ed Baker puts it "You can know all there is to know about ice, and know nothing about water." What was true under the old system ceases to be true when you change the system. As a manager who has succeeded with the Deming Philosophy put it to

me “It is completely disorienting.” Fortunately the system changes slowly, so there is time to adjust to the new reality. Because of the strangeness of the Deming Philosophy, it is very hard to explain it. We usually explain things by relating them to what is already familiar. But there is hardly anything familiar that is relevant. We do not even have the language or the concepts needed to describe it, without a lot of work. This is quite a normal problem to the scientist. All science is strange, or it can hardly be called science: how do you explain General Relativity or Quantum Theory to someone unfamiliar with either? But that does not disturb people, because those theories do not apply to “ordinary life.” But the Deming Philosophy is scientific strangeness applied to business and decision making. “Ordinary” things that people imagine they understand. Everyone finds the four aspects of Deming’s System of Profound Knowledge strange - if they think about them at all. It involves concepts, like the difference between common and special causes, that are completely outside the ways of normal thinking.

2. Short term thinking. I have said it takes time, and that it is a good thing it does, but that is also one of the difficulties. There are always pressing short-term problems, and so to tell the manager “You must be patient. Don’t expect any real results for about five years” is asking a lot. But that must be faced. There are ways to make short-term gains, but they must be used with great care. They

look better than they are. Deming's actual words were "Don't be misled by the short-term gains." The short-term gains come from solving problems. The Deming Management Philosophy does suggest ways to solve problems. Unfortunately they will just come back in another form. What is needed is to prevent the problems arising in the first place. Just as everyone says "Prevention is better than cure" in medicine - but ignores it in practice, so managers find solving problems more attractive than preventing them, until they learn a new way of thinking. This is very understandable. Many managers have got where they are by being good in a crisis. I can remember my own experience of this. When everyone was panicking, and I was the one who knew what to do, I felt good. So managers have to learn to get their satisfaction by thinking deeply, and long term. That is difficult. I remember one manager telling me "I have a second in command who is really good in a crisis. But I am beginning to run out of crises for him to handle. I just don't know what I will be able to do with him when we don't have crises any more."

3. Fear of the "invisible." Deming used to say: "The most important figures in any business are unknown and unknowable." That causes enough problems. What is worse, I think, is that it is impossible to trace the cause and effect relationships that we take for granted in ordinary life. Many cause and effect relationships we

take for granted in ordinary life are imaginary. But they provide comforting "explanations" of what we see. The Deming Philosophy, if properly applied, works, and we can see the remarkable results. But they come about by such indirect and complex systems of cause and effects that we cannot see how the results, when they come, have happened. This is what I take "invisible" to mean.

Respondent 21

1. Change in management before the process is established enough to be self-reliant. The new management does not understand the Deming method and/or is antagonistic towards it.
2. Impatience with the process is the second problem. A corollary to short-term thinking is impatience for a process to get firmly enough established to survive. At first the results may be minor or non-existent.
3. A third problem is focusing the changes in a particular area, be it a particular department or a particular method. For instance, many firms thought that SPC was Dr. Deming's method and wondered why, by itself, it did so little.

Respondent 22

1. Establishing baseline knowledge in fast moving environments.
2. Turnover of managers and staff.
3. Impact of corporate systems.

Respondent 23

1. Lack of an effective master plan.
2. Absence of a design and development team.
3. Logistics, or as we call it, a lack of Macro-logistics thinking. (Without a roadmap, you are lost.)

Respondent 24

1. The changes Deming advocated imply culture change. When this begins to occur, the prevailing organizational culture squashes it unless all involved understand the "big picture" of what the organization is attempting to accomplish.
2. The assumptions underlying Deming's advice run counter to those embedded in US culture.
3. Lack of understanding of Deming's philosophy by those who lead its implementation.

Respondent 25

1. Convincing management at the top of the necessity.
2. Persuading middle management that it is not a job threat.
3. Teaching management that labor is an ally, not an enemy.

Respondent 26

1. Desire of senior management for a rapid "plug and play" implementation.
2. Dr. Deming outlined a very different way of seeing things,…this holistic approach takes time to grasp (but it is worth it).

3. Cynicism about possibility of real, transformative change.

Respondent 30

1. Time for staff development.
2. Lack of understanding by all.
3. More comfortable to blame others.

Respondent 32

In a way, the same as the above three [given in question 1]. Plus:

1. Paying executives in options that are valued in the financial market rather than paying them on things they control.
2. Deming followers who are too rigid in the face of the need for profits. They serve their clients poorly.
3. The split between the operating level and the managerial hierarchy has not been bridged in many firms.

Respondent 33

1. Perceived understanding—prior to the 1st big "ah ha" that comes when the same word begins to take on new meanings.
2. Institutional memory.
3. Organizational systems—performance appraisals, pay systems, purchasing systems.

Respondent 34

1. People look for quick fixes, [they are] not patient.
2. Takes time to implement.
3. Old habits are hard to break.

Respondent 38

1. Misrepresenting that the Deming approach was used successfully in Japan and continues to be the dominant Japanese approach.
2. Consultants who try to create a Deming cult.
3. Trying to show the relationship to ISO 9001 and the Baldrige award.

Respondent 40

1. Inability to look at the world in a different way.
2. Emphasis on short-term financial results.
3. Misplaced confidence in competition, combined with the belief that motivation comes from outside oneself.

Response Tabulation, Analysis and Conclusions

The above responses were informally coded, resulting in a certain degree of evidence upon which at least one informal conclusion was drawn. From the answers provided by the 27 respondents, 79 codable responses were categorized. In general, many of the same codings seen under the preceding question emerged once again. The most common response coding was failure of "management" for various reasons, but did not specifically make reference to senior management. Failure of management accounted for twelve of the seventy-nine coded responses, approximately 15% of the total coded responses. Nine other coded responses specifically referenced failure of senior management. When these two codings are considered together, the Deming SME's attributed implementation problems to management (or senior management) in 28% of their coded responses. This data certainly offers a certain degree of informal evidence to

conclude that Deming implementations problems are most often due to management, most frequently the lack of commitment by senior management. Again, this conclusion is in general alignment with Dr. Deming's known posture toward the criticality of senior management support. The five most frequent codings are Pareto charted in the Figure 6 below.

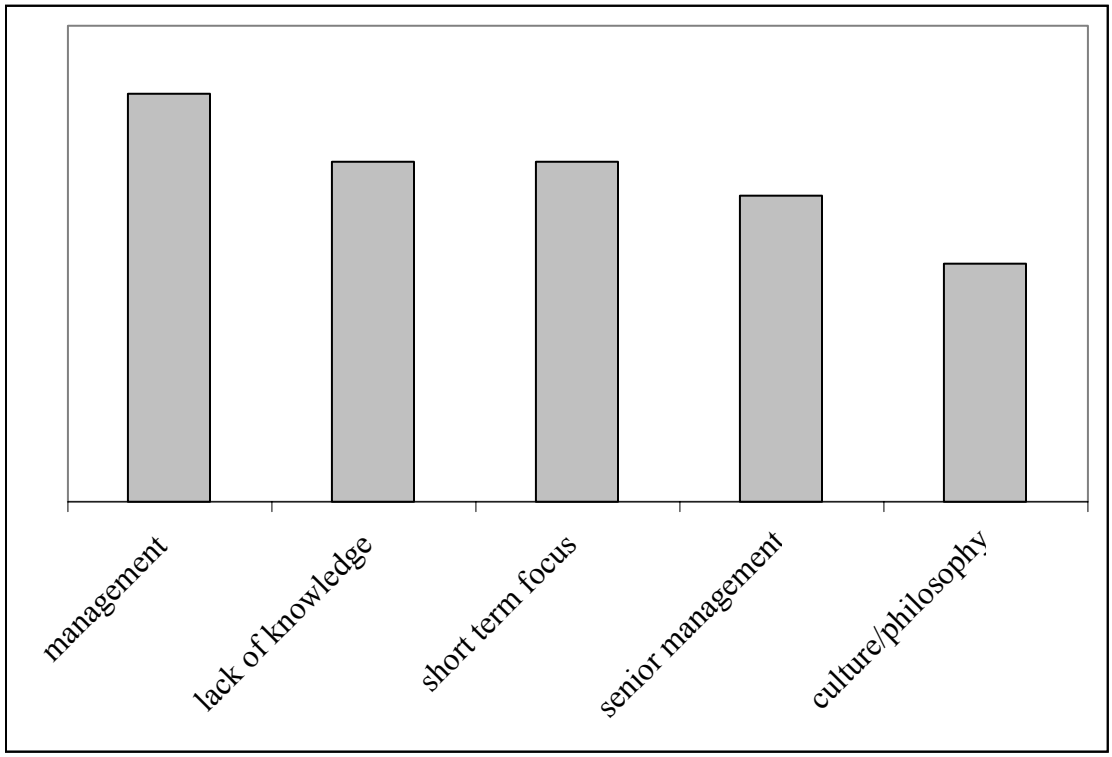

Figure 6: Pareto Charting of Open Response Question 2

In total, ten other duplicated codings emerged from the responses: inadequate understanding of Demingism (ten responses), lack of long-term focus and/or short-term thinking (ten responses), organizational culture/philosophy that conflicted with Demingism (seven responses), poor or partial implementation (three responses), lack of a

good Deming consultant (three responses), lack of a "systems" perspective (three responses), blaming individuals (two responses), fear (two responses), employee turnover (two responses) and intractable corporate systems (two responses). There were fourteen other unduplicated responses that were coded as "miscellaneous."

Open Response Question 3: What percentage of the Deming philosophy do you believe is addressed by the preceding survey instrument?

Full Listing of the Responses

Respondent 3

> 50%. Cooperation (a little). Optimization of organization, not components (not at all). Process tasks, not results focus (very little). Balance intrinsic vs. extrinsic motivation (so/so).

Respondent 4

> 88%.

Respondent 5

> While many of the statements may be symptomatic of a "Deming-type" organization, the survey does not seem to me to address the many important aspects of the Deming philosophy. If I have to guess at a percent…it would be between 5 and 15%.

Respondent 7

> 0-10%.

Respondent 8

> 20%. Job satisfaction, management-employee relationship, on-the-job learning (continuous improvement).

Respondent 9

This is an impossible question as there is no context. This makes all of the questions ambiguous. I don't know what the managers, supervisors, workers believe, have been told, how they understand their aim or how to achieve it. The survey seems to reflect a single event point of view; the Deming philosophy is based on the opposite, an appreciation of a system. There is no mention and few hints of interdependence, cooperation, continual improvement, seeing problems as opportunities or acknowledgement of the dynamic nature of the organization.

Respondent 10

50%.

Respondent 11

I am unwilling to put a number on this. I would say a significant portion of Deming's ideas are NOT addressed by the instrument. I see nothing about the organization as a system, constancy of purpose, cooperation, variation, prediction, systematic learning and improvement, knowledge and prediction, relationships with suppliers, understanding needs of customers, the nature of transformation, etc. The survey instrument dwells almost entirely on the nature of supervision and the relationship of supervision with employees.

Respondent 12

1%.

Respondent 13

> Maybe 20%. Actually what you see here is the work environment that should be the result of the implementation of the Deming philosophy.

Respondent 15

> I don't know what the % is, but the emphasis is only on the environment aspects of the workplace. Matters relating to the non-psychology aspects of the SoPK (theory of knowledge, appreciation for a system, theory of variation) are only peripherally addressed. Deming (also) expressed concern with multiple choice tests/instruments suggesting that (practical) questions are never really true/false—the question should be under what conditions would (question) be true/false? I don't believe it is impossible to interpret the survey responses without knowing why a person answered each question the way that they did.

Respondent 17

> 50% or less. Survey's focus appears to be on symptoms vs. causes. Systems thinking, theory of learning, variation are addressed indirectly for the most part, maybe at best…I wonder how much the survey designers view employees as "bionic machines" for the supervisors, versus there being an interdependent type of relationship.

Respondent 18

> Major missing piece is importance of learning (and application of knowledge). 75%

Respondent 19

60%.

Respondent 20

It is very difficult to make any kind of sense of this question. The best I can do is to suggest three alternative wordings, that might be what you mean, and answer them.

First version: What percentage of "yes" answers to the questions in the survey must managers achieve to bring about the transformation Deming writes of be achieved? This may seem a strange interpretation, but it is one that fits in with the teaching and practice of some consultants. Deming's System of Profound Knowledge (SoPK) consists of four aspects: Systems, Variation, Theory of Knowledge, and Psychology. It does seem that quite a number of consultants who claim to practice the Deming Philosophy concentrate wholly on psychology. Perhaps many more do this than admit to it. They appear to believe that transformation can be achieved by psychology alone. The reason may be that psychology sounds the least "strange" part of Deming's approach. But no part of the SoPK can be isolated from the rest: it is all or nothing. So on this interpretation of the question, the answer is 0% - or perhaps it is better to say that the question is irrelevant. It is quite likely that concentrating wholly on psychology (or systems, or variation, or scientific method) will do some good. But it will not be transformation in Deming's sense. Some other

writers do use the word transformation of a much less radical change - but they are not talking about the same thing.

Second version: What percentage of the "work environment score" questions are relevant to the Deming Philosophy? In that case the answer is 100%. Everything to do with people is relevant. So is everything to do with systems, or variation, or scientific method.

Third version: What percentage of the "work environment score" questions would receive a favorable answer if the Deming Philosophy is applied? In that case the proportion would be quite high, provided "favorable" is correctly interpreted. It is not obvious. Nothing is in this business. The details follow in comments on the individual items. Let us say about 98%.

Respondent 21

I can only answer that a large percentage relates to Deming's philosophy if one interprets the meaning in that way. For example, question 3, "People pay a lot of attention to getting the work done" can be interpreted in two ways. In one way it means that they are forced to do so by external motivation, in the other way, they do so based on internal motivation. I took the second view as a Deming process. Someone else, however might adopt the first meaning and answer exactly opposite to the way I interpreted it. If one counts such a question as pertaining to Deming's ideas, the vast majority of the questions pertain. If one takes a narrower

view, there would be less although more than half of the questions still would pertain.

Respondent 22

20%.

Respondent 23

I would say about 50%. The Theory of Variations is not addressed in much detail, nor is the notion of Systems. On the other hand, over 75% (70 of the 90 questions) deal with the Deming prescription.

Respondent 24

5%

Respondent 25

I don't know that a philosophy can be addressed by a true-false survey. Perhaps it can, but I would not want to quantify the possibility.

Respondent 26

Approximately 7 of the Fourteen Points were "touched on" so, I would say 50-60%. Dr. Deming's system of profound knowledge "touched on," say 20%. The Deadly Diseases—50%. Overall, 35%.

Respondent 30

30%.

Respondent 32

The Work Environment Scale form R is not related to quality of Deming. Perhaps 15% of the questions touch on quality issues, but this is barely more than chance. Plus, these hits are accidental and form no pattern.

Respondent 33

Less than 25%.

Respondent 34

10%. Very little.

Respondent 38

30%.

Respondent 40

12.3% (Obviously, I have no basis for the second or third "significant" digit.).

Response Tabulation, Analysis and Conclusions

From the answers provided for this question by the twenty-seven respondents, twenty-one usable percentages were obtained. There was little agreement among the respondents regarding this question. The calculated mean is 36.2%, the standard deviation is 24.2%, the minimum value is 1% and the maximum value is 88%. The initial rationalization herein regarding this high degree of variance is that, as the respondents had almost no possible way to even know what constructs were being measured, they had very little accurate information upon which to base their responses. The high degree of variance in the responses is visualized within Figure 7 below where the responses are bar charted into 10% frequency buckets. Figure 7 appears to generally suggest that more Deming SMEs than not believe the Work Environment Scale instrument measures less than half of the Deming prescription. Due to the degree of varience, however, the specific informal conclusion drawn from this data is that the Deming SMEs did not provide

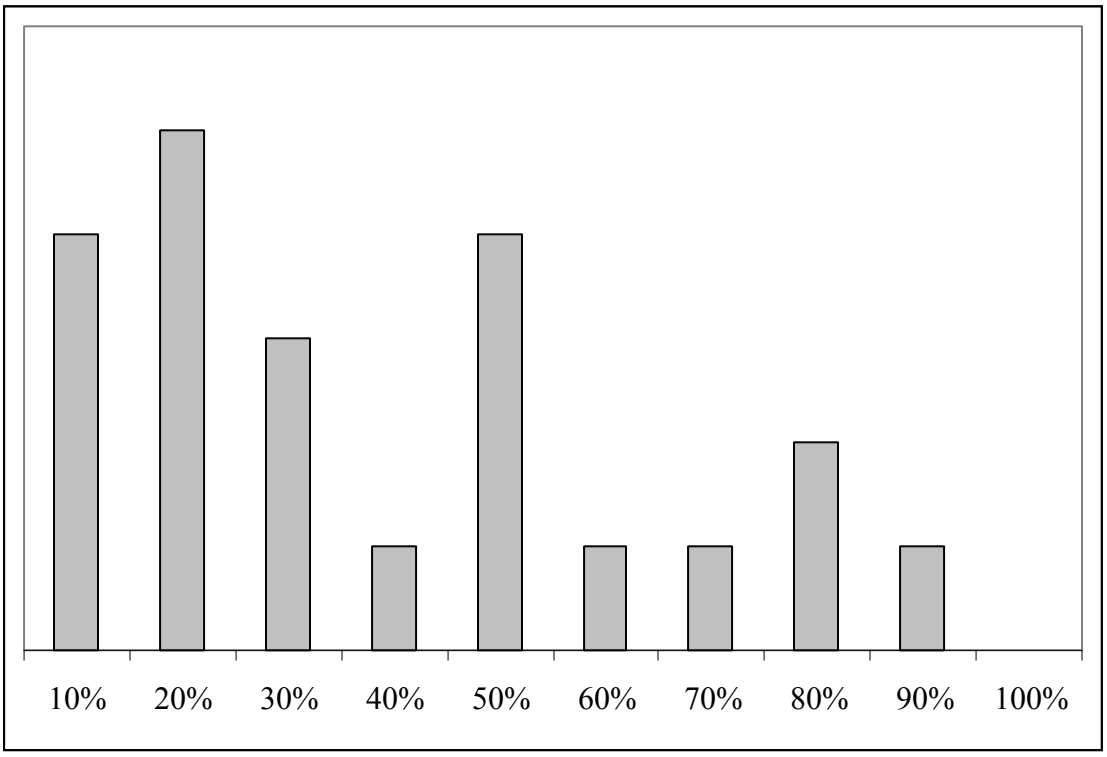

Figure 7: Frequency Charting of Open Response Question 3

adequate evidence to support the idea that the WES instrument measures the Deming prescription to some specific degree.

Open Response Question 4: Which of the questions in the preceding survey instrument (the Work Environment Scale) must be answered true for a Deming company?

Full Listing of the Responses

Respondent 3

Several questions are misleading and fail to pick up empowerment (SDSA/PDSA) in a Deming context.

Respondent 4

See survey questions I answered. “X” indicates it really doesn’t apply. All the others are important. “M” means must. [The survey as received was not marked in the manner described by this respondent.]

Respondent 5

Sorry…I reread each one again and conclude that none must be answered true…without at least some qualification. For example: #84 is true to the extent supervisors should meet regularly with employees to talk about their work. What is meant in this case by “…their future work goals” is unclear to me. However, it is likely that many of the statements will be true for those working in a “Deming-type” organization.

Respondent 7

33, 41.

Respondent 8

1,2, 5, 9, 13, 14, 17, 18, 19, 20, 22, 24, 25, 29, 31, 33, 34, 35, 36, 37, 40, 41, 42, 47, 52, 53, 60, 61, 64, 65, 67, 72, 73, 74, 79, 81, 82, 83, 84, 88, 89. 41 questions in total.

Respondent 9

See above. [The respondent stated in the preceding question that “This is an impossible question as there is no context.”]

Respondent 10

5, 8, 9, 19, 25, 28, 31, 34, 47, 64, 83, 84.

Respondent 11

I found many items that should have been answered "it depends on the situation," but I was not given the option of providing such an answer. Therefore, I just arbitrarily marked something in those cases. Deming talked about optimization. Optimization requires understanding of context and some judgment and wisdom. This survey does not allow for any of that. It seems to me that one of the things people may miss about Deming's thinking is that there is not a fixed recipe that can or should be followed. One uses the System of Profound Knowledge to make sound judgments and wise decisions.

Respondent 12

What is a Deming Company? He never described such an organization. Maybe Toyota or Honda.

Respondent 13

20, 22, 24, 25, 31, 33, 34, 35, 37, 41, 42, 47, 48, 52, 61, 64, 65, 73, 74, 79, 81, 83, 84.

Respondent 15

Blank.

Respondent 17

1, 5, 24, 31, 41, 44, 47, 64, 84. That is a tough question to answer, because so often I got to the point of saying, "It depends!" Depends on the type of work being done, the customer, the potential for change in the market, how long a company has had a Deming foundation.

Respondent 18

All that I answered true! [The questions Respondent 18 answered true were 1, 2, 5, 9, 13, 14, 17, 19, 20, 22, 24, 25, 29, 31, 34, 35, 37, 41, 42, 44, 45, 46, 47, 48, 52, 60, 61, 64, 65, 67 ,72, 73, 74, 79, 80, 81, 83, 84, 87, 88, 89, 90.]

Respondent 19

At least 60%; for some questions, whether it is true or false depends on the situation and the meaning of the words and the system.

Respondent 20

Very few, since the circumstances of each company differ so much. The Deming Philosophy is universal: it can be applied to any kind of organization, in any kind of circumstances. What is appropriate in one circumstance is not in another. Again, I will try to note this as I go through the list.

Respondent 21

Based on my interpretation, the ones that I marked as true are such candidates. [The question Respondent 18 answered true were 1, 2, 5, 9, 13, 14, 17, 18, 19, 20, 22, 24, 25, 29, 31, 33, 34, 35, 36, 37, 40, 41, 42, 44, 45, 46, 47, 52, 53, 54, 60, 61, 64, 65, 66, 67, 71, 72, 73, 74, 79, 80, 81, 83, 84, 87, 88, 89, 90.]

Respondent 22

1, 9, 19, 31, 44, 64, 81.

Respondent 23

A total of thirty-five as follows: 1, 2, 5, 9, 13, 14, 17, 19, 20, 22, 24, 25, 28, 31, 33, 34, 35, 37, 41, 42, 44, 47, 53, 60, 61, 64, 74, 79, 80, 81, 83, 84, 87, 88, 90.

Respondent 24

31. The instrument, for me, was difficult to complete, as I would answer N/A to most of the items.

Respondent 25

1, 9, 13, 17, 19, 29, 31, 33, 41, 42, 44, 47, 61, 64, 74, 79, 81.

Respondent 26

2, 5, 22, 31, 34, 35, 41, 42, 45, 47, 53, 64, 67.

Respondent 30

31, 33, 35, 42, 84.

Respondent 32

A total of 25 questions: 1, 5, 8, 13, 17, 25, 28, 29, 31, 33, 35, 37, 41, 47, 48, 55, 64, 65, 74, 76, 78, 81, 83, 84, 87. Questions that MUST BE FALSE for a Deming company (mirror of #4 above): 3, 14, 15, 23, 24, 27, 34, 38, 43, 44, 57, 58, 59, 75, 77, 85.

Respondent 33

19, 24, 27 and 28 (note the paradox), 31, 34, 64, 74.

Respondent 34

2, 19, 31, 64, 81.

Respondent 38

2, 4, 8, 9, 11, 13, 14, 19, 22, 23, 24, 28, 29, 31, 33, 41, 42, 44, 47, 57, 59, 61, 74, 76, 77, 81, 83, 84, 87, 89.

Respondent 40

None of them. As I examined each question I could imagine, following the Deming philosophy, the possibility of answering "false" to each. No prescribed set of behaviors or conditions are indicative of the Deming philosophy.

Response Tabulation, Analysis and Conclusions

Table 10 below illustrates the data regarding how many questions were selected by each of the twenty-seven Deming SME respondents. The lack of agreement seen in Table 10 further suggests, as seen within Open Response Question 3, the specific informal conclusion that the Deming SMEs did not provide adequate evidence to support the idea that the WES instrument measures the Deming prescription to some specific degree.

Table 10: Open Response Question 4, Respondent Frequency

# of Questions Selected	# of Respondents	# of Questions Selected	# of Respondents
49	1	12	1
42	1	9	1
41	1	8	1
35	1	7	1
30	1	5	2
25	1	2	1
23	1	1	1
17	1	Zero	10
13	1		
		Total	27

There was, however, some degree of consensus among the respondents regarding the individual questions selected. Table 11 below aggregates the frequency, in descending order, with which each question was selected by the seventeen respondents who did select questions. As Table 11 illustrates, all but one of the seventeen respondents who did select questions selected Question 31, and they did so to a much higher degree than other questions.

Table 11: Open Response Question 4, WES Question Selection Frequency

Number of Times a Questions was Selected	Percentage of Times a Question was Selected	Question Number(s)
16	94.1%	31
13	76.5%	64
11	64.7%	41, 47
10	58.8%	19, 81, 84
9	52.9%	33, 42, 74
8	47.1%	1, 5, 9, 24, 34, 35, 83
7	41.2%	2, 13, 22, 25, 44, 61
6	35.3%	17, 29, 37, 79
5	29.4%	14, 20, 28, 65, 87
4	23.5%	52, 53, 60, 67, 73, 88, 89
3	17.6%	8, 45, 48, 72, 80, 90
2	11.8%	8, 36, 40, 46, 76
1	5.9%	4, 11, 23, 27, 54, 55, 57, 59, 66, 71, 77, 78, 82
Zero		3, 6, 7, 10, 12, 15, 16, 21, 26, 30, 32, 38, 39, 43, 49, 50, 51, 56, 58, 62, 63, 68, 69, 70, 75, 85, 86

Therefore, the strongest specific informal conclusion that can be drawn from the responses to this question is that the Deming SMEs provided a degree of evidence that

the fact that "people seem to take pride in the organization" *must* be true regarding a Deming company. This conclusion finds a great deal of concordance with Deming's own pronouncement on the importance of worker pride, as in his specification of its requirement within his Fourteen Points. The reader will find a more detailed discussion regarding the importance of worker pride as required by Deming within Chapter 3 under the heading of Development of P6: Degree of Involvement.

Open Response Question 5: What are the expected outcomes of traditional measures under the Deming philosophy?

Full Listing of the Responses

Respondent 3

> Joy in work.

Respondent 4

> As Deming predicted, "Quality improves, scrap and rework decrease, costs go down, productivity increases, customer satisfaction improves, market share increases, the company grows, employment increases.

Respondent 5

> Long-term viability in the marketplace by: effectively competing for customers and achieving customer loyalty…while generating profits sufficient for long-term re-investment in the organization's future as well as competitive rewards for investors, employees and suppliers. Such profitability is the result of added value of product/service and reduction of cost through improved efficiencies and reduction of waste.

Respondent 7

Profits and sales improve.

Respondent 8

Traditional measures will vary in response to changing market and other conditions, but over the long-term will be expected to improve: Employee turnover, sales volume, ROI, profit, productivity, market share, etc.

Respondent 9

Blank.

Respondent 10

Increased profitability Increased employee satisfaction. Increased customer satisfaction.

Respondent 11

The meaning of your question is not particularly clear. However, I will attempt to provide a response. It may be that people expect "traditional measures" to look bad if they are "practicing" the Deming philosophy. I would cite two items: (1) the chain reaction on page 3 of *Out of the crisis* and (2) the statement that appears on page 51 of *The new economics, second edition:* "The aim proposed here for any organization is for everybody to gain-stockholders, employees, suppliers, customers, community, the environment—over the long term." Deming never implied that organizations that used his ideas would be unprofitable or operate at high cost. Use of the Deming philosophy is not an excuse for poor performance. Having said this, expectations that organizations would

always be more profitable every quarter than they were the previous quarter or that organizations should sacrifice the well-being of their employees, suppliers, or the communities in which they operate in order to meet the expectations of financial analysts for the quarterly dividend are seen as damaging and unethical if one uses the Deming philosophy and some knowledge of systems and variation to view the world. I was often concerned to hear people say they were using Deming's ideas for management and improvement, only to find out that they were not using those ideas intelligently—if at all—and then they were claiming that the reason they showed no improvement over a lengthy period was that they were using Deming's ideas. This was, and still is, very damaging to the reputation of Deming and his philosophy.

Respondent 12

The problem is that this survey instrument does not address Deming's system of profound knowledge. Very poor instrument.

Respondent 13

I am not sure I understand the question. Most traditional measures result in sub-optimization of the system.

Respondent 15

I don't understand what you're asking for here.

Respondent 17

Long term profits will increase, market will grow, high customer satisfaction, high employee retention, quality will increase.

Respondent 18

They focus on finance and are result oriented. They are not looked at on control charts to separate common and special causes as a basis for actions. Also, multiple measures are not looked at together as a system.

Respondent 19

The most important thing can't be measured: success, happiness, morale…But some traditional measures over time might be growth, profits, low turnover/low absenteeism.

Respondent 20

By traditional measures, I suppose that you mean profit, productivity, absenteeism, staff turnover ... and so on. The answer is that they will improve. So will a lot of others - in fact any measurement that reflects the well-being of the organization will improve, in the long term. Few if any will get worse in the short term, but there will be a marked difference between long and short-term results. This is because of the very nature of the Deming Management Philosophy, which includes the principle "everybody gains." This arises because of the impossibility of predicting exactly what will happen in response to a change in a complex system. The most we can do, in some cases, is to predict the direction of the change. For example, we can predict that the elimination of special causes, as taught by Walter A Shewhart, will reduce variation, increase productivity, and decrease costs. But we cannot predict how much. Compare this with the more traditional approach to management. This

tends to assume that any change will have both good and bad effects. For example, if you want higher quality, you can get it by buying better machinery, or tightening up inspection, or by sacking workers who make mistakes. You will probably get better quality this way, but at a cost, in money or in worker dissatisfaction. In other words, traditional management is based on trading off one advantage against another, on the assumption that you will never get something for nothing. But the problem with this is that you cannot predict the result of the changes you make, because of the complexity of the system. For example, let us suppose that you can safely predict that the new machinery will improve quality. But by how much? You cannot tell. So the trade-off between investment cost and higher quality is a shot in the dark. What is more, there will be hidden costs that are even more difficult to guess. The new machinery may require new skills, and make old skills redundant. It may create fear among the workers, leading to higher turnover, and in the long run, higher costs. Under the Deming Philosophy it will be impossible to avoid tradeoffs completely. Many changes are necessary, owing to market forces, and innovation. But most improvement is based on a "sure thing." And by adopting a management system that creates trust, flexibility, and creativity, the invisible costs of change are greatly reduced.

Respondent 21

I am having trouble understanding the question. If it means what happens to some measures such as turn-over, profits, etc., there are some

indications in the measures looked at by Dr. Kano (1983) and Dr. Soin (1992). Kano showed that the Deming Prize winners outperformed all other Japanese manufacturer in several key measures over a ten-year period. Soin extended this research. Kano, N., Tanaka, H., & Yamaga, Y. (1983). TQC Activities and Their Economical Effects Seen from the Deming Prize Awarded Enterprises. *Hinshitu (Quality, Journal of the Japanese Society Control [in Japanese])*, 13(2), 171−179.

Respondent 22

General improvement of measures that reflect organization performance. cycles, depending on market conditions.

Respondent 23

The following is a summary of measurement system outcome objectives: a) translate the vision to measurable outcomes that all staff can understand, b) Focus and align the direction of employees based upon measurable results, c) Track systems-related breakthroughs and continuous improvement results, d) Foster accountability and commitment e) Integrate strategic plans, business plans, quality, and benchmarking, f)Provide standards for benchmarking operations, g) Problem-solve business problems throughout the extended enterprise, h) Provide a fair basis for rewards and recognition, i) create individual and shared views of performance, j) drive out fear.

Respondent 24

Employee satisfaction goes up, development of new markets go up, innovation up, customer satisfaction up, employee retention up, competitive advantage maintained (over time), and cooperative relationships with business partners is up.

Respondent 25

I'm sorry, but I don't understand the question.

Respondent 26

Increased profits and growth (because of alignment with customers), increased productivity and ROI, and increased employee retention.

Respondent 30

Long term improvement of all aspects of the organization.

Respondent 32

The Deming philosophy establishes a causal structure based on scientific method. Traditional measures are based on statistical surveys based on a distribution around a mean. Thus, everything is relative to everything else. This reveals patterns in the tea leaves but not causal structures.

Respondent 33

Increase in job satisfaction, profit, responsiveness to customers, repeat business. Decrease in employee turnover, emphasis (almost exclusively) on here and now, absenteeism.

Respondent 34

> Higher quality, lower cost and higher productivity.

Respondent 38

> A happy organization, but not a highly productive one, or one with world class quality. Usually not the leader in the field.

Respondent 40

> If you mean measures like sales, profits, market share, costs, safety, quality, and such, they will improve. However, if plotted regularly, they should not show artificial periodicity related to ends of quarters or years.

Response Tabulation, Analysis and Conclusions

The question was intended to capture opinion as to whether or not the Deming philosophy would have positive outcomes (e.g., growth) while simultaneously having a negative effect upon other traditional performance measures (e.g., manufacturing efficiency). However, it appeared from the sense of the responses that many of the respondents misread the question "What are the expected outcomes *of traditional measures* under the Deming philosophy?" as "What are the expected outcomes under the Deming philosophy?" In fact, five of the twenty-seven respondents directly stated that they did not understand the question. Only respondents 11, 13 and 18 made statements that indicated they understood the question as it was intended. Most of the respondents who responded based upon their misunderstanding of the intended question replied, in varied fashion, that numerous measures will improve, i.e., they stated that the Deming prescription will improve all aspects of organizational measures. Due to this

misinterpretation of the question, coding of the data would not have been purposeful and, accordingly, there were neither conclusions drawn nor data tabled or charted.

Summary

This chapter presented the analysis of the data collected toward this study. The response rate information was presented, the results of the specific hypothesis tests associated with the study's twenty propositions were discussed, tabled and charted. The responses from the Deming SMEs regarding the study's five open response questions were listed, aggregated and/or codified. Where appropriate, informal conclusions were drawn and the data was tabled and/or charted. The following chapter employs the preceding data analysis, as well as the specific conclusions that fall from that data, as the foundation for the formation of the study's final general conclusions and the associated discussions.

CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Introduction

This chapter employs the preceding data analysis, as well as the specific conclusions that fall from that data, as the foundation for the formation of the study's final general conclusions and associated discussions. The following section of this chapter conducts certain discussion prerequisite to forming the general conclusions of this study.

The next three sections present and discuss, in order of relative strength, the primary, secondary and tertiary general conclusions of this study reached through interpretation of the outcomes resulting from the formal and informal analysis of the data. The next section of the chapter discusses the general and most significant limitations and assumptions regarding this study. The final major section of the chapter discusses the implications of the general conclusions of this study and suggests areas for future research that those conclusions imply.

Discussion Prerequisite to Conclusions

This section of this chapter conducts certain discussion prerequisite to forming the general conclusions of this study. Specifically, prior to drawing the general conclusions of this study, a discussion regarding the opposition of the *z*-statistic hypothesis test results and the "one standard deviation" hypothesis test results, as seen in Table 9, regarding

Propositions 1 through 10, the comparisons of the Deming work environment with the WES normative values, is prerequisite and appropriate.

The opposition of these results is not entirely surprising. Table 1, WES Subscale Normative Means and Variances, reveals that the WES normative means tend to fall near 4.5–5.5 and the WES normative standard deviations tend to fall near 1.0. Therefore, for a *z*-test to find significance against the null hypothesis, the sample mean would have to the sample mean would have to fall approximately below 0.5–1.0 or above 8.0–8.5. Given that a sample mean is based upon the averaging of responses to a ten-point scale, where the lowest value is 0.0 and the highest value is 9.0, such a sample mean seems highly unlikely. For example, in order for a sample mean to find significant difference toward a "high degree," i.e., in order to obtain scores near enough to nine in order to average to a number that finds significant difference, almost every one of the respondents would have to select the "high degree" choice for every one of the nine "high degree" questions on the instrument. Restated more directly, in order for a *z*-test to find a significant difference, almost all of the nine responses on the instrument, from almost all of the participants, would have to be the high value response. This means that evidence of significant statistical difference would only be reflected by data that represents the most extreme difference possible on the instrument … again and again by each respondent. This is not the true intent of tests of significant difference.

This anomaly is the consequence of the high WES normative standard deviation. The variance is high since is it based upon a large sample of diverse work environments, that being the intention of the developers of the instrument. The normative standard deviation represents the state of affairs between all work environments. The normative

standard deviation does not represent the state of affairs within a single entity possessing a "median" work environment; if it did, we would theoretically expect the variance to be a lower value than the values seen in Table 1, i.e., a value representing less dispersion than seen between all the work environments in the entire population of work environments.

Given this situation, the classic "difference of means" test is, in this situation, more so testing to see if a specific work environment differs from the "entire universe" of known work environments. This is a test we would almost certainly expect to fail (i.e., to reject the null hypothesis) if the instrument developers have done well toward finding a truly diverse normative sample of work environments (which, again, was their intention), and that likelihood of failure is seen in the "high bar" set by the normative standard deviation. If, on the other hand, most all of the respondents were to respond with the most extreme value, that would indeed describe a work environment that is extremely different from most all other work environments which, as the values found in Table 1 indicate, are not terribly extreme in nature.

This situation is very likely why the test developers recommend that researchers employ one standard deviation as the appropriate, if not statistically typical, test for significant difference. Work environments that differ by that one standard deviation, within the "entire universe" of work environments, are different indeed from one another.

This issue did not impact the results from the *z*-tests conducted toward Propositions 11 through 20 as those tests did not employ the WES normative values. Accordingly, the results of the *z*-statistic hypothesis test results and the "one standard deviation" hypothesis test results, as seen in Table 9, are far more concordant.

Given the preceding discussion, some degree of weight was subjectively deducted from the results of the Deming versus normative *z*-tests when forming the general conclusions of this study as discussed in the following sections of this chapter.

Primary General Conclusions

This section of the chapter presents and discusses the primary general conclusions of this study reached through interpretation of the outcomes resulting from the formal and informal analysis of the data. The conclusions are presented in order of their relative strength.

General Conclusion 1: Deming methods prescribe a degree of involvement that is extremely higher-than-average. This is the strongest single conclusion to emerge from this study. Again, involvement was operationalized as the degree to which employees are concerned about and committed to their jobs. This conclusion is supported by a *p*-value of .004, where *p*-values less than .010 are customarily considered "highly significant." In fact, this was the strongest statistical test of significant difference found within the entire study. Given this level of significance, especially in light of the preceding discussion regarding the negative effect of the high normative variance upon the "Deming versus average" *z*-tests conducted, the conclusion is extremely well supported.

General Conclusion 2: The work environment prescribed by Deming and the work environment prescribed by the Baldrige Award criteria are extremely similar. This conclusion responds to the second of the two research questions that guided this study, specifically "What differences are there between the organizational work climate prescribed by Deming prescription and that prescribed by other managerial philosophies?"

This is the second strongest conclusion of this study and is also well supported statistically. Ten *z*-based hypothesis tests were conducted toward this conclusion, one for each subscale of the Work Environment Scale, that resulted in *p*-values (in descending order) of 0.993, 0.987, 0.981, 0.980, 0.950, 0.938, 0.909, 0.906, 0.888 and 0.878. These *p*-values statistically demonstrated a very high degree of concordance between the two work environments. There was even strong agreement seen in the high variance that resulted from both groups under the work pressure construct. This concordance is also clearly visualized previously within Figure 4. Of course, no significant difference was found between the two prescriptions on any subscale and the ten propositions were also supported by the "one standard deviation" test recommended in the literature.

The similarity of the work environment under the Deming prescription and the Baldrige prescription is a surprising result and it is the most surprising result from this study. The reader is asked to recall that, in Chapter 4, the hypotheses associated with this conclusion were formed, not on the basis of argument, but merely as "neutral" propositions, in order that some type of Deming versus Baldrige comparison could be conducted. Current general opinion has been that these two prescriptions differ greatly. The Baldrige award is thought by many to have metamorphosed into something like a "performance-driven" award, with its recent criteria heavily emphasizing numerical and financial outcomes. Such a posture is in almost direct conflict with Deming philosophy, which generally prescribes a "process (improvement) driven" perspective versus an "outcome driven" perspective. Further, Deming's admonishments regarding the inappropriateness of short-term financial measures as a gauge of appropriate performance are well understood. Yet this conclusion surprisingly finds a high degree of similarity in

the two work environment prescriptions. This somewhat paradoxical result is initially rationalized herein as being effected by the common mentality of quality that bound both the Deming and Baldrige SMEs, above and beyond Deming's renown quotations or MBNQA's formal criteria, as they completed the survey instrument used in this study.

Given this conclusion, no further conclusions are drawn regarding the Baldrige prescription; those conclusions drawn regarding the Deming prescription are, through General Conclusion 2, equivalent regarding the Baldrige prescription.

General Conclusion 3: The work environment prescribed by Deming is different than the typical work environment. This conclusion responds to the first of the two research questions that guided this study, specifically "What organizational work climate is prescribed by Deming?" Aside from the aforementioned conclusion regarding the prescription of high involvement, the other specific facets of the prescribed Deming work environment are presented below in the section regarding secondary conclusions. These facets can also be seen together in Table 9.

This is the third strongest conclusion of this study; it found support within all ten of the "one standard deviation" tests recommended by the literature by rejecting every test of equality. This general conclusion is further supported by one of the ten associated *z*-tests that resulted in a *p*-value of .004 as noted above. This difference is clearly visualized in Figure 3. Again, while the normative values do not represent a single, "normal" work environment, they do represent the values that a large number of work environments tend toward, and the Deming work environment values were found to greatly differ from them.

General Conclusion 4: Deming prescription failures and implementation problems are often and most frequently due to failure of management, especially the lack of commitment by top management. This conclusion, while informal in nature, found strong support within the responses provided by Deming SMEs within the open response questions. Regarding cause of failure, 42% of the responses made reference to management as cause. Several of the respondents attributed top management as the sole cause of failure. Regarding cause of implementation problems, 28% of the responses made reference to management as cause. Such agreement forms the basis for a relatively strong conclusion.

Secondary General Conclusions

This section of the chapter presents and discusses the secondary general conclusions of this study reached through interpretation of the outcomes resulting from the formal and informal analysis of the data. The conclusions are presented in order of their relative strength.

General Conclusion 5: Deming methods prescribe a higher-than-average degree of innovation. The hypothesized prescription by Deming of high innovation, i.e., a work environment where, to a high degree, emphasis is placed upon variety, change, and new approaches, found good support. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .072 found gives very strong support to the conclusion.

General Conclusion 6: Deming methods prescribe a higher-than-average degree of coworker cohesion. The hypothesized prescription of high coworker cohesion, i.e., a work environment where, to a high degree, employees are friendly and supportive of one

another, found good support. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .080 found gives very strong support to the conclusion.

General Conclusion 7: Deming methods prescribe a higher-than-average degree of clarity. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .094 found gives very strong support to the conclusion that Deming prescribed a work environment where, to a high degree, employees know what to expect in their daily routine and how explicitly rules and policies are communicated. This conclusion was somewhat surprising, as no argument was initially formed regarding the clarity construct.

General Conclusion 8: Deming methods prescribe a higher-than-average degree of supervisor support. The hypothesized prescription by Deming of high supervisor support, i.e., a work environment where management, to a high degree, is supportive of its employees and encourages employees to be supportive of one another, found good support. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .131 found gives strong support to the conclusion.

General Conclusion 9: Deming methods prescribe that people must take pride in the organization. All but one of the seventeen Deming subject matter experts (SMEs) who responded to the associated Open Response Question 4 agreed with this conclusion. However, as such pride is prescribed *verbatim* within Deming's Fourteen Points, this finding is not unexpected.

Tertiary General Conclusions

This section of the chapter presents and discusses the tertiary general conclusions of this study reached through interpretation of the outcomes resulting from the formal and informal analysis of the data. The conclusions are presented in order of their relative strength.

General Conclusion 10: Deming methods prescribe a higher-than-average degree of autonomy. The hypothesized prescription by Deming of high autonomy, i.e., a work environment where, to a high degree, employees are highly encouraged to be self-sufficient and to make their own decisions, found good support. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .277 found gives reasonable support to the conclusion.

General Conclusion 11: Deming methods prescribe a higher-than-average degree of clarity. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .298 found gives reasonable support to the conclusion that Deming prescribed a work environment where, to a high degree, the physical surroundings contribute to a pleasant work environment. This conclusion was somewhat surprising, as no argument was initially formed regarding the physical comfort construct.

General Conclusion 12: Deming methods prescribe a lower-than-average degree of work pressure. The hypothesized prescription by Deming of low work pressure, i.e., a work environment that, to a great degree, is not dominated by high work demands and time pressure, found good support. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .406 found gives reasonable support to the conclusion.

General Conclusion 13: Deming methods prescribe a higher-than-average degree of task orientation. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .441 found gives reasonable support to the conclusion that Deming prescribed a work environment where good planning, efficiency, and getting the job done is highly emphasized. This conclusion was somewhat surprising, as the argument initially formed regarding the task orientation comfort construct propositioned merely an average degree of task orientation.

General Conclusion 14: Deming methods prescribe a lower-than-average degree of managerial control. Given that the literature recognizes difference of one standard deviation as significant, the *p*-value of .693 found gives some amount of support to the conclusion that Deming prescribed a work environment where, to a high degree, management uses rules and procedures to keep employees under control. This conclusion was somewhat surprising, as no argument was initially formed regarding the managerial control construct.

Limitations and Assumptions

This section of the chapter discusses the general and most significant limitations and assumptions regarding this study.

This study was not intended to answer all the questions that are required to fully describe or map the Deming prescription. Indeed, the study found that the WES survey instrument cannot be said to measure the Deming prescription to some specific degree and the general consensus was that it likely measures less than half of the relevant constructs.

This work is exploratory, not theory-testing, in nature, in a subject area where, according to one well respected scholar, "academic attention … has, in fact, been surprisingly sparse." (Anderson et al., 1994) As stated within the introductory areas of this work, the results contributed knowledge regarding only certain facets of the Deming organization in the form of observations that may be conducive to the future building of theory. In addition, the WES survey results contribute to a quantitative profile of the Deming prescription that can be used in future empirical research and hypothesis testing.

Another caveat is appropriate. Surveys are a research methodology that tends to maximize with the generalizablity of results, while sacrificing a degree of precision and control found under lab experiments and a degree of realism and context found under field studies (see McGrath, 1981). This limitation in the chosen methodology was recognized and accepted under the conduct of this study. The review of the literature found the topic already rich in field studies and anecdotal evidence that contribute realism, while more precision and generalizablity in research was clearly lacking and therefore warranted. Accordingly, an intentional choice was made to maximize generalizablity and to add a degree of precision through use of survey methodology.

Implications for Future Research

This section of the chapter discusses the implications of the general conclusions of this study and suggests areas for future research that those conclusions imply.

As discussed in Chapter 1, the usefulness of the Deming work environment profile that resulted from this study toward the contribution of knowledge is manifold. It facilitates future research in the forms of comparison with other management work environment prescriptions, comparison with the work environments of "successful" or

"unsuccessful" organizations, comparison with companies that profess to practice the Deming prescription as well as comparison with the work environment of organizations practicing or desiring to practice the Deming prescription toward diagnosis. In addition, the conclusions of this study now present at least two very noteworthy and interesting opportunities for future research.

First, two of the strongest conclusions resulting from this study appear to be paradoxical in nature. Deming subject matter experts quite strongly agreed that Deming prescription failure is, by far, most often due to the posture of management and leadership. On the other hand, they also quite strongly agreed that an extremely high degree of worker involvement, the degree to which employees are concerned about and committed to their jobs, was the most critical construct within the Deming work environment. Worker concern and commitment, however, is intrinsic in nature, not so directly under the influence of management. How is it, then, that management's lack of commitment is the primary instigator of failure of the Deming prescription, when it is the work forces' intrinsic commitment, not managerial control or supervisor support, that is, by far, the most requisite factor within a Deming work environment? Future research that results in finding and discussion that resolves this issue would clearly contribute to better understanding of the Deming prescription as well as to explain how it can be employed toward improvement.

Second, the aforementioned and surprising result that both Deming and the Baldrige criteria prescribe extremely similar work environments invites further research along several avenues. The conclusion suggests that comparison to other quality prescriptions is clearly appropriate. In addition, further study that results in finding and

discussion that is explanatory regarding this congruence would also surely of be of interest to academics within the quality community.

Additional areas for future research could include the completion of one or two case studies in order to effect triangulation upon the results of this study, inter-item comparison upon the true/false WES question responses. Further the problematic open response questions could be restated and resurveyed; for example, Question 3, "What percentage of the Deming philosophy do you believe is addressed by the preceding survey instrument?" could be restated as "What percentage of the Deming work environment do you believe is addressed by the preceding survey instrument?"

Summary

This chapter presented the general conclusions resulting from this study. The study concludes that the management philosophy of W. Edwards Deming prescribes a work environment with an extremely high degree of worker involvement, that it prescribes high degrees of innovation, coworker cohesion, clarity and supervisor support, that it prescribes levels of autonomy, physical comfort, task orientation that are higher than typically found in work environments and that it prescribes a level of work pressure that is lower than typically found in work environments. The study also surprisingly concludes that the Malcolm Baldrige National Quality Award criteria prescribes a work environment remarkably similar to the work environment prescribed by Deming. Another major conclusion of this study is that Deming prescription failures and implementation problems are, in the opinion of Deming subject matter experts, often and most frequently due to failure of management, especially the lack of commitment by top management.

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APPENDIX A

ANNOTATED LIST OF DEMING EXPERTS SURVEYED

There is no existing definitive listing of Deming subject matter experts. This appendix serves as evidence that each of the fifty-three individuals selected for this study can rightly be considered to be a Deming SME. Most of the individuals included in this list are well known and are generally accepted as Deming experts within the Deming community. The majority of the biographical matter in this appendix is sourced either from the SME's publicly available professional biographical sketch or the self-reported information returned with the survey. The list is presented in alphabetical order and does not correspond in any way to mailing or respondent order.

Dr. Russell L. Ackoff. The basic relationship between Dr. Ackoff and Dr. Deming is that both share a strong and common perspective of organizations as systems. In Volume 21 of *The Deming library* (Dobyns & Crawford-Mason, 1990) the two discuss the practical importance of viewing schools and other kinds of organizations as social systems. In their conversation Dr. Deming and Dr. Ackoff agree that the need to understand a system applies to education and business—indeed, to any organization. In that volume, Dr. Ackoff states, "The characteristic way of management that we have taught in the Western world is to take a complex system, divide it into parts and then try to manage each part as well as possible. And if that's done, the system as a whole will behave well. But that's absolutely false, because it's possible to improve the performance of each part taken separately and destroy the system at the same time." Dr. Ackoff further concludes that that cooperation is more effective than internal competition in leading any organization to work more effectively. Ultimately, Dr. Ackoff worked with CC-M Productions, which had been, to that point, primarily devoted to documenting the Deming

philosophy, to complete a series of four videos titled *Better management for an improving world* in which he explains his theory of the evolution of organizational thinking from the mechanical systems of the early 20th Century production lines, to the biological systems epitomized by the auto companies which emphasized growth above all else, to the social systems model in which development of the organization and its employees begins to be seen as essential to long-term survival. As these examples suggest, the philosophies of Dr. Ackoff and Dr. Deming are highly complimentary, and are seen to be so by the Deming community. He is mentioned by name twice within *The new economics for industry, government, education* (Deming, 1994). Dr. Ackoff is author or co-author of 19 books covering the areas of systems thinking, general management, social research and operations research. Those books most relevant to Demingism are *On purposeful systems* (Ackoff & Emery, 1972), *Redesigning the future: A systems approach to societal problems* (Ackoff, 1974), *Ackoff's fables: Irreverent reflections on business and bureaucracy* (Ackoff, 1991), *The democratic corporation: A radical prescription for recreating corporate America and rediscovering success* (Ackoff, 1994), *Re-creating the corporation: A design of organizations for the 21st Century* (Ackoff, 1999b) and *Ackoff's best: His classic writings on management* (Ackoff, 1999a). Dr. Ackoff has had an illustrious academic career by any measure. He is a charter member and former president of the Operations Research Society of America (ORSA), a founding member of the Institute of Management Sciences (TIMS) and a former president of the Society for General Systems Research (SGSR). Among his many academic kudos are the Silver Medal and the George E. Kimbail Medal, both from the Operations Research Society (UK). In addition to his 19 books, Dr. Ackoff has published more than 200

articles in a wide variety of journals and has researched and consulted on behalf of over 350 corporations and 75 government agencies throughout the world. Those clients include the likes of ALCOA, American Airlines, Anheuser-Busch, AT&T, Department of Justice, Eastman-Kodak, Emerson Electric, Ford, General Electric, General Foods, General Mills, Government of Mexico, IBM, Internal Revenue Service, Martin Marietta, Metropolitan Life, Monsanto, National Institute of Mental Health, National Science Foundation, the U.S. Army and the U.S. Air Force. He has served in an editorial capacity for at least twenty well-respected journals. Currently, Dr. Ackoff is Chairman of the Board of INTERACT, The Institute for Interactive Management, a Philadelphia-based firm dedicated to education, research, and consulting. Since 1986, he has held the title of Anheuser-Busch Professor Emeritus of Management Science, The Wharton School, University of Pennsylvania. His previous academic positions include the August A. Busch Jr. Visiting Professor of Marketing, John M. Olin School of Business, Washington University as well as Professor of Operations Research, and Director, Operations Research Group, Case Institute of Technology. Dr. Ackoff holds a Ph.D. in Philosophy of Science and a B.A., Architecture from the University of Pennsylvania. His honorary degrees include Doctorates of Science from the University of Lancaster and Washington University.

Rafael Aguayo. In 1983, Mr. Aguayo met Dr. Deming while he was his student at New York University. Aguayo then spent the next seven years studying under Dr. Deming as Deming supervised Aguayo's authoring of a book that popularized the Deming philosophy. In 1990, Aguayo published *Dr. Deming: The American who taught the Japanese about quality* (Aguayo, 1990). The book is forwarded by Dr. Deming as an

accurate representation of his prescription. Many Deming experts believe this to be the most authoritative popularization of the topic. The book has sold over 250,000 copies and is now published in over a dozen languages. After publication, Aguayo entered into full-time consulting, primarily in Deming methods, for companies such as Bell Canada, Merck, MCI, Hewlett-Packard, Digital Equipment, EAB and Northern Telecom. In 1995, ASTD (American Society of Training and Development) recognized him for excellence in Organizational Transformation. He has also been a keynote speaker for ASQ (American Society for Quality). Mr. Aguayo is currently the managing partner of Millennia Management Associates, Ltd. which consults in quality, management and strategy. He holds an undergraduate degree with concentrations in physics and economics from Brown University as well as an M.B.A. in Finance and International Business from New York University.

Kelly Allan. Mr. Allan founded Kelly Allan Associates, Ltd., a management consulting firm that, since 1981, seeks to help companies accomplish the transformation prescribed by Deming through application of Deming's theories and practices. In order to accomplish this aim, Mr. Allan has read over 1,300 Deming-related books and articles. He is regularly active within the Deming community and Deming-oriented organizations such as the Ohio Quality and Participation Forum, the British Deming Association, and the Association for Quality and Participation (the latter organization has now merged with ASQ). Mr. Allan shared an especially close relationship with Peter Scholtes, and now proxies for Mr. Scholtes, who has retired due to reasons of health. Jim Clauson is also associated with the firm.

Nida Backaitis, Ph.D. Dr. Backaitis, consultant in statistics and systems, works with business, government and educational organizations to help them align their internal processes and competencies to meet external challenges. Dr. Deming was a member of Dr. Backaitis' dissertation committee; her dissertation topic merges Dr. Deming's work with the area of strategy. During the period from 1987 through 1993, she worked with Dr. Deming as an intern in his consultancy, assisted in his seminars, as well as contributed toward his writing of *The new economics for industry, government, education* (Deming, 1994), where her contributions are referenced by name seven times. Dr. Backaitis has delivered numerous presentations and published several articles regarding the Deming philosophy. She hold a personal letter from Dr. Deming stating his endorsement of her to properly represent his philosophy. Dr. Backaitis serves as a member of the Council of Advisors for the Deming Scholars MBA program as Fordham University. She is also an advisory board member for Quality Network News, a publication of the American Association of School Administrators. She holds a B.A. in Economics and Psychology from the University of Virginia, an M.A. in Economics from Columbia University and a Ph.D. in Management of Corporations and Corporate Strategy from the Columbia University Graduate School of Business.

Dr. Edward Martin Baker. Dr. Baker worked for Ford Motor Company from 1972 to 1992. From 1987 to 1992, he was Ford's Director, Quality Strategy and Operations Support. Dr. Baker was Ford Motor's primary contact with Dr. Deming during his consultations there. Dr. Baker was also responsible for the development and application of methods to improve quality and strengthen competitive position. Dr. Baker also facilitated for Dr. Deming in many of his Four-Day Seminars. His Deming-related

articles include “The Deming philosophy of continuing improvement in a service organization - the case of Windsor Export Supply” (Baker et al., 1985). Dr. Baker contributed content to *Out of the crisis* (Deming, 1986) at pages 76, 90 and 211 and also contributed content to *The new economics for industry, government, education* (Deming, 1994) at pages 10, 37 and 124. The American Society for Quality awarded Dr. Baker the 1995 Ishikawa Medal and the 1997 Deming Medal. Currently, Dr. Baker consults, teaches, holds seminars and writes. His recent book *Scoring a whole in one* (Baker, 1999) reflects Dr. Baker’s perspective on management as influenced by Dr. Deming. Dr. Baker is a member of the Council of Advisors for the Deming Scholars MBA Program at Fordham University. He is also an Associate Trustee of the W. Edwards Deming Institute (WEDI). Dr. Baker holds a B.A., Psychology and an M.B.A. from City College of New York (CUNY) as well as a Ph.D. in Industrial and Organization Psychology from Bowling Green State University.

Dr. Thomas J. Boardman. Dr. Boardman is Professor of Statistics at Colorado State University. He co-directs the Center for Quality & Productivity Improvement at Colorado State University; the Center aims to foster understanding of Dr. Deming’s philosophy. Dr. Boardman began direct correspondence with Dr. Deming in 1980 and, at Dr. Deming’s request, began attending Dr. Deming’s Four-Day Seminars in July of 1983. Dr. Boardman ultimately attended a total of fifteen such seminars. He also had opportunities to travel with Dr. Deming and participate in extended meetings between Dr. Deming and other Deming subject matter experts. Dr. Boardman’s Deming-related articles include “The statistician who changed the world” (Boardman, 1994), “Don’t touch that funnel!” (Boardman & Boardman, 1990) and “W. Edwards Deming’s red bead

experiment fosters profound knowledge" (Boardman, 1995). Dr. Boardman recently created a course that explores the relationship between statistical science and process improvement based upon on his interactions with Dr. Deming. He has published over 90 articles and proceedings. Dr. Boardman is a Fellow and past Board Member of the American Statistical Association, a past Baldrige National Quality Award Reviewer, a Fellow of the American Society for Quality and an elected Member of the International Statistical Institute. His areas of interest are quality improvement and statistical thinking, statistical graphics and computing, consulting, statistical methodology in biological research. The American Society for Quality awarded Dr. Boardman its 1999 Deming Medal. Dr. Boardman holds a Ph.D. and M.S. in Statistics from Rutgers University and a B.A. in Mathematics from Bucknell University.

Linda A. Borsum. Ms. Borsum began her career as a school teacher, association president, contract negotiator and then became an assistant superintendent responsible for a school district's K-12 Restructuring Through Quality effort. In the course of her efforts to improve education through quality techniques, she worked closely with individuals those advocating Deming methods in education such as David Langford, Lee Jenkins and Myron Tribus as well as Dr. Deming himself. According to Lee Jenkins (Jenkins, 1997), she "… was fortunate enough to have studied with W. Edwards Deming for several years—during the period when he was especially interested in American education. As students and practitioners of Dr. Deming's concepts, we have worked for the past five years to introduce his concepts in schools." Currently, she runs the consulting firm Quality Learning Systems International (QSLI), which she founded. QLSI promotes wider adoption of educational quality and Deming's educational theories as well as the

complementary theories of Reuven Feuerstein. She is also a certified senior examiner for the Malcolm Baldrige Award and the Michigan Quality Council.

Dr. Ian Bradbury. Dr. Bradbury worked closely with Dr. Deming when serving as Senior Statistician for Product Engineering in General Motors Powertrain Group during Dr. Deming's consulting for General Motors. While there, he was also in charge of their Powertrain Statistical Network. Dr. Bradbury has also been an active participant of, and speaker at, various Deming conferences. Dr. Bradbury also spent several years facilitating Deming Four-Day Seminars. He also traveled with Dr. Deming during a number of his consultations. After Dr. Deming's death, Dr. Bradbury led development of videotapes to mimic Deming's seminars, presentations and exercises that are now marketed by the W. Edwards Deming Institute. Currently, Dr. Bradbury is President of Peaker Services, Brighton, Michigan, a company that remanufactures and services high horsepower diesel engines, componentry and control systems. Peaker Services and its CEO, Dick Steele practice Deming methods. Dr. Bradbury earned his Ph.D. in Statistics from Birmingham University.

Ben Carlson. Mr. Carlson is a former Executive Vice President of Vernay Laboratories, Yellow Springs, Ohio. Deming made ten personal visits to consult with Vernay Laboratories between 1984 and 1987 while Mr. Carlson was its Vice President of Manufacturing, during which time they enjoyed a close working relationship. Vernay Laboratories' practice of the Deming philosophy was documented within three volumes of *The Deming library* (Dobyns et al., 1990), a set of twenty-six instructional videotapes that received final approval from Dr. Deming. Of this video library, Deming once said it was "the finest presentation of my philosophy." Mr. Carlson has working relationships

with other individuals identified herein as Deming subject matter experts, including Gipsie Ranney, Peter Scholtes, Brian Joiner and Ed Baker. He attended three of Dr. Deming's Four-Day Seminars as well as numerous other Deming presentations of various type. As of this writing, Mr. Carlson is the Chair, Board of Directors, The Ohio Quality and Productivity Forum (OQPF). OQPF promotes management practices primarily based on the Deming philosophy and, for the last fifteen years, hosted the largest and best known annual Deming conference in America. Mr. Carlson has co-authored five monographs regarding the Deming philosophy under the auspices of OQPF.

Jim Clauson. Mr. Clauson has been involved with various Deming activities since the late 1980s. He is the founder, moderator and webmaster of the Deming Electronic Network (DEN), a discussion list and website devoted to Deming content. The DEN is most likely the most robust and active Deming website in existence today. Mr. Clauson was also heavily involved in the initial development of the website for the W. Edwards Deming Institute website, and also created and hosted web sites for OQPF, the British Deming Association and The Deming Forum UK. He is also the founder, director and webmaster of the Deming Virtual College, which develops and provides distance learning courses regarding the Deming philosophy. Mr. Clauson has also provided Deming-related course content for Athabasca University, Alberta, Canada and virtual courses in quality management for the University of Maryland system, California State University system and Oklahoma State University. He also instructed courses with extensive Deming content for almost ten years at Roane State Community College, Harriman, Tennessee, where he was also Director of Quality Training Programs for their Center for Quality and Innovation. His Deming-related publications include "Continuing and expanding

Deming's legacy" (Clauson, 1996). He has also been an active participant of, and speaker at, various Deming conferences. Mr. Clauson also provides Deming-related services via his consulting organization, Breakthrough Systems as well as under the auspices of Kelly Allan Associates. Mr. Clauson holds Masters degrees in Manufacturing Engineering and Business as well as a B.S. in Production Management.

James Robert Crow. Mr. Crow is arguably the foremost proponent of Demingism in the Atlanta area. He is a former President of the Atlanta Area Deming Study Group (1993 & 1994), an organization to which he still provides leadership and facilitation on a regular basis through his position on its board (1996-present); he has been a member of that group since 1991. Mr. Crow has served as an assessor for the Georgia Oglethorpe Award, the premier quality prize awarded by the State of Georgia. He also presents regularly at various quality conferences worldwide. Mr. Crow has authored a number of Deming-related articles, for example "You cannot improve my performance by measuring it!" (Crow, 1996) Mr. Crow has previously worked in several large firms in turnaround situations. He currently operates his own consulting firm, The Crow Group, which consults in quality, continual improvement, process improvement, organizational effectiveness and human resources. The Crow Group perspective is greatly influenced by the philosophy of Dr. Deming.

Marcia Daszko. Ms. Daszko is a consultant, business strategist, executive coach, and the 1990 founder of the Bay Area Deming Users Group (BADUG) in northern California. She attended over twenty of Deming's Four-Day Seminars and is a regular participant and speaker at the W. Edwards Deming Institute. Currently, Ms. Daszko operates Daszko and Associates, a California-based consulting organization. Through her

firm she guides organizations in developing leadership, new business models, strategies, and systems for the Internet Age, guides leaders as they transition their organization from traditional revenue models into the E-commerce framework, and helps young firms learn sound management principles and apply them to create an infrastructure for growth and innovation. She has held positions in corporate communications management and has also instructed management courses at both Berkeley and at San Jose State University. Her formal education includes a B.A., English, Written Communications from Santa Clara University as well as an M.S. in Mass Communications from San Jose State University.

Kenneth T. Delavigne, Jr. Mr. Delavigne became a student of Dr. Deming in 1982. To some extent, assisted Dr. Deming in his seminars. Mr. Delavigne's best-known association with Dr. Deming is his co-authorship of *Deming's profound changes: When will the sleeping giant awaken?*(Delavigne et al., 1994) Currently, he is an independent quality methods consultant. Priority to his consultancy, Mr. Delavigne worked for IBM for 24 years, twelve of those years within the area of quality.

Lloyd Dobyns. Mr. Dobyns was closely associated with Dr. Deming and his work in various ways for nearly thirteen years. Dobyns worked with Dr. Deming and Claire Crawford-Mason to develop and edit the twenty-volume videotape set titled *The Deming library* (Dobyns et al., 1990). Of this video library, Deming once said it was "the finest presentation of my philosophy." Dobyns is co-author of two books that are well respected in their representation of the Deming philosophy: *Quality or else: The revolution in world business*, (Dobyns & Crawford-Mason, 1991b) and *Thinking about quality: Progress, wisdom, and the Deming philosophy* (Dobyns et al., 1994). Dobyns also co-

produced a number of other Deming-related video presentations such as *The Deming revolution* (Dobyns, 1995) and *Quality or else* (Dobyns & Crawford-Mason, 1991a). In fact, Lloyd Dobyns was involved in the 1980 NBC white paper project *If Japan can…why can't we?* that introduced Dr. Deming to his American audience. His other Deming-related work include "Ed Deming wants big changes, and he wants them fast" (Dobyns, 1990). Dobyns served as a NBC news anchor and correspondent for many years. He may be best remembered by the public for his teaming with Linda Ellerbee in the late 1980s to co-anchor the classy, irreverent *NBC News Overnight and Weekend*. Since 1997, Mr. Dobyns has held the position of Professor of Journalism, Ayers Chair of Broadcasting, School of Journalism, Jacksonville State University, Alabama, where he teaches courses in advanced electronic news, introduction to reporting, advanced reporting, and internet news research. Mr. Dobyns holds a B.A. from Washington and Lee University.

Dr. Linda Doherty. In her former role as Director of The Under Secretary of the Navy, Total Quality Leadership Office, Dr. Doherty employed Deming methods to improve quality within the U.S. Navy. One documentation is found in Chapter 5 of *Deming management at work* (Walton, 1990a). She directly contributed to the content of *The new economics for industry, government, education* (Deming, 1994) and has also commented on the Deming philosophy within *The Deming revolution* (Dobyns, 1995) as well as within *The Deming library* (Dobyns et al., 1990). Dr. Doherty is also referenced a number of times within *Thinking about quality: Progress, wisdom and the Deming philosophy* (Dobyns et al., 1994). Currently, Dr. Doherty acts as Director, Strategic

Planning and Analysis Office, Assistant Secretary of the Navy for Manpower and Reserve Affairs (ASN M&RA).

Dr. Nelson M. Fraiman. Dr. Fraiman acts as Co-Director, W. Edwards Deming Center for Quality, Productivity and Competitiveness, Columbia Business School. He joined Columbia's faculty in 1995 after a seventeen-year career at International Paper Company, where his most recent position was Chief Technology Officer for eight manufacturing divisions. Previously, he developed and managed a group responsible for productivity improvement and process innovation. Dr. Fraiman teaches operations and technology management; his research explores institutionalizing quality improvement and six sigma quality. Dr. Fraiman holds a Ph.D., M.B.A., M.S. and B.S., all from Columbia.

Andrea Gabor. Andrea Gabor is the author of *The man who discovered quality: How W. Edwards Deming brought the quality revolution to America: The stories of Ford, Xerox, and GM* (Gabor, 1990). Gabor has written for *New York Times*, *Los Angeles Times*, *Smithsonian* and *Harvard Business Review*. Currently, Ms. Gabor is an English professor at Baruch College, City University of New York. In addition to teaching at Baruch, for the past five years, Ms. Gabor has served as an adjunct professor in a course on Critical Issues in International Economics at Columbia University's Graduate School of Journalism. Her main areas of interest and expertise are biography, management and workplace diversity. She holds a B.S. degree in German and government at Wesleyan University as well as a degree from Columbia.

Dr. Robert J. Gelina. Dr. Gelina may well be the foremost proponent of Demingism in the state of Iowa. He is on faculty in the Department of Industrial

Education and Technology, College of Education, Iowa State University. Dr. Gelina is also Co-founder and Director of The Center for Continuous Quality Improvement, Incorporated (CCQI), established in 1991 and located in the Iowa State University Research Park. CCQI consults in continuous improvement implementation and trains quality facilitators to guide organizational quality transformation via a model that draws upon the philosophies of Dr. Deming, Dr. Eli Goldratt and Dr. Stephen Covey, but CCQI, according to Dr. Gelina "primarily delivers Deming-based knowledge." Dr. Gelina attended five of Dr. Deming's seminars and regularly interacts with other Deming SMEs as named herein and attends various Deming conferences. He facilitated the implementation of his Deming-based methods in a number of organizations in the greater Des Moines area, including Bridgestone-Firestone, Color Converting Industries, The Printer, Incorporated, Tone Brothers, Incorporated and the town of Huxley, Iowa. In a 1990 newspaper article describing Dr. Gelina's work, Ron Barry, President of Color Converting Industries, declared his company "a Deming company" (Couch, 1990). A 1994 article in *Graphics Arts Monthly* discusses the operational practices of The Printer, Incorporated in detail and states that all 150 employees practice the Deming philosophy (Toth, 1994). Dr. Gelina holds a Ph.D. in Industrial Education from the University of Maryland; he has been previously affiliated with University of Wisconsin at Stout, University of Northern Iowa and University of the West Indies. In 1990, Dr. Gelina received the Governor's Iowa Quality Award.

Dr. Howard S. Gitlow. Dr. Gitlow is Professor, Management Science, University of Miami, where he teaches two courses based upon Dr. Deming's theories. Between 1980 and 1983, Dr. Gitlow traveled American with Dr. Deming as he consulted and

assisted him in his Four-Day Seminars. Dr. Gitlow was the President of one of the first major Deming organizations to appear during the 1980s. In 1988, Florida Power & Light, the first American company to win the Deming Prize, awarded funds to Dr. Gitlow to found, and act as Executive Director of, an Institute for Study of Quality in Manufacturing and Service at the University of Miami. Dr. Gitlow's Deming-related works include *The Deming guide to quality and competitive position* (Gitlow et al., 1987) (which is forwarded by Dr. Deming), a *Harvard Business Review* article (reviewed by Dr. Deming) entitled "Product defects and productivity" (Gitlow et al., 1983) and "A comparison of Japanese total quality control and Deming's theory of management" (Gitlow, 1994). He has also instructed at City University of New York (Baruch) and the Science University of Tokyo. Dr. Gitlow has been a senior member in the American Society for Quality since 1985. He has also received quality-related grants from the National Science Foundation (NSF), the American Society for Quality and the Association for the Advancement of Collegiate Schools of Business (AACSB). Dr. Gitlow has extensively consulted industry in the area of quality management. Dr. Gitlow holds a Ph.D., M.B.A., and B.S., all taken at New York University.

William A. J. Golomski. Mr. Golomski was one of Dr. Deming's closest professional associates. He worked with Dr. Deming as early as 1950 and consulted in Japan at Dr. Deming's request on no less than 160 occasions. Dr. Deming frequently called upon Mr. Golomski for advice. Mr. Golomski was awarded the 1989-1990 Deming Medal by the American Society for Quality. Deming mentioned Mr. Golomski by name on pages 19 and 64 of *Out of the crisis* (Deming, 1986). Golomski was president of ASQ during 1966-1967 and was founder of its *Quality Management Journal*. He has served as

both a Malcolm Baldrige National Quality Award judge and a RIT/*USA Today* Quality Cup judge. Prior to his retirement, Mr. Golomski operated W. A. Golomski & Associates, a Chicago-based international technical and management consulting firm and was also a senior lecturer of business policy and quality management within the Graduate School of Business, University of Chicago. Mr. Golomski is the author of more than 300 papers and ten books, most in the area of quality control. He holds masters degrees form the Milwaukee School of Engineering, the University of Chicago, Marquette University and Roosevelt University.

Heero Hacquebord. Dr. Deming and Heero Hacquebord were well acquainted for fourteen years and Mr. Hacquebord is a strong advocate of the Deming perspective. Dr. Deming once favored Mr. Hacquebord by describing him as "a man of knowledge." Mr. Hacquebord contributed content to *Out of the crisis* (Deming, 1986) at pages 59, 84, 146, 316 and 317. He also contributed content to *The new economics for industry, government, education* (Deming, 1994) at pages 98 and 185. Mr. Hacquebord is also a well recognized instructor of Deming philosophy. He often facilitated for, and instructed alongside, Dr. Deming in many of his Four-Day Seminars during the years 1987 through 1993. Mr. Hacquebord has also been an active participant of, and speaker at, a number of major Deming conferences. Mr. Hacquebord continues his twenty years of consulting experience through his current role as President of DecisionPartners Limited, a firm that holds seminars and consults in the areas of systems management, cultural changed, continual improvement, customer orientation and statistical process control. DecisionPartners Limited includes 3M, BMW, Boeing, Ford Motor, General Motors, Humana, Kraft, Miller Brewing and the Department of Defense within its client list. Mr.

Hacquebord holds a Bachelors degree in Mathematics and Mathematical Statistics from the University of Pretoria as well as a Masters degree in Business Leadership from the University of South Africa.

Dr. Harold S. Haller. Dr. Haller met Dr. Deming in a 1981 meeting. At the end of that meeting, Deming simply told Dr. Haller that "he would like to know him better." From that time until Dr. Deming's death, the two communicated weekly regarding Haller's work toward implementing Deming transformations at various companies such as Boeing and Proctor & Gamble. Starting in 1985, Haller assisted Deming two to ten times a year at Deming's Four-Day Seminars. Haller authored the book *Managing with profound knowledge: A management process based on the Deming management theory* (Haller, 1995) that discusses how Demingism can improve each of Fayol's Four Functions of Management. On page 470 of *Out of the crisis* (Deming, 1986), Dr. Deming thanked Dr. Haller for his contribution toward that portion of the book. In 1983, Haller founded Harold S. Haller & Company to promote Demingism within American industry. Accordingly, it provides organizations with continuous improvement and organizational culture transformation consulting services based in large part upon the Deming philosophy. The company also offers other Deming-related services such as a "Managing with Profound Knowledge" seminar, a "Fundamentals of Deming management" seminar, and a self-paced tutorial kit titled "A self directed journey to managing with Profound Knowledge." The company consults in other areas of quality and customer satisfaction as well. Dr. Haller holds a Ph.D., Mathematical Statistics, Case Institute of Technology, an M.A., Mathematics, American University, and a B.S. in Engineering Physics from Lehigh University.

Dr. Lee Jenkins. Dr. Jenkins was introduced to the Deming philosophy in 1990 by leaders of the American Association of School Administrators, and he attended a Deming Four-Day Seminar sponsored by that group in 1992. Since that time, Demingism has been the central philosophy guiding Dr. Jenkins' efforts toward classroom improvement. The American Society for Quality approached Dr. Jenkins and asked that he document and publish his improvement efforts, which resulted in his 1997 book *Improving student learning: Applying Deming's quality principles in classrooms* (Jenkins, 1997). Dr. Jenkins was, for over twelve years, Superintendent, Enterprise School District, Redding, California. He later served as Superintendent, Antioch Unified School District, Antioch, California. He has also previously held positions as teacher, principle, assistant superintendent and professor.

Dr. H. Thomas Johnson. Dr. Johnson is the Herbert Retzlaff Professor of Quality Management at the School of Business at Portland State University, Portland, Oregon. Dr. Johnson is best known within the Deming community for his accounting and quality books that highly complement the Deming philosophy. His 1987 book, *Relevance lost: The rise and fall of management accounting* (Johnson & Kaplan, 1987), was noted in 1997 by *Harvard Business Review* as one of the fourteen most influential books to appear in the 75 years of HBR's history. His next book, *Relevance regained: From top-down control to bottom-up empowerment* (Johnson, 1992b), is also well regarded; it carries kudos from production/quality experts Dr. Steven C. Wheelwright and Dr. Richard J. Schonberger as well as Dr. Thomas J. Murrin, Former Dean, School of Business Administration, Duquesne University. Dr. Johnson's most recent book is *Profit beyond measure: Extraordinary results through attention to work and people* (Johnson &

Broms, 2000). He is also known within the Deming community for his W. Edwards Deming Institute keynote address (Johnson, 1997) integrating the philosophy of Dr. Deming with that of the anthropologist and social scientist Gregory Bateson. Dr. Johnson's Deming-related articles include "Deming's message for management accountants" (Johnson, 1992a) and "Revisiting Deming's Fourteen Points in light of Japanese business practices" (Johnson, 1996). Drs. Deming and Johnson were indeed acquainted; Dr. Johnson is mentioned by Dr. Deming on page 94 of *The new economics for industry, government, education* (Deming, 1994). Dr. Johnson currently researches in the design of people-oriented improvement processes for achieving customer satisfaction and profitability in global enterprises. Dr. Johnson holds an AB from Harvard University, an M.B.A. from Rutgers University as well as both an M.A. and a Ph.D. from the University of Wisconsin at Madison.

Dr. Brian L. Joiner. Dr. Joiner was a close associate of Dr. Deming for over three decades. He is mentioned by name four times within Deming's *The new economics for industry, government, education* (Deming, 1994) and twice within Deming's *Out of the crisis* (Deming, 1986). He is the author of *Fourth generation management: The new business consciousness* (Joiner, 1994), a book that, within the Deming community, is viewed as being highly complementary with Demingism. The book advocates quality as the guiding principle for the next generation of management. Other Deming-related publications by Dr. Joiner include "Variation, management and W. Edwards Deming" (Joiner & Guadard, 1990). Dr. Joiner was awarded the 1986-1987 Deming Medal by the American Society for Quality. Dr. Joiner was one of the nine original Malcolm Baldrige National Quality Award judges. Dr. Joiner is cofounder and Chairman of the Board of

Oriel (formerly known as Joiner Associates), a Madison, Wisconsin-based continuous improvement consulting firm. He is currently working on how Deming's ideas can help us address the larger system issues of our physical environment. Dr. Joiner holds Ph.D. and M.S. degrees from Rutgers.

Emeritus Professor David Kerridge, FIS. Professor Kerridge met Dr. Deming at a research weekend organized by the British Deming Association. Shortly thereafter, Dr. Deming invited him to speak at one of his New York University seminars, and he continued to do so until those seminars ended. He was also invited to participate in a series of Deming-based management seminars held by a team that included Dr. Joyce Orsini, Dr. Gipsie Ranney, Ron Moen and Dr. Kosako Yoshida. Professor Kerridge attended fourteen of Dr. Deming's Four-Day Seminars. Dr. Deming used many of Professor Kerridge's papers toward his teaching. Professor Kerridge is generally acknowledged within the Deming community as highly knowledgeable in Deming theory. Professor Kerridge served as Director of Research for the British Deming Association and served for more than two decades as chairman of the Department of Statistics at the University of Aberdeen, Scotland.

Alfie Kohn. The basic relationship between Dr. Deming and Alfie Kohn is that both share a strong and common perspective regarding the negative aspects of competition, extrinsic rewards, contrived ranking. Deming once said of Kohn, "By perceiving that cooperation is the answer, not competition, Alfie Kohn opens a new world of living." Kohn's perspective was well researched and was often cited by Dr. Deming. Kohn is mentioned by name five times within Deming's *The new economics for industry, government, education* (Deming, 1994). The books written by Kohn that most

compliment the Deming perspective are *No contest: The case against competition* (Kohn, 1986) and *Punished by rewards: The trouble with gold stars, incentive plans, A's, praise, and other bribes* (Kohn, 1993). Alfie Kohn is well recognized as a leader in this perspective. He has spoken at numerous conferences and corporate programs and has published numerous articles in national magazines, including *Harvard Business Review*, *Atlantic Monthly*, *Nation*, and *Psychology Today*, and has appeared a number of times on national television presenting the perspective. *Time* recently described him as "perhaps the country's most outspoken critic of education's fixation on grades [and] test scores." He and his perspective have also been profiled in the *Washington Post* and the *Los Angeles Times*. Currently, Kohn translates his perspective toward the improvement of education. Kohn was educated at Brown University and the University of Chicago. Mr. Kohn lives in the Boston area.

David Langford. Mr. Langford was featured in the PBS film *Quality or else* (Dobyns et al., 1991a) and has appeared in several Deming-related documentaries including *The Deming revolution* (Dobyns, 1995) and *The Deming library* (Dobyns et al., 1990). Mr. Langford was directly involved in the implementation of Deming principles at Mount Edgecumbe High School, Sitka, Alaska; the school is often offered as a exemplar of Deming principles in education (see Dobyns et al., 1991b). As of this writing, Mr. Langford, through his consulting organization Langford International, provides seminars, lectures, training and materials related to quality in education; his Four-Day Seminar focuses on the Deming philosophy of Profound Knowledge as it is applied to learning organizations. Mr. Langford received a Masters in Educational Administration and

Supervision from Arizona State University as well as a B.S., K-12 Education from Montana State University-Billings.

Dr. William J. Latzko. In 1960, Dr. Latzko began his doctoral work at New York University and studied statistics under Dr. Deming there and he assisted Dr. Deming in the proofing of his book on sampling. At the end of the first semester, Dr. Deming recommended Latzko to CBS for the position of chief statistician. Latzko subsequently enrolled in all the courses that Deming instructed at the time. As Deming became better known and began to hold seminars at NYU, Latzko was invited to present his perspective on "statistics in the trenches." As Deming worked on *Out of the crisis* (Deming, 1986), he sent drafts to Latzko for his review. In addition to mentioning his name nine times in the book, Deming gives Dr. Latzko credit (on page 14) for significant authorship of Chapter 7; he is also mentioned by name four times within Deming's *The new economics for industry, government, education* (Deming, 1994). Dr. Latzko holds a letter of reference from Dr. Deming, in which he refers to Dr. Latzko as "a master of his theories." He also assisted Deming with his Four-Day Seminars on a number of occasions. In 1995, Dr. Latzko co-authored *Four days with Dr. Deming: A strategy for modern methods of management* (Latzko et al., 1995); Deming reviewed and endorsed the book. Dr. Latzko was awarded the 1995-1996 Deming Medal by the American Society for Quality and is a Fellow of that organization. Dr. Latzko has also served as Director of Quality Control for Mundet Cork, Director of Management Science and Quality Control for CBS, and Vice President for Quality Control for Irving Trust. Since 1983, Dr. Latzko has consulted through his firm Latzko Associates, which helps firms apply Dr. Deming's methods to achieve quality. He is also Adjunct Associate Professor of Management Systems,

Graduate School of Business, Fordham University. Dr. Latzko holds a Ph.D. from Kennedy Western University, a DB from Rutgers/Stonier Graduate School of Banking, an M.B.A. fro Rutgers and a B.S. from Fordham University.

Dr. Barbara Lawton. Dr. Lawton was one of Dr. Deming's last students. She worked closely with him as she assisted him with the preparation of *The new economics for industry, government, education* (Deming, 1994); on pages 49 and 92, he gives her credit for most of the work contained in Chapters 3 and 4. In 1994, Dr. Lawton was appointed W. Edwards Deming Professor of Management at the University of Colorado; according to Richard Seebass, former Dean of the School of Engineering, Dr. Deming endowed that chair himself in 1992. Dr. Lawton is also a Member of the Council of Advisors for the Deming Scholars MBA Program at Fordham University. Currently, Dr. Lawton is Chief Research Officer (CRO) for Ignite!, Incorporated, a company that develops and markets online instructional software based on interactive and adaptive learning methodologies. As CRO, she is responsible for validating and continually improving the effectiveness of the software products. Dr. Lawton's previous positions include Vice President of Business and Quality Processes for Storage Technology Corporation (StorageTek), E-business Strategist for Starpoint Solutions (formerly known as TIS Worldwide) and Associate Vice President for Technology for The University of Colorado System. Dr. Lawton holds Barbara holds a B.S., Biology from The American University, an M.A. in Statistics from Pennsylvania State, and a Ph.D. in Statistics from the University of Wyoming. She also completed Columbia University's Management Development Program.

Robert (Bob) W. Mason and Clare Crawford-Mason. The Masons have been strong advocates of the Deming philosophy since 1980, when they were involved in the production of the 1980 NBC white paper project *If Japan can…Why can't we?* It is this production that is often credited with introducing Dr. Deming to the United States and so beginning the American quality revolution. It was at Ms. Crawford-Mason's initiative, who at that time was a senior producer at NBC, that the fifteen-minute segment documenting Dr. Deming's work was included in that production. In 1981, they co-founded CC-M Productions to specifically develop Deming media and content. During this time, the Masons went on to collaborate closely with Dr. Deming in order to explain and clarify his management philosophy for popular audience in popular media. Since then, the Masons produced *The Deming library* (Dobyns et al., 1990). Of these videos, Deming once said it was "the finest presentation of my philosophy." The Masons dined with Dr. Deming bi-weekly during the years (1986-1993) they worked on the production. The Masons also produced four PBS Deming documentaries. They were also involved in two best-selling Deming-related books, *Quality or else* (Dobyns et al., 1991a) and *Thinking about quality: Progress, wisdom, and Deming philosophy* (Dobyns et al., 1994). This 1994 book was the last book Deming personally approved as representative of his ideas. In the process of these productions, Ms. Crawford-Mason interviewed hundreds of CEOs, managers, supervisors and workers who were implementing Deming's philosophy under his direction. Ms. Crawford-Mason has also been an active participant of, and speaker at, various Deming conferences. Both of the Masons have also founded a successful magazine; Mr. Mason founded *Smithsonian*, Ms. Crawford-Mason founded *People*.

Kim I. Melton, Ph.D. Dr. Melton was co-founder of the Richmond (Virginia) Deming Study Group, and has been a regular participant in conferences organized by The W. Edwards Deming Institute and the Ohio Quality and Productivity Forum, and has consulted with education, manufacturing, health care, and service organizations about how to apply Dr. Deming's teachings in their organization. She participated in over a dozen seminars conducted by Dr. Deming and to facilitated satellite downlinks of his seminars in Richmond and Pittsburgh. Dr. Melton is a Council member and holds various responsibilities within the W. Edwards Deming Institute. She also speaks regularly at the Atlanta Area Deming Study Group (AADSG). Dr. Melton is currently an Associate Professor of Business Administration at North Georgia College and State University where she teaches Business Statistics, Quantitative Methods, and Production and Operations Management. She was previously on faculty at School of Business, Virginia Commonwealth University. Dr. Melton holds an M.S. and Ph.D. from Tennessee.

Ronald D. Moen. Mr. Moen first met Dr. Deming when they served on a ASTM committee from 1976 through 1979. Mr. Moen's work with Dr. W. Edwards Deming includes acting as a primary contact with Dr. Deming during the implementation of Deming principles at Pontiac Motor Division between 1982 and 1986. He also assisted Deming in various ways at over seventy of Deming's Four-Day Seminars between 1983 and 1993. Moen's contributions to *Out of the crisis* (Deming, 1986) are noted at pages 40 and 113. Moen participated in question & answer sessions at Deming's Four-Day Seminars between 1982 and 1993. His Deming-related publications include *The performance appraisal system: Deming's deadly diseases* (Moen, 1989). He is a co-founder of the Greater Detroit Deming Study Group. Moen was on the Board of

Directors of the W. Edwards Deming Institute between 1993 and 1996 and has served on its Design Council since that time. Ronald D. Moen is presently a statistician, consultant, and teacher to industry, government, and education working under the auspices of Associates for Process Improvement (API), a company that employs several Deming experts. API teaches and applies the Deming philosophy to managerial practices and establishes quality as an organization business strategy. Moen has also been an Adjunct Lecturer at University of Michigan-Flint since 1995. He has also lectured at University of Wisconsin-Oshkosh and Murray State University. He holds a Master of Science degree in Mathematics and a Master of Arts degree in Statistics from University of Missouri. He has done additional graduate work at George Washington University, University of Minnesota, and Rutgers University.

Professor Henry R Neave, Ph.D., B.Sc., F.S.S. Professor Neave first became involved with the Deming management approach in 1980 through his appointment as Statistical Quality Consultant to the British subsidiaries of the Nashua Corporation, one of the forerunners in the wide-scale application in America of Dr. Deming's teachings during the 1980s. He was, along with Bill Scherkenbach, one of Dr. Deming's two main assistants during Dr. Deming's British Four-Day Seminars in Britain; in fact, Professor Neave assisted at every such British seminar. In addition, he assisted at many of Dr. Deming's Four-Day Seminars throughout Europe during the final ten years of Dr. Deming's life. He has also given conference presentations, seminars and lectures on the Deming philosophy in America, Sweden, Norway, Holland, Ireland and Singapore as well as many seminar series in Britain under the auspices of the British Deming Association. He is mentioned by name twice within *The new economics for industry,*

government, education (Deming, 1994). Professor Neave is best known in the Deming community for his 1990 authorship of *The Deming dimension* (Neave, 1990), a popularization of the Deming philosophy. In 1998, the book was described in an ASQ publication as "the best overall theoretical yet practical explanation of the Deming philosophy." Dr. Deming authored the forward to the book. Professor Neave's other Deming-related publications include "Deming's Fourteen Points for management: Framework for success" (Neave, 1987). Professor Henry Neave was the 1987 founder, and later the Director of Education of, the British Deming Association. Professor Neave is a Fellow of the Royal Statistical Society and a member American Society for Quality and the American Statistical Association (ASA). Professor Neave is affiliated with Nottingham Trent University, having served as a Professor of Statistics within its Department of Mathematics as well as on the faculty of its Quality Unit inside the Nottingham Business School. In 1998, Nottingham Trent University created and granted him the title of W. Edwards Deming Professor of Management.

Ardel "Del" E. Nelson. Mr. Nelson was a guest speaker and facilitator at many of Dr. Deming's Four-Day Seminars throughout the 1980s and 1990s. He served as initiator and project manager of the Federal Pacer Share demonstration project test of the redesign of the U.S. Civil Service based on the teaching of Dr. Deming. He also consulted in Deming methods with other clients such as the Department of Defense, the Oregon Supreme Court, Chevron Oil and Sony. Mr. Nelson is a highly active and visible member of the Deming Electronic Network (DEN) and the Bay Area Deming Users Group. Mr. Nelson has taught both undergraduate and graduate courses at UCLA, California State University at Sacramento, Embry-Riddle Aeronautical University,

Sacramento City College, and Consumnes River College. He has also prepared course content on systems thinking for Deming Virtual College. Currently, he is Spokesperson/Chair and Professor of the Management Department at American River College in Sacramento, California. There he is responsible for that school's AA Certificate in Modern Management, a program of study comprised of nine courses based upon Deming's System of Profound Knowledge. The program, begun in 1988, is the first degree program in the United States based upon Deming's teaching. Mr. Nelson holds an M.S. from the US Air Force Institute of Technology and an B.A. from University of San Diego.

Dr. Lloyd S. Nelson. Dr. Deming gave Dr. Nelson a great deal of inspirational credit toward the development of Deming theory. On page 20 of *The new economics for industry, government, education* (Deming, 1994), Deming states that "the reader of this book will find on nearly every page application of Dr. Nelson's pronouncements." In fact, Dr. Nelson is mentioned by name no less than fourteen times in *Out of the crisis* (Deming, 1986) and three times in *The new economics for industry, government, education* (Deming, 1994). Dr. Deming credited Dr. Nelson with a number of concepts that became Deming theory trademarks, including the funnel experiment, as well as the statements that "The most important figures for management are unknown and unknowable" and "If you can improve productivity … by 5 per cent next year … without a plan for improvement, they why were you not doing it last year?" Dr. Nelson was awarded the 1984-1985 Deming Medal by the American Society for Quality. His other awards include ASQ's first Distinguished Service Medal, American Statistical Association's 1982-1983 Statistician of the Year Award, ASQ's 1978 Shewhart Medal,

and the 1964 title of ASQ Fellow. As the editor of ASQ's *Industrial Quality Control* during the 1960s, Dr. Nelson then proposed dividing the magazine into two publications, the general-interest magazine *Quality Progress* and the more technical quarterly *Journal of Quality Technology*. He became first editor of, and a regular contributor to, that latter journal, though he prefers to be recognized as the author of its Technical Aids column, which he wrote for more than twenty years. Dr. Nelson's industrial background includes his position as Director of Statistical Methods, Nashua Corporation, which implemented Deming theory during his tenure. Dr. Nelson retired from the Nashua Corporation in 1992. Before joining Nashua Corporation, he was a consulting statistician with General Electric Lamp Division in Cleveland and then manager of Applied Mathematics Laboratory for General Electric Appliance Division in Louisville, Kentucky. Currently, Dr. Nelson is a free-lance statistical consultant living in New Hampshire. Dr. Nelson holds a Ph.D., Chemistry from the University of Connecticut.

Dr. Thomas W. Nolan. For many years, Dr. Nolan has been regularly and highly active within much of the Deming community in a variety of ways. He was well acquainted with Dr. Deming. He is mentioned by name within Dr. Deming's *The new economics for industry, government, education* (Deming, 1994); Dr. Deming was especially fond of relating the story contained therein regarding how Dr. Nolan's son charted the daily arrival time of his school bus to illustrate common cause and special cause variation (Neave, 1990). He is a co-author (with Ron Moen and Lloyd Provost) of the Deming-oriented text *Improving quality through planned experimentation* (Moen, Nolan, & Provost, 1991). Dr. Nolan was awarded the 2000-2001 Deming Medal by the American Society for Quality; the medal was presented to him by Joyce Orsini. Dr.

Nolan has previously instructed at Adelphi University. Currently, Dr. Nolan consults Deming methods under the auspices of his co-founded firm, Associates in Process Improvement. Dr. Nolan holds a Ph.D. in Statistics from George Washington University.

Dr. Joyce Nilsson Orsini. Dr. Deming directed Dr. Orsini's doctoral dissertation at New York University. Dr. Orsini met almost weekly with Dr. Deming between 1971 and 1993 during which time she assisted him with his teaching at NYU and his planning of Four-Day Seminars. She also traveled with him on many consulting visits. Dr. Orsini was awarded the 1994-1995 Deming Medal by the American Society for Quality. Dr. Orsini is mentioned twice my name within *Out of the crisis* (Deming, 1986), three times within *The new economics for industry, government, education* (Deming, 1994). She is a member of the Board of Trustees of the W. Edwards Deming Institute. Within the banking industry, Dr. Orsini held the positions of Vice President and Chief Statistician, Chief Human Resources Officer, Chief Financial Officer and Chief Operations Officer. Dr. Orsini is currently Associate Professor of Management Systems at Fordham University Graduate School of Business, where she directs the Deming Scholars MBA Program. She holds M.S., M.Phil. and Ph.D. degrees from NYU as well as a B.S. from CUNY.

Donald E. Petersen. Mr. Petersen is the former CEO of Ford Motor who initiated and facilitated the consultations of Dr. Deming for Ford in the 1980s. During that period, Dr. Deming and Mr. Petersen had numerous meetings where Dr. Deming discussed how his philosophy should be applied within Ford. In *Out of the crisis* (Deming, 1986) at page 118, Dr. Deming stated that he believed the work at Ford under Petersen's direction would be "a powerful signal to all Western industry." Mr. Petersen, in the early pages of

his *A better idea: Redefining the way Americans work* (Petersen & Hillkirk, 1991), gives Dr. Deming much credit for saving Ford from bankruptcy. Mr. Petersen is the 1999 recipient of the American Society for Quality's Deming Medal.

Lloyd P. Provost. Mr. Provost worked closely with Dr. Deming at both Ford and Pontiac during the 1980s. He also assisted with a dozen of Deming's Four-Day Seminars and participated in various study groups with Dr. Deming. Mr. Provost remains very active within the Deming community. He is mentioned by name at page 210 of Deming's *The new economics for industry, government, education* (Deming, 1994). Mr. Provost is presently working under the auspices of Associates for Process Improvement (API), a company that employs several Deming experts. API teaches and applies the Deming philosophy to managerial practices and establishes quality as an organization business strategy. Mr. Provost holds a Bachelor of Science in Statistics from the University of Tennessee and a Master of Science in Statistics from the University of Florida.

Dr. Michael E. Quigley. Dr. Quigley was acquainted with Dr. Deming even before Dr. Deming was "discovered" by America in 1980. At that time, Dr. Deming was already consulting at both the Nashua Corporation and Rivier College in Nashua, New Hampshire. Dr. Quigley was on faculty at Rivier College at the time; he and Dr. Deming worked to develop and implement at Rivier one of the first academic programs in quality based upon statistical process control and other Deming techniques. Dr. Quigley coordinated the Rivier College quality program for many years. He served as a "understudy," ready to assist Dr. Deming in his Four-Day Seminars when emergency situations arose. Currently, Dr. Quigley heads the Organizational Leadership program at Brevard College, Brevard, North Carolina. The Brevard program is "designed to educate

and train students for professional life in the new economic age with a curriculum inspired by the principles of learning, management and leadership advocated by Dr. W. Edwards Deming." As such, the Brevard program is one of only a very few academic programs in America dedicated to Demingism. In addition to his Ph.D. from Boston College, Dr. Quigley holds a B.A. from London University, an M.A. from both Lancaster University and Manhattan College and he completed postdoctoral work at Cambridge University, Institute Catholique (Paris) and the Boston Theological Consortium.

Dr. Gipsie B. Ranney. Dr. Ranney was one of Dr. Deming's close associates during the 1980s. For almost that entire decade, Dr. Ranney regularly facilitated for Dr. Deming during his signature Four-Day Seminars. She also accompanied him on consulting visits and worked with him closely as he consulted General Motors while she was employed there as Director of Statistical Methodology for their Powertrain Group from 1988 to 1992. She has given many presentations on the Deming philosophy during her career. Dr. Ranney contributed content to *Out of the crisis* (Deming, 1986) at pages 258, 320 and 327; page 327 suggests that Dr. Ranney was involved in the development of Dr. Deming's well-known "funnel experiment." Dr. Ranney's contributions to the content of *The new economics for industry, government, education* (Deming, 1994) are noted at pages 33, 36, 154 and 193. Dr. Ranney's Deming-related articles include "Deming and the Fourteen Points: A personal view" (Ranney, 1986) and "Getting back to Deming" (Ranney, 1996). The American Society for Quality awarded Dr. Ranney the 1996-1997 Deming Medal. Dr. Ranney has provided leadership within a number of prominent Deming organizations. She sits as a Member of the Council of Advisors for the Deming Scholars MBA Program at Fordham University, New York City. Since its

founding, Dr. Ranney has also served as an Associate Trustee of the W. Edwards Deming Institute, Washington, District of Columbia; she also served as its first President. Dr. Ranney also serves as a member of the Board of Directors of the Ohio Quality and Productivity Forum. OQPF promotes management practices primarily based on the Deming philosophy and, for the last fifteen years, hosted the largest and best known annual Deming conference in America. Dr. Ranney is a Professor of Management at the Jack C. Massey Graduate School of Business, Belmont University, Nashville, Tennessee. Previously, Dr. Ranney was on the faculty of the Department of Statistics at the University of Tennessee, Knoxville, Tennessee for fifteen years. While there she became a co-founder of the University of Tennessee's Institute for Productivity through Quality. She earned her Ph.D. in Statistics from North Carolina State University. Dr. Ranney also holds a B.S. in Mathematics from Duke University and completed coursework at North Carolina State University in industrial engineering and operations research culminating in the M.E.S. degree.

Daniel J. Robertson. Mr. Robinson first learned of Demingism in 1980 while working toward quality initiatives as a manager within Hewlett-Packard in 1980. In 1989, he co-founded the Bay Area Deming Users Group, one of America's most active Deming groups, which he continues to organize and facilitate on a regular basis. In 1994, Mr. Robertson co-authored *Deming's profound changes: When will the sleeping giant awaken?* (Delavigne et al., 1994) Mr. Robinson historically has been a consistent participant in major Deming conferences such as the W. Edwards Deming Institute, Ohio Quality and Productivity Forum and The British Deming Association. Currently, Mr.

Robinson is Director, Customer Repair Services, 3Com Corporation, Santa Clara, California, where he continues to practice and apply Deming principles.

William W. Scherkenbach. For nearly twenty years, Mr. Scherkenbach was a close associate that Dr. Deming strongly endorsed; Dr. Deming once said of Scherkenbach that "… he was my student, and there's none better in the world. It takes a little ingredient called profound knowledge, and he's got it." Deming mentioned Scherkenbach's name nine times within *Out of the crisis* (Deming, 1986); nine times within *The new economics for industry, government, education* (Deming, 1994). By Mr. Scherkenbach's own reckoning, he was in the company of Dr. Deming on over 1,000 occasions. He also holds strong endorsements regarding his proficiency in the Deming perspective from both Don Petersen, the 1999 Deming Medallist and former CEO of Ford Motor Company, as well as Bob Stempel, the former CEO of General Motors. During his attendance at New York University, Mr. Scherkenbach studied under Dr. Deming. Ultimately, Mr. Scherkenbach became Director of Statistical Methods, Ford Motor Company upon the recommendation of Dr. Deming. In that capacity, he was responsible for guiding the implementation of Dr. Deming's philosophies throughout Ford's worldwide operations. Mr. Scherkenbach then joined General Motors as Group Director, Statistical and Process Improvement Methods to lead its efforts to establish world-class quality in the Buick, Powertrain, and Cadillac Divisions. In 1991, under Mr. Scherkenbach's guidance, Cadillac received a Malcolm Baldrige National Quality Award. Mr. Scherkenbach has also served as a Deming consultant to the Joint Chiefs of Staff. Mr. Scherkenbach has significantly contributed to understanding of the Deming philosophy. His 1986 book, *The Deming route to quality and productivity: Roadmaps*

and roadblocks (Scherkenbach, 1986), has sold over 300,000 copies and has been reprinted in French, Spanish, Portuguese, Romanian and Chinese. In 1991, Mr. Scherkenbach authored a second Deming treatise, *Deming's road to continual improvement* (Scherkenbach, 1991). He also was the major contributor to a CD-ROM Deming primer entitled *Deming, best efforts are not enough*. In 1992, the American Society for Quality awarded Bill Scherkenbach its Deming Medal. Currently, Mr. Scherkenbach is CEO of WWS, Incorporated, a Deming-based consulting company with clients in health-care, auto, insurance, defense and communications industries. He holds an undergraduate degree from the U.S. Naval Academy and a graduate degree from the Stern School of Business, New York University.

Ronald D. Schmidt. Mr. Schmidt is Co-Chairman, Board of Directors, Artesyn Technologies, Incorporated, as well as the retired Chairman and Chief Executive Officer of Zytec Corporation, which merged with Artesyn Technologies in 1997. Under Dr. Deming consultancies, Mr. Schmidt began practicing Deming methods at Zytec in 1984. Successes attributed to that practice includes 28% revenue growth during the 1991 recession, receipt of the 1991 Malcolm Baldrige National Quality Award, receipt of the Minnesota Quality Award, on-time delivery performance improvement of 22% from 1990 levels to 99.4% in 1992, scrap and rework reduction of 66% in five years to 0.23% of sales, warranty costs reduction of 72% in five years, and productivity improvement of 75% in five years (Altany, 1992). Zytec also claimed four-sigma quality and a Zytec power supply mean-time-between-failure (MTBF) of over 1,000,000 hours. Zytec's practice of the Deming philosophy was documented within two volumes of *The Deming library* (Dobyns et al., 1990), a documentation that received final approval from Dr.

Deming. One discussion of the founding of Zytec and its adoption of the Deming philosophy can be found within Dixon (Dixon, 1987).

Peter R. Scholtes. From 1987 to 1993, Mr. Scholtes often shared the platform with Dr. Deming, helping educate corporations about Deming's philosophy of management. He was one of the first to synthesize organizational teamwork theory with the Deming theory of management. Deming mentions him by name at page 247 of *Out of the crisis* (Deming, 1986) and page 38 of *The new economics for industry, government, education* (Deming, 1994). Mr. Scholtes is the author of *The team handbook: How to use teams to improve quality* (Scholtes, 1988) which has sold more than 800,000 copies worldwide, and *The leader's handbook: Making things happen, getting things done*. (Scholtes, 1998). Other Deming-related publications by Mr. Scholtes include "What's pride got to do with it?" (Scholtes, 1996) In March of 1995, *Quality Digest* recognized Mr. Scholtes as one of the 50 quality leaders of the decade. In May, 2000, Mr. Scholtes was awarded the Ishikawa Medal by the American Society for Quality. Peter Scholtes is presently retired due to reasons of health. Mr. Scholtes' professional concerns are currently addressed by another Deming subject matter expert, Mr. Kelly Allen.

Dr. Myron Tribus. Dr. Tribus was one of Dr. Deming's closest associates during his work in the United States. In recent years, he has regularly written on the Deming philosophy; a collection of his many writings on Demingism are publicly posted at the Deming Electronic Network (DEN) website. Dr. Tribus also contributes to the DEN discussion list on an almost daily basis. Dr. Deming mentions Dr. Tribus in *Out of the crisis* (Deming, 1986) at page 427 and thanks him for his contribution to *The new economics for industry, government, education* (Deming, 1994) at pages 20-21. Dr.

Tribus had great influence in the decision to publish these two books, as well as an extensive set of Deming videotapes (Deming, 1991) under the auspices of the Massachusetts Institute of Technology. Some of the articles published by Dr. Tribus regarding Dr. Deming include "Deming way" (Tribus, 1988), "He saw what needed to be done and set about doing it" (Tribus, 1996a) and "Quality in education according to the teachings of Deming and Feuerstein" (Tribus, 1996b). Dr. Tribus is an Associate Trustee of the W. Edwards Deming Institute, Washington, District of Columbia. Dr. Tribus has a thoroughly distinguished background. The book *Profiles in quality* (Schultz, 1994) devotes a full chapter to Dr. Tribus and his contributions to the discipline of quality. In his early career, Dr. Tribus worked as a design engineer toward the development of the jet engine by General Electric. Later, he also held the position of Senior Vice President for Research and Engineering for Xerox, where he was responsible for those aspects of their main copier product line. Dr. Tribus left Xerox to join the Massachusetts Institute of Technology. While at MIT, he served as the Dean of the Thayer School of Engineering (Dobyns et al., 1991b) and, for twelve years ending in 1986, he also served as Director of MIT's Center for Advanced Engineering Study. Dr. Tribus also held other significant academic positions. For eight years, he was Dean of Engineering, Dartmouth College (Main, 1994) where he lead the faculty in developing a curriculum based on engineering design and entrepreneurship. He was also on faculty for sixteen years at UCLA within the College of Engineering as well as at the University of Michigan for two years. Dr. Tribus also served for two years as Assistant Secretary for Science and Technology in the U. S. Department of Commerce under the Nixon Administration. For twelve years, Dr. Tribus was a Partner and Director of Research for Exergy, Incorporated, specializing in the

design of advanced, high-efficiency, geothermal power production systems. The U.S. Department of Energy reported that Exergy technology doubled the amount of land that may be used for geothermal production. Ultimately, General Electric purchased worldwide rights to Exergy technology. Dr. Tribus also founded the American Quality and Productivity Institute (APQI), which was devoted to teaching and promoting the fundamentals of quality management. AQPI eventually merged to form the Community Quality Council (CQC), an organization with the aim of fostering the growth and development of community quality centers throughout the United States. CQC was ultimately absorbed by the Association for Quality and Participation (AQP), which continues the CQC mission. Prior to his interest in the Deming philosophy, Dr. Tribus published over 100 papers on topics ranging from academic subjects such as heat transfer, fluid mechanics, probability theory, statistical inference and thermodynamics to applied topics such as sea water demineralization, aircraft heating, aircraft ice prevention and the design of engineering curricula. He worked with Nobel Prize winner Irving Langmuir during his cloud-seeding research. Dr. Tribus has also published and lectured on topics of social interest such as the position of engineers in politics, the decline of US competitiveness in world trade, the role of decision theory in political decision making and the role of technology in society. Dr. Tribus has also published several groundbreaking technical books including *Rational descriptions, decisions and designs* (Tribus, 1996b) and *Thermostatics and thermodynamics* (Tribus, 1969). In 1993, Dr. Tribus received the Distinguished Service Award from the National Society of Professional Engineers. Dr. Tribus currently devotes his attention to the improvement of K-12 education through the integration of the Deming philosophy with principles of

cognitive modifiability developed by Dr. Reuven Feuerstein. Dr. Tribus has also been an active participant of, and speaker at, various Deming conferences. He holds a B.S., Chemistry from the University of California, Berkeley and a Ph.D., Engineering from UCLA. He holds two other honorary doctorates as well.

Michael Tveite, Ph.D. Dr. Tveite had frequent opportunities to learn from Dr. Deming helping Deming with 25 of his famous Four-Day Seminars and accompanying Dr. Deming on consulting visits between 1986 and 1993. He is mentioned by name twice within *The new economics for industry, government, education* (Deming, 1994). He consulted Deming methods for fourteen years under the auspices of the now-defunct Minneapolis-based Tetrad Group, which he founded. Dr. Tveite serves on the Board of Trustees of the W. Edwards Deming Institute as well as the Board of Advisors of the Deming Scholars MBA program at Fordham University. He has presented at eleven OQPF conferences. Since February, 2000, Dr. Tveite holds the position of Acting Director of Quality for Polaris Industries, a Minnesota-based snowmobile manufacturer. Dr. Tveite holds Ph.D. and M.S. degrees in statistics from Iowa State University, and an undergraduate degree in mathematics from St. Olaf College.

Frank Voehl. Mr. Voehl first met Dr. Deming in the late 1960s when he was a student at St. John's University, where one of Dr. Deming's "disciples," Dr. Jean Namias, mentored Mr. Voehl in statistics. During the 1970s and 1980s, Voehl attended, and sometimes assisted, Dr. Deming with his seminars, and made personal visits to Dr. Deming at his New York City apartment. Over the years, Mr. Voehl enjoyed the privilege of many conversations with Deming on various aspects of his philosophy. Mr. Voehl was the former Chief Operating Officer of Florida Power & Light's (FPL) Quality Services

Department, and was instrumental in FPL's decision to pursue the Deming Prize, and FPL became the first American company to take the prize. The FPL Quality Management system, developed by Mr. Voehl's office, became the initial basis for the Malcolm Baldrige National Quality Award. After Dr. Deming's passing, Mr. Voehl authored *Deming: The way we knew him* (Voehl, 1995), a book that contains tributes to Deming from many of his closest associates. Mr. Voehl developed close relationships with two other Deming subject matter experts, Dr. Myron Tribus and Mary Walton, author of the popular *The Deming management method* (Walton, 1986) and the follow-up book *Deming management at work: Six successful companies that use the quality principles of the world-famous W. Edwards Deming* (Walton, 1990a). Mr. Voehl was also well acquainted with Dr. Deming's first graduate student, Ernie Kurnow, as well as his last graduate student, Maureen Glassman. Mr. Voehl assisted another Deming advocate, Lou Schultz, with the transferal of the Deming philosophy into South American regions. Currently, Mr. Voehl is the President and CEO of Strategy Associates, which consults with a quality, continuous improvement and teamwork focus. He is the National Chair of ASQ's Community Quality Council Technical Committee and is a visiting professor at Florida International University and the University of Miami. Mr. Voehl holds an undergraduate degree from St. John's University; he did his graduate studies at both NYU and Columbia. His academic background is in industrial engineering, math, philosophy, and law.

Mary Walton. Ms. Walton as the author of two books that are the most successful popularizations of the Deming philosophy, *The Deming management method* (Walton, 1986), which has sold more than 250,000 copies, and *Deming management at work: Six*

successful companies that use the quality principles of the world-famous W. Edwards Deming (Walton, 1990a). Other Deming-related publications by Ms. Walton include "The Deming management method: A bedrock philosophy comes home" (Walton, 1990b). Ms. Walton is also the author of *Car: A drama of the American workplace* (Walton, 1997), that documents the 1996 redesign of the Ford Taurus based upon an unprecedented access to Ford Motor Corporation; Ms. Walton was likely granted such access based upon Ford's prior relationship with Dr. Deming. She is a former reporter for the *Philadelphia Inquirer* and lives in Ocean Grove, New Jersey.

John O. Whitney. Since 1987, Mr. Whitney has been Professor of Management and Executive Director of W. Edwards Deming Center for Quality, Productivity and Competitiveness at Columbia Business School. In 1994, he authored *The trust factor: Liberating profits & restoring corporate vitality* (Whitney, 1994), a book that advocates employee trust in the manner so advocated by Dr. Deming; the book contains a forward By Dr. Deming. He is mentioned by name at page 44 of *The new economics for industry, government, education* (Deming, 1994). Previously, Mr. Whitney was, for six years, a member of the faculty and Associate Dean at Harvard Business School. Mr. Whitney holds an A.B. from the University of Tulsa.

Dr. Kosaku "Ko" Yoshida. Dr. Yoshida studied under Dr. Deming at New York University and spoke at many of his Four-Day Seminars. He is quoted and mentioned by name on page 75 of Deming's *The new economics for industry, government, education* (Deming, 1994). Dr. Yoshida is included in the list of recommended Deming consultants maintained by the Deming Cooperative. His Deming-related publications include "The Deming approach to education: A comparative study of the USA and Japan" (Yoshida,

1994), “Revisiting Deming’s Fourteen Points in light of Japanese business practices,” (Yoshida, 1996) and “Deming management philosophy: Does it work in the US as well as in Japan?” (Yoshida, 1989) Dr. Yoshida has consulted the Deming theory of management in order to improve the quality, productivity and competitive position of companies such as Hughes Aircraft, PEMEX, and Baxter Healthcare and the governments of the United States, the State of California and the County of Sacramento, California. He has spoken on Demingism at numerous organizations including AT&T, Loral Aerospace, Brown and Root, Unisys, Tandem Computers, Toyota, NEC and Tokyo Electric Power. Dr. Yoshida has presented his Deming-oriented Three-Day Joy of Work Seminar throughout the United States, Mexico, South America, India and the United Kingdom. He has also been was invited by the Chinese government to give lectures on quality improvement in Beijing and Shanghai. He was an active mentor to the Deming Management Alliance Improvement Roundtable of Southern California and, from 1988 to 1992, served as Productivity Commissioner to the City of Los Angeles. Currently, Dr. Yoshida is Professor of Management in the Graduate School of International Management at Aoyama Gakuin University, where his instructional load includes a course in Deming Management Philosophy. He is also Professor Emeritus of Finance and Quantitative Methods, Department of Finance, School of Management, California State University, Dominguez Hills, where he taught from 1975 to 1999. He also is a member of the editorial advisory board of *The International Journal of Quality and Reliability Management*. Dr. Yoshida holds a Ph.D. from New York University, an M.B.A. from the University of Montana as well as an undergraduate degree from Waseda University.

APPENDIX B

DEMING EXPERTS' POINTS OF CONTACT

The following data represents the best known points of contacts for the Deming subject matter experts initially selected for this study. These points of contact were almost entirely compiled from public sources (e.g., white pages, conference attendance rosters, biographical sketches, etc.) Certain points of contact, determined only after the completion of the data collection phase of this study, were still included in this appendix toward completeness.

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APPENDIX C

BALDRIGE EXPERTS' POINTS OF CONTACT

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APPENDIX D

SURVEY COVER LETTERS

Deming Expert Cover Letter

Dear Deming Subject Matter Expert:

As you may know, I have taken a very strong interest in the Deming philosophy, have attended a number of Deming conferences and have included much Deming content in the courses that I instruct. I would now like to begin, via my doctoral dissertation, to conduct academic research about the Deming philosophy. Due to your expertise with the Deming philosophy, **you were individually and specifically selected** to participate in this study which aims to better understand the work environment expected within organizations that practice the Deming philosophy.

Your response is very, very important to this study. Unlike many research surveys that are sent out at random to thousands of individuals, this survey is being sent to only about fifty individuals, those individuals thought to have nothing less than the very, very best understanding of the Deming philosophy. This makes every response—that is, ***your response***—extremely important in order to accurately represent the philosophy of Dr. Deming as it is understood by individuals such as yourself who worked so closely with him.

The Work Environment Scale survey contains only true/false questions and usually takes less than fifteen minutes to complete. Please answer all of the questions in the Work Environment Scale survey as though you were describing the ideal (or a very good) Deming organization. Some of the questions will appear very relevant to the Deming philosophy, while others may seem less relevant. Nevertheless, please be sure to answer every statement within the Work Environment Scale survey.

The completion time for the open response questions will vary somewhat and depends on the length of your responses. An addressed, stamped envelope is included for your convenience. You also may fax the completed survey to my attention at 319.273.2922. Any survey participant may receive a copy of the study results upon request.

All data gathered will be held in the strictest of confidence. Data analysis will be that of a summarized nature from the entire survey group and will not reference any specific individuals or organizations. I would, however, like to include you in an annotated appendix that lists the Deming experts that participated in this survey, unless you object.

If you have any questions, please contact me at 319.273.6380. You may also Email me at Tony.Polito@uni.edu. Thank you very much for your time, effort and interest. I look forward to receiving your response.

Sincerely,

Tony Polito

For questions or problems about your rights please call or write: Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone: 706.542.6514; E-Mail Address: IRB@uga.edu.

Baldrige Award Senior Examiner Cover Letter

Dear Baldrige Award Subject Matter Expert:

Thank you in advance for your participation in this study to better understand the work environment expected within organizations that practice according to the Baldrige criteria.

Your response is very, very important to this study. Unlike many research surveys that are sent out at random to thousands of individuals, this survey is being sent to only about fifty individuals, those individuals thought to have nothing less than the very, very best understanding of the Baldrige Award criteria. This makes every response—that is, ***your response***—extremely important in order to accurately represent the nature of the Baldrige Award.

The Work Environment Scale survey contains only true/false questions and usually takes less than fifteen minutes to complete. Please answer all of the questions in the Work Environment Scale survey as though you were describing the ideal (or a very good) Baldrige Award winning company. Some of the questions will appear very relevant to the Baldrige Award criteria, while others may seem less relevant. Nevertheless, please be sure to answer every statement within the Work Environment Scale survey.

An addressed, stamped envelope is included for your convenience. You also may fax the completed survey to my attention at 319.273.2922. Any survey participant may receive a copy of the study results upon request.

All data gathered will be held in the strictest of confidence. Data analysis will be that of a summarized nature from the entire survey group and will not reference any specific individuals or organizations. I would, however, like to include you in an annotated appendix that lists the Baldrige Award winners/judges that participated in this survey, unless you object.

If you have any questions, please contact me at 319.273.6380. You may also Email me at Tony.Polito@uni.edu. Thank you very much for your time, effort and interest. I look forward to receiving your response.

Sincerely,

Tony Polito

For questions or problems about your rights please call or write: Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411; Telephone: 706).542.6514; E-Mail Address: IRB@uga.edu.

APPENDIX E

WES SURVEY QUESTIONS

Below are listed, at the request of the committee, the ninety questions that comprise the Work Environment Scale instrument. The units' digit of each question identifies the construct with which it is associated, according to the following crossover table:

WES Subscale	Units' Digit
Involvement	1
Coworker Cohesion	2
Supervisor Support	3
Autonomy	4
Task Orientation	5
Work Pressure	6
Clarity	7
Managerial Control	8
Innovation	9
Physical Comfort	20

1. The work is really challenging.
2. People go out of their way to help a new employee feel comfortable.
3. Supervisors tend to talk down to employees.
4. Few employees have any important responsibilities.
5. People pay a lot of attention to getting work done.
6. There is constant pressure to keep working.
7. Things are sometimes pretty disorganized.
8. There's a strict emphasis on following policies and regulations.
9. Doing things in a different way is valued.
10. It sometimes gets too hot.
11. There's not much group spirit.
12. The atmosphere is somewhat impersonal.

13. Supervisors usually compliment an employee who does something well.
14. Employees have a great deal of freedom to do as they like.
15. There's a lot of time wasted because of inefficiencies.
16. There always seems to be an urgency about everything.
17. Activities are well-planned.
18. People can wear wild looking clothing while on the job if they want.
19. New and different ideas are always being tried out.
20. The lighting is extremely good.
21. A lot of people seem to be just putting in time.
22. People take a personal interest in each other.
23. Supervisors tend to discourage criticisms from employees.
24. Employees are encouraged to make their own decisions.
25. Things rarely get "put off till tomorrow."
26. People cannot afford to relax.
27. Rules and regulations are somewhat vague.
28. People are expected to follow set rule in doing their work.
29. This place would be one of the first to try out a new idea.
30. Work space is awfully crowded.
31. People seem to take pride in the organization.
32. Employees rarely do things together after work.
33. Supervisors usually give full credit to ideas contributed by employees.
34. People can use their own initiative to do things.
35. This is a highly efficient, work-oriented place.

36. Nobody works too hard.
37. The responsibilities of supervisors are clearly defined.
38. Supervisors keep a rather close watch on employees.
39. Variety and change are not particularly important.
40. This place has a stylish and modern appearance.
41. People put quite a lot of effort into what they do.
42. People are generally frank about how they feel.
43. Supervisors often criticize employees over minor things.
44. Supervisors encourage employees to rely on themselves when a problem arises.
45. Getting a lot of work done is important to people.
46. There is no time pressure.
47. The details of assigned jobs are generally explained to employees.
48. Rules and regulations are pretty well enforced.
49. The same methods have been used for quite a long time.
50. The place could stand some new interior decorations.
51. Few people ever volunteer.
52. Employees often eat lunch together.
53. Employees generally feel free to ask for a raise.
54. Employees generally do not try to be unique and different.
55. There's an emphasis on "work before play."
56. It is very hard to keep up with your work load.
57. Employees are often confused about exactly what they are supposed to do.
58. Supervisors are always checking on employees and supervise them very closely.

59. New approaches to things are rarely tried.
60. The colors and decorations make the place warm and cheerful.
61. It is quite a lively place.
62. Employees who differ greatly from the others in the organization don't get on well.
63. Supervisors expect far too much from employees.
64. Employees are encouraged to learn things even if they are not directly related to the job.
65. Employees work very hard.
66. You can take it easy and still get your work done.
67. Fringe benefits are fully explained to employees.
68. Supervisors do not often give in to employee pressure.
69. Things tend to stay just about the same.
70. It is rather drafty at times.
71. It's hard to get people to do any extra work.
72. Employees often talk to each other about their personal problems.
73. Employees discuss their personal problems with supervisors.
74. Employees function fairly independently of supervisors.
75. People seem to be quite inefficient.
76. There are always deadlines to be met.
77. Rules and policies are constantly changing.
78. Employees are expected to conform rather strictly to the rules and customs.
79. There is a fresh, novel atmosphere about the place.

80. The furniture is usually well-arranged.

81. The work is usually very interesting.

82. Often people make trouble by talking behind other's backs.

83. Supervisors really stand up for their people.

84. Supervisors meet with employees to discuss their future work goals.

85. There's a tendency for people to come to work late.

86. People often have to work overtime to get their work done.

87. Supervisors encourage employees to be neat and orderly.

88. If an employee comes in late, he can make it up by staying late.

89. Things always seem to be changing.

90. The rooms are well ventilated.

APPENDIX F

OPEN RESPONSE QUESTIONS FOR DEMING EXPERTS

1. What are the top three reasons effecting failure of Deming prescription in cases where it has failed?
2. What are the three biggest problems encountered in implementing the Deming prescription?
3. What percentage of the Deming philosophy do you believe is addressed by the preceding survey instrument?
4. Which of the questions in the preceding survey instrument (the Work Environment Scale) must be answered true for a Deming company?
5. What are the expected outcomes of traditional measures under the Deming philosophy?
6. Could you please outline your significant contact with Dr. Deming and/or his philosophy? Such information will serve to validate your inclusion as a Deming subject matter expert to those who are less familiar with the Deming community.

The sole purpose of Question 6 is to gather information for use in Appendix A. Accordingly, its responses are not tabulated in any manner within the data analysis.