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THESIS

A STUDY AS TO THE FEASIBILITY OF THE
DEPARTMENT OF DEFENSE MANDATING ITS SUPPLIER
BASE ADOPT TOTAL QUALITY MANAGEMENT

by

Donald J. Reiter

December 1989

Thesis Advisor:

E. Neil Hart

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A Study as to the Feasibility of the Department of Defense
Mandating its Supplier Base Adopt Total Quality Management

by

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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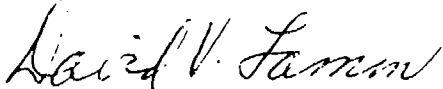


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ABSTRACT

The purpose of this thesis is to study the issues surrounding whether DoD can successfully mandate its supplier base adopt Total Quality Management (TQM), or an equivalent quality-oriented management philosophy. Hewlett-Packard and Motorola, Inc., two firms currently requiring their suppliers adopt a quality-focused management philosophy, were studied. The researcher determined that DoD could successfully mandate its supplier base adopt TQM provided the following infrastructure was in place and well established prior to the mandate: adequate in-house experience and expertise; comprehensive supplier training program; supplier performance tracking capability; comprehensive supplier quality audit procedure; formal joint DoD-industry TQM council; and congressional support.

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I. INTRODUCTION

A. BACKGROUND

There is hereby established a government-wide program to improve the quality, timeliness, and efficiency of services provided by the Federal Government. The goal of the program shall be to improve the quality and timeliness of service to the public and to achieve an average annual productivity increase of three percent in appropriate functions. Each Executive department and agency will gradually include appropriate functions in the Productivity Improvement Program, so that by 1991 all appropriate functions are covered. (President Ronald Reagan, Executive Order 12637)

The above Executive Order superseded Executive Order 12552 which initially laid out the President's productivity objectives. Based on the original Executive Order, Secretary of Defense Carlucci, in a memorandum dated March 30, 1988, placed,

...top priority to the DoD Total Quality Management (TQM) effort as the vehicle for attaining continuous quality improvement in our operations....Quality in weapons systems is central to the DoD mission. Therefore I have asked the Under Secretary of Defense for Acquisition to lead the TQM thrust by implementing it as an integral element of the entire acquisition process....He will develop the policies and seek the appropriate Federal Acquisition Regulation and other regulatory changes to ensure that TQM is enforced in requirements formulation, design, development, production planning, solicitation and source selection, manufacturing, fielding, and support. (DoD TQM Handout, p. i)

With this guidance, the Under Secretary of Defense for Acquisition (USD/A), as well as other key DoD leaders, initiated a DoD TQM awareness drive by publishing numerous articles in military and private industry publications. These articles espoused the TQM philosophy; including the numerous

potential benefits possible through TQM, the founders of the philosophy, Dr. W. Edwards Deming, Dr. Genichi Taguchi, Joseph M. Juran, and others, as well as its application to DoD.

TQM can be defined as a philosophy that stresses continued performance improvement of all processes, through an all hands commitment, especially top management, to quality improvement. One of TQM's primary tools, statistical process control (SPC), was originally practiced in the United States during World War II. Due primarily to the United States's domination of many of the world markets following WWII, the use of SPC fell out of use. It simply was easier to use intuition and subjective judgment to make business decisions instead of using quantitative methods such as SPC.

Shortly thereafter, in June 1950, while in Toyko, Dr. Deming introduced TQM to a standing room only crowd of over 500 Japanese industrialists, engineers, and businessmen. Japan quickly embraced Dr. Deming's teachings, channeling their formidable talents and will towards becoming one of the world's leading industrial, manufacturing, and financial powers.

By 1980, numerous U.S. companies were standing up and taking notice as Japan was slowly but surely winning over market share at the U.S. firms' expense. Companies, such as Nashua Corporation, Ford, and General Motors, then recruited Dr. Deming to help implement the TQM philosophy in their respective companies. All three companies, as well as

countless others, have realized substantial gains in productivity through the implementation of the TQM process.

DoD does not have to face the economic competitiveness of private industry, however, recent cutbacks in the defense budget in the last three years, has required DoD to make some very tough decisions. DoD has decided to address this funding problem with increased efficiency and productivity, through the implementation of TQM.

One of the basic tenets of TQM is an organization should be able to control the quality of materials it receives from its suppliers. Thus, it is imperative that DoD develop effective methods, within the TQM framework, to motivate the defense industry to embrace the concepts of continuous process improvement through SPC and other TQM principles. Although there now exists a considerable amount of written material on TQM and its relationship with DoD, policy on exactly how to motivate contractors to adopt its principles is still being developed.

Many DoD senior officials feel the best approach to incentivizing private industry to adopt TQM would be to incorporate TQM criteria into the source selection criteria, a time when competition should aid in the selection of the best contractor for the job. Other senior officials, as well as industry leaders, have indicated any approach to mandate TQM to its supplier base would fail. This thesis will be a

scholarly analysis of the various issues surrounding this controversy.

B. OBJECTIVE AND RESEARCH QUESTIONS

1. The Objective

This thesis will explore the issues surrounding DoD mandating suppliers to adopt TQM or an equivalent quality-oriented management philosophy. My objective will be to analyze the key factors relating to the above issues and arrive at a conclusion as to whether DoD can successfully mandate TQM to its supplier base.

2. The Research Questions

The following research questions will be addressed.

a. Primary Research Question

Can DoD successfully mandate its supplier base adopt TQM or an equivalent quality-oriented management philosophy?

b. Subsidiary Questions

- What issues, facing DoD and the defense industry, can TQM address?
- Can a business/organization successfully mandate its supplier base adopt TQM or an equivalent quality-oriented management philosophy?
- Which essential element(s) of TQM might be incorporated into the source selection process?

C. SCOPE OF EFFORT

This thesis will focus on examining the issues surrounding whether DoD can successfully mandate its supplier base to

adopt TQM or equivalent quality-focused effort. This thesis can be classified as a study of a policy problem. Although the researcher attempted to refrain from delving too deeply into the specific technical aspects of TQM, certain pertinent points required a moderate level of detail.

D. METHODOLOGY

The methodology of this thesis included a comprehensive examination of current literature and interviews with numerous DoD civilian and military personnel, as well as personnel from private industry, representing various levels of contracting and the TQM implementation process, i.e., acquisition policy development, contracting personnel, TQM researchers, implementors, etc.

An exhaustive review of current literature was carried out on both the areas of TQM and quality. This review of literature involved conducting several computer data base searches including, Defense Logistics Studies Information Exchange (DLSIE), Defense Technical Information Center (DTIC), National Technical Information System (NTIS), and Defense RDT&E On-Line System (DROLS).

A data collection trip was made to Washington D.C. primarily to interview key DoD civilians and military involved with acquisition and TQM policy formulation. Interviews were conducted with: Mr. Gerry Hoffmann, Specification Control Advocate General of the Navy; personnel from his office;

personnel from the Office of the Assistant Secretary of Defense (Production and Logistics); RADM William R. Morris, SC, USN, NAVAIR 02 (Contracting); and Mr. Ray Malentino, Special Assistant for TQM to NAVAIR 51. The trip allowed me access to up-to-the-minute policy that is currently in development, as well as a substantial amount of printed matter on the issues not yet available through conventional means.

Interviews were also conducted with personnel from Hewlett-Packard and Motorola, Inc., the two firms used in the research effort.

E. LIMITATIONS AND ASSUMPTIONS

1. Limitations

The basis of this thesis is an intensive six-month study of TQM and its applicability as a requirement in the source selection criteria. This study involved a comprehensive review of literature, as well as numerous interviews. Additionally, the researcher was first exposed to TQM during his 1986 to 1988 tour at the Naval Supply Center (NSC), San Diego, CA. Although his experience was limited to that of middle management; exposure to the cultural transformation, which is inherent in any TQM implementation process, has provided the researcher with valuable insight.

This thesis will not discuss the numerous issues surrounding the legal implications of incorporating elements of TQM in the source selection process such as, the

Competition in Contracting Act's (CICA) requirement for full and open competition versus TQM's close seller-buyer relationship. Rather, it will concentrate on the feasibility of successfully requiring DoD's suppliers to adopt TQM or an equivalent philosophy.

2. Assumptions

Although Chapter II provides a discussion of key TQM concepts, the researcher assumes the reader is familiar with the basic tenets of the TQM philosophy. A reader who is not familiar with TQM will have to look elsewhere for an in-depth explanation of the theory, principles, and tools of TQM.

The benefits of this study will be the additional information arrived at concerning motivating contractor involvement in TQM. This may prove valuable in the formulation of current, as well as future policy.

F. ORGANIZATION OF THE STUDY

This research effort is organized into six chapters. Chapter I provided an introduction to the subject matter. Additionally, Chapter I discussed: The objective of thesis, the primary and subsidiary research questions, the scope of the thesis, the methodology employed by the researcher, and the limitations and assumptions involved with this effort. Chapter II discusses three key areas: The first section provides an analysis of quality from the perspective of both industry and Government; the second section offers a

discussion of select TQM concepts; and the third section presents an analysis of the issues facing DoD and the defense industry and the applicability of TQM in helping resolve those issues. Chapter III provides a discussion of DoD's source selection process. Chapter IV presents the researcher's findings of how two large firms have incorporated a quality-oriented philosophy in their selection of suppliers. Chapter V provides an analysis of the industry findings and their relevance to DoD's source selection policy. The last chapter, Chapter VI, presents the researcher's final conclusions and recommendations.

II. TOTAL QUALITY MANAGEMENT

Total Quality Management is the key phrase....Dick Cheney [Secretary of Defense] supports it, I support it, I know John Betti [Under Secretary of Defense for Acquisition] supports it, and I hope everybody in this Department gets behind it because we're going to force this issue all the way down until we in the Department of Defense adopt it and bring to bear products which truly represent the finest in the world. (Atwood)

A. INTRODUCTION

The purpose of this chapter is threefold: First, the concept of quality is discussed from industry's point of view, as well as from the Department of Defense (DoD); secondly, a general discussion of TQM and its key principles is presented; and lastly, a discussion of the issues confronting DoD and the defense industry, and the applicability of TQM in helping resolve those issues is addressed.

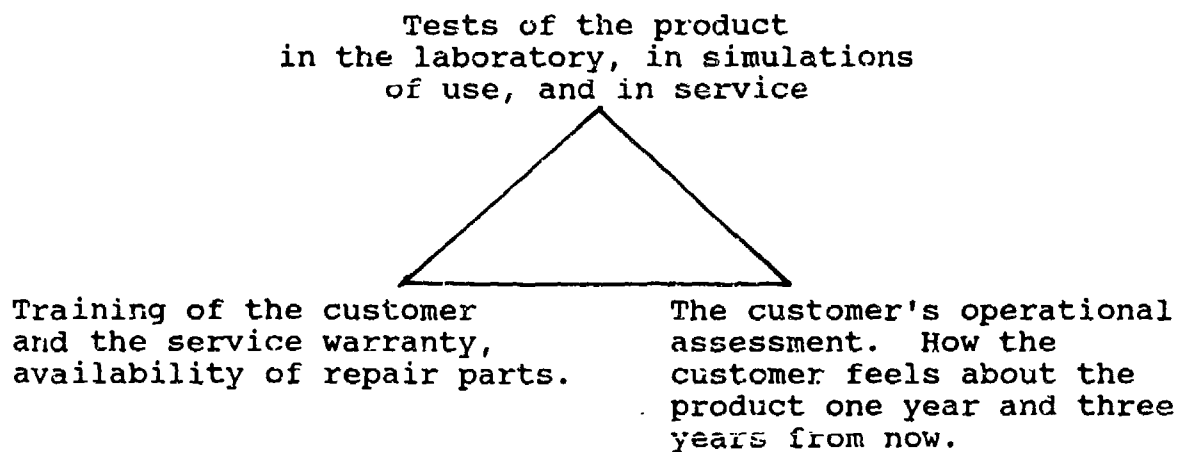
B. QUALITY FROM AN INDUSTRY PERSPECTIVE

Although there is no single, universally-accepted definition of quality, many acknowledged experts on the subject, such as W. Edwards Deming, Philip B. Crosby, Genichi Taguchi, and Joseph M. Juran, agree that quality means, at a minimum, meeting the requirements of the customer. Dr. Deming further states that a buyer simply listing his requirements in the form of specifications will not give the potential

supplier enough insight to provide the buyer with a satisfactory product.

This will mean...continued movement towards one supplier, for any one item, so far as possible. Because of one thing, you don't have knowledge nor manpower to work with two when you can't even work with one. (Walton, p. 29)

Dr. Deming uses a triangle to define the three corners of quality (see Figure 2-1). He states quality should be measured by the interaction of: the product; the customer and how he uses the product; and lastly, instructions for use of the product, training of the servicer, and availability of parts. (Deming, p. 177)



Source: (Deming, p. 177)

Figure 2-1 The Three Corners of Quality

1. Five Approaches to Quality

Mr. David A. Garvin presents a more in-depth, detailed view of quality when he states there are five major approaches to quality:

- the transcendent approach of philosophy;
- the product-based approach of economics;
- the user-based approach of economics, marketing and operations management;
- the manufacturing-based approach of operations management; and
- the value-based approach to operations management.
(Garvin, 1984, pp. 25-43)

The transcendent approach defines quality as "innate excellence." Quality is further defined by this approach as an ambiguous property that is learned through experience and possesses both an absolute and universally recognizable set of inflexible standards.

The product-based approach emphasizes differences in quality. This approach usually focuses on the quantity of some desired component or attribute which makes up the product, such as the number of knots per inch in an oriental rug, the greater the number, the higher the quality.

The user-based approach is very subjective and is based on the premise that quality lies in the eyes of the beholder. One major problem with this approach is how to aggregate widely varying views so that a meaningful definition of quality can emerge.

As a contrast to the user-based definition of quality, the manufacturing-based approach defines quality as conformance to specifications. Once a deviation occurs from these specifications a decrease in quality results. A decrease in quality means more rework, scrap, and warranty expenses.

The value-based approach takes the manufacturing-based approach definition one step further. The value-based approach incorporates cost into the manufacturing-based approach. Thus, we have a quality product when it meets the specifications at an acceptable price. A recent consumer survey supports that a value-based view is becoming more popular.

Dr. Garvin's discussion of the varied perceptions of quality helps explain why the various departments within a large firm view quality differently, such as, marketing and manufacturing. The marketing people will generally view quality from a user- or product-based perspective. From this vantage point quality relates to more features, enhanced performance, and higher cost. The manufacturing group, however, would tend to view quality from a manufacturing-based approach emphasizing conformance to specifications.

Dr. Garvin further suggests that a firm should shift their perspective of quality as the product evolves from the design to market stage. During its conception stage, the characteristics which describe quality should be determined

by adequate communication with the customer. This market survey approach is closely related to the user-based approach. These characteristics must then be converted into specific product attributes suggesting a product-based approach. These attributes are then translated, by manufacturing, into specifications. Dr. Garvin states that if the three steps are not carefully followed, the firm most likely will have a product deficient in quality. (Garvin, 1984, pp. 26-32)

2. Eight Dimensions of Quality

Dr. Garvin, in his same article, identifies eight dimensions of quality. They are as follows.

a. Performance

Performance refers to the primary operative characteristics of the product, such as tonal clarity and volume for a stereo set. Brands can usually be judged objectively on at least one of the primary operating characteristics.

b. Features

Features refer to the various options that can be applied to the product. The difference between a feature- and a primary-operating characteristic is the degree of importance to the user.

c. Reliability

Reliability, typically measured by the mean-time-to-first-failure (MTFF) or the mean-time-between-failures

(MTBF), reflects the probability of the product's failure within a set time frame.

d. Conformance

Conformance refers to the degree to which the product meets pre-established standards. Internal, as well as external elements are involved in this dimension of quality. Internal elements are usually referred to as incidence of defects; the proportion of units that do not meet specification while still on the factory floor, and require some level of rework or repair. External elements can be measured in two ways: incidence of service calls and frequency of repairs under warranty. Improvements in the area of conformance and reliability have generated genuine gains in quality because field failures are regarded as undesirable by virtually all customers.

e. Durability

Durability of a product can be affected by the product's technical aspects, as well as the economic environment. Durability may refer to the amount of use the customer enjoys before it fails and replacement is preferred instead of repair. The economic situation can influence the length of time a product is kept in service, such as, in an economic downturn, it is common to see consumers hang on to their cars longer, versus during a stronger economic environment, when larger purchases are made.

f. Serviceability

Serviceability can be defined as the speed, courtesy, and competence of repair. The speed of repair is typically measured in mean-time-to-repair (MTTR), whereas the competence of repair factor can be derived from the frequency of multiple service calls to repair the same problem.

g. Aesthetics

The aesthetics dimension of quality deals primarily with how the product interacts with the senses; how it feels, smells, looks, tastes, and sounds.

h. Perceived Value

The perceived value of a product refers to the numerous indirect associations the customer may have with the product, such as the image of the producer or quality of the product's advertising. This facet of quality and the aesthetics dimension of quality are the most subjective and, accordingly, the most difficult to measure.

Although the eight dimensions of quality cover a full range of concepts, the diversity of the concepts assists the reader in understanding the five traditional approaches (see Table 2-1). "Understanding the distinctions of the eight dimensions of quality and how they relate to the evolution of the product; from design stage to the market stage, is critical if the firm is to more fully utilize quality to its benefit." (Garvin, 1984, pp. 25-43)

TABLE 2-1

RELATIONSHIP OF THE FIVE DEFINITIONS OF QUALITY
AND THE EIGHT DIMENSIONS OF QUALITY

<u>Definitions of Quality</u>	<u>Dimensions of Quality</u>
Transcendent Definition	Aesthetics Perceived Quality
Product-Based Definition	Performance Features Conformance
User-Based Definition	Aesthetics Perceived Quality
Manufacturing-Based Definition	Conformance Reliability Durability
Value-Based Definition	Conformance Reliability Serviceability

To understand how quality is measured in today's corporations, it is valuable to look at how the measurement of quality has evolved over time.

3. Four Phases of Quality

Quality control has undergone a transformation over the last 200 years, which can be categorized into four phases. (Garvin, 1983, pp. 65-75)

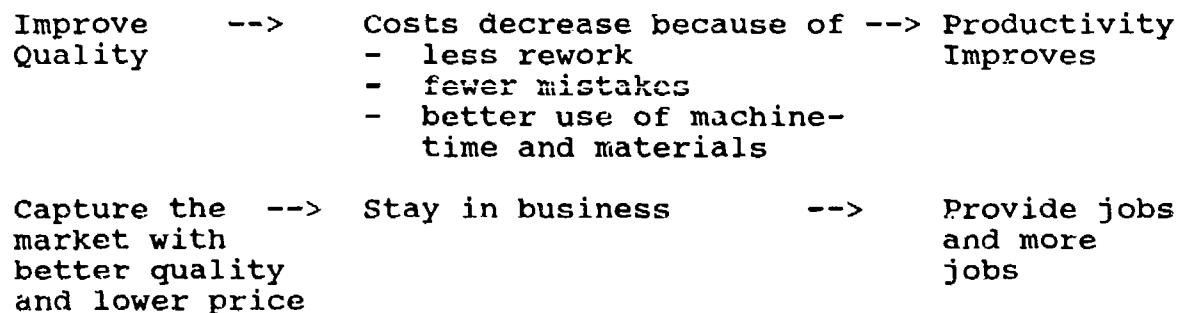
The first phase, called the Inspection Era, occurred during the 18th and 19th centuries. As can be derived by its title, the Inspection Era relied heavily on:

- determining a standard;
- developing a process that resulted in products with close conformance to the standard; and

- verifying the conformance through end of production line sampling.

The second phase, called the Statistical Quality Control Era, was largely attributed to the teachings of Walter A. Shewhart. It was this soft-spoken statistician from Bell Laboratories who initially defined the basic principles of statistical process control (SPC). Dr. Deming who was strongly influenced by Shewhart's findings, stated in his book, Out of the Crisis: "The results [of Shewhart's book Economic Control of Quality of Manufactured Product] were exciting, showing that production does indeed improve as variation is reduced...." (Deming, p. 3)

Partly as a result of Shewhart's literature on quality and Dr. Deming's teachings, a chain reaction diagram (see Figure 2-2) was created and "as on the blackboard of every meeting with [Deming and] top management in Japan from July 1950 onward." (Deming, p. 3)



Source: (Deming, p. 3)

Figure 2-2 Improvements Resulting from Quality

The third era, identified as the Quality Assurance Era, occurred roughly from 1955 to the 1960's. Numerous QA concepts emerged as a result, such as Total Quality Control and Zero Defects. Emphasis was slowly turning towards methods of prevention rather than detection of quality deficiencies.

The fourth and last phase is called the Strategic Management Era. This phase is primarily the continuing development and maturation of the philosophy called Total Quality Management (TQM). TQM is a management philosophy which emphasizes continuous process improvement through active involvement of everyone in an organization. The results of these all-hands efforts to continuously improve the processes of the firm, are to reduce the number of defects, lower product prices, and become more competitive. This, in turn, increases market share, boosts profits, and improves future competitive position (see Figure 2-2). TQM will be discussed more fully in the following section. (Strickland, pp. 17-21)

4. Current Erroneous Views of Quality

Although quality control management philosophy has undergone a phenomenal transformation over the past two centuries, the majority of American firms' general attitudes towards quality reflects erroneous views which were popular over 30 years ago. (Crosby, pp. 17-23)

a. Quality Means Goodness or Luxury

Quality means goodness or luxury is used to project a relative value to a product or idea, such as

"quality of life." The problem is that no one really knows what that relative value really is. It is undefined and immeasurable. However, by defining quality as "conformance to requirements" management can define it in such a way that is can be measured, and thus, controlled.

b. Immeasurability

The second misperception of quality is that it is intangible and, accordingly, immeasurable. However, quality can be measured by the expenses resulting from nonconformance, commonly referred to as the "costs of quality." Juran explains that a firm "can spend 15 to 20 percent...[of its] sales dollar" on the costs of quality. (Juran and Gryna, p. 60)

A.V. Feigenbaum, in his book, Total Quality Control, Engineering and Management, indicates there are three major categories of quality costs.

(1) Prevention Costs. Prevention costs refer to the costs the firm will have to make to prevent costs from occurring, such as employee training in quality and quality control engineering.

(2) Appraisal Costs. Appraisal costs are those costs which a firm incurs trying to maintain the existing quality program. These costs include expenses for inspection, tests, and quality audits.

(3) Failure Costs. Failure costs are costs associated with defective materials and products which fail to

meet the company quality requirements. These costs include such elements as rework, scrap, and spoilage. (Feigenbaum, pp. 83-84)

Failure costs make up the lions share, approximately 70 percent, of the quality cost budget, whereas appraisal costs are approximately 25 percent. Generally, prevention costs only make up about five percent of the quality cost budget.

In a nut shell, this cost analysis suggests we've been spending our quality dollars the wrong way: A fortune down the drain because of product failures; another large sum to support a sort-the-bad-from-the-good appraisal screen to try and keep too many bad products from going to customers; and comparatively nothing for the true defect-prevention technology that can do something about reversing the vicious upward cycle of higher quality costs and less reliable product quality. (Feigenbaum, p. 84)

c. Affordability

The third erroneous assumption is that the firm can't afford to improve the quality of their product. This belief indicates they do not understand the concept of quality.

d. Origination of Problem

The fourth assumption of quality which is incorrect is that quality problems are originated by workers. In reality, only approximately 20 percent of defective products can be attributed to the line worker. Management, who actually "controls" the processes, is primarily responsible for the system, which equates to the remaining 80 percent. (Ishikawa, p. 75)

e. Responsibilities of Quality

The fifth erroneous assumption is that quality is the responsibility of the quality department. Quality is definitely an all-hands effort from the president of the firm to the part-time assembly worker. All workers can contribute substantially to the quality of the product. (Crosby, pp. 17-21) "But quality departments, wielding figures that show what happened in the past--not what will happen in the future, which they cannot predict--often mystify managers to the point that they continue to leave quality in the departments hands." (Walton, p. 38)

Dr. Deming, in his book, Out of the Crisis, painstakingly discusses costs involved in the various methods of testing for incoming material which are or could be employed by industry. The methods presented included 100 percent inspection, Joyce Orsini rules, Dodge-Romig average outgoing quality limit (AOQL), Dodge-Romig lot tolerance percentage defective (LTPD), and Military Standard 105D. His analysis revealed: "Any sampling plan whatever introduced initially with the aim to decrease the average incoming quality...will only increase above minimum the average total cost per item." (Deming, p. 430)

An organization which purchases material on an AOQL of three percent is telling their supplier they only want 97 percent deficient-free items. The only alternative is to strive for a defect-free incoming material line. Although a

100 percent defect-free incoming material line may never be a reality, through TQM, methods can be deployed to minimize the occurrence of purchasing defective material. (Deming, p. 428)

Dr. Ishikawa states that many firms in the United States "still consider inspection equals quality assurance." The ratio of inspectors to line workers in Japan is typically less than one-third the ratio used in American firms.

Many developing countries ship their products without imposing adequate inspection, knowing full well that these shipments contain many defects. Obviously they are still at the pre-quality control stage. (Ishikawa, p. 79)

C. QUALITY FROM A FEDERAL GOVERNMENT PERSPECTIVE

The Federal Government does not offer a specific, concise definition of quality in the Federal Acquisition Regulation (FAR), however, Part 46, entitled Quality Assurance, provides a general framework from which a reasonable definition can be derived. The FAR describes "control quality requirements" as the "technical requirements in the contract relating to the quality of the product or service and those contract clauses prescribing inspections...to assure that the product or service conforms to the contractual requirements." (FAR 41.101)

The operative phrase is "conforms to the contractual requirements." The FAR provides three general methods to administer quality assurance. The first method allows the government to rely on the contractor to perform the required inspection and testing needed to ensure the supplies "conform

to contract quality requirements." The second method involves the government's use of standard inspection requirements. The clauses which delineate those inspection requirements:

- Require the contractor to maintain an acceptable inspection system;
- Permit the government to conduct inspections and tests while work is in progress; and
- Mandates the contractor maintain a complete set of inspection records for government oversight. (FAR 46.202)

The third method involves procedures for purchases involving more complex and critical items [FAR 46.202]. The Department of Defense Federal Acquisition Regulation Supplement (DFARS) states the Military Specification MIL-Q-9858A contains the essential elements of an acceptable quality program for these more complex items. (DFAR 46.202) MIL-Q-9858A also requires contractors to be fully responsible for the quality of parts furnished by their suppliers. The Quality and Reliability Assurance Handbook (H50) provides guidance to personnel tasked with evaluating a contractor's quality program under MIL-Q-9858A. It indicates, throughout its 37 pages, that the primary method of ensuring conformance with the contractual requirements is by inspecting. (Quality and Reliability Assurance Handbook, pp. 1-37)

Portions of MIL-Q-9858A reflect more current thinking on quality control such as when it suggests use of statistical process control (SPC) to assist in maintaining "the required control of quality." However, for the most part, the primary

method of quality control is made up of various inspections and tests performed on the product after it has been manufactured. (MIL-Q-9858A, p. B-11)

In summary, it appears that DoD, for the most part, reflects the same inspect-at-the-end-of-the-assembly-line mentality concerning quality that is representative of the majority of American businesses. To be fair, DoD had adopted a number of programs which mirror the current trends in quality control in private industry, such as reliability engineering and value engineering. More recent efforts within DoD suggest an increasing awareness of the benefits that can be derived by increasing the emphasis on quality. These include the Navy's Red, Yellow, Green Program and the Army's Contractor Performance Certification Program (CP)², both of which attempt to recognize contractors who have proven they provide quality products. The Defense Logistics Agency's In-Plant Quality Evaluation (IQUE), which "focuses on measuring and continuously improving process quality" through SPC, is another example of efforts within DoD to employ more modern tools for purposes of upgrading quality. (DoD 5000.51G, pp. 34-88)

D. TOTAL QUALITY MANAGEMENT (TQM)

TQM is a philosophy which emphasizes continuously improving all processes by adhering to specific management principles and quantitative methods.

With Secretary of Defense Carlucci's signing of the March 1988 memorandum, DoD started the process to adopt the TQM philosophy. TQM primarily uses the teachings of Dr. Deming for its overall guidance, however, other quality experts, such as Dr. Juran and Philip Crosby, have also contributed to DoD's new quality position.

Dr. Juran's philosophy centers around three basic efforts: quality planning, quality control, and quality improvement. Quality planning involves establishing quality goals and developing a strategy to meet those goals. Quality control, the function of the operation's work force, focuses on use of quantitative methods to control process variation. Quality improvement aims at constantly outperforming the past through methods such as process control and project team problem solving. (Juran and Gryna, p. 410)

Philip Crosby's efforts focus on systemized quality improvement using a 14-step process. These steps emphasize quality improvement principles such as management commitment to quality improvement, controlling the process through quantitative methods, and goal setting. (Crosby, pp.132-9)

Dr. Deming's 14 points for management (see Table 2-2) provide the basis "for transformation of American industry." With only minor changes to the 14 points over 38 years, the principles are essentially the same Dr. Deming introduced to the Japanese in 1950 and continued to teach in subsequent years. (Deming, p. 23)

TABLE 2-2

DR. DEMING'S 14 POINTS

1. Create constancy of purpose toward improvement of product and service. The goal is to become competitive, stay in business, and to provide jobs.
2. Adopt the new philosophy. American businesses must realize their current and future competitive positions and take on leadership for change.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on the basis of price tag.
5. Improve constantly and forever the processes of production and service, to improve quality and productivity, and thus, constantly decrease costs.
6. Institute training on the job.
7. Institute leadership. The aim of supervision should be to help people do a better job.
8. Eliminate fear from the workplace.
9. Break down barriers between staff areas.
10. Eliminate slogans and targets for the workforce.
11. Eliminate numerical quotas for the workforce and numerical goals for management.
12. Remove barriers that rob people of pride of ownership. Eliminate the annual rating or merit system.
13. Institute a vigorous program of education and self-improvement for everyone.
14. Put everyone in the company to work to accomplish the transformation.

Source: (Deming, pp. 23-24)

DoD's basic aim is to promote "continuous improvement of products and services." The definition of the word "product" is not limited to hardware systems, but also includes "acquisition and logistics functions, including design, procurement, maintenance, supply, and support activities." (DoD TQM Master Plan, p. 1) Basically, TQM will eventually affect every process within DoD. In some cases the change will be subtle. In most, however, the changes will sharply contrast with the way DoD currently conducts business. The remainder of this section will discuss the key concepts of TQM from the DoD perspective.

DoD defines TQM as follows:

TQM is both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. TQM is the application of quantitative methods and human resources to improve the material and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customer are met, now and in the future. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continuous improvement. (DoD 5000.51-G, p. 1)

E. TQM, A CULTURAL CHANGE

The DoD TQM philosophy emphasizes continuous process improvement, "involving everyone in the organization, managers and workers alike in a totally integrated effort toward improving performance of every process at every level." (DoD 5000.51-G, p. ii) TQM changes the focus of current DoD management practices, which emphasize failure detection, to

one of highlighting achievements and building quality improvement into every process.

Culture is defined as "the set of important understandings (frequently unstated) that members of a community share in common." These shared understandings include "norms, values, attitudes and beliefs." The community involved may be as large as an industry or as a small office in a small business." (Soner, p. 373)

Another major change to the standard way of doing business within DoD involves "reinstating the individual as the key element" in the organization and then systematically, with the worker and management working together, to improve the process. Appendix A provides a table contrasting the principles and practices of traditional "western" style management with those of TQM.

The following three concepts highlight some of the differences between the existing management styles prevalent in both American businesses and DoD, and that which should be strived for under the TQM philosophy.

1. Long-Term Commitment

Top management's focus on the quarterly financial statements versus the company's long-term competitive position has contributed substantially to America's diminished competitive position. Another factor of the long-term versus short-term outlook is the mobility of top management, characterized by job-hopping every two to three years. DoD

also experiences a high ratio of movement of its military, at all ranks, as well as many of its civilian employees.

There is increasing concern within the professional civil service that the ability to obtain constancy of purpose is becoming a lost cause...politically appointed managers must comprehend the [Deming's] 14 points and the deadly diseases and the obstacles. Only then may they place themselves in roles of leadership. (Deming, p. 119)

The same screening and education process should be applied to the prospective leaders of industry and DoD.

Long term commitment, both to TQM and to the future of the organization, is required by top management to adequately effect long-term planning and execution. If the management knows it will transfer before the long-range plans can reach any appreciable level of execution, then, perhaps the plans will not be as well thought out as they might have been. Also, an incoming manager is less likely to feel compelled to adhere to and support a management philosophy he had little to do with in developing. (Strickland, p. 18; Crosby, p. 133)

Lastly, top management must demonstrate their long-term commitment by ensuring the organization is adequately prepared for a long-term cultural change. Key issues here include adequate staffing, funding for training, courage to withstand critics of the process, and a willingness to stand by their convictions.

2. Recognize Your Most Important Resource--People

"The greatest waste in America is failure to use the abilities of people." (Deming, p. 53) There are certain

human resource-related issues under this category which are significant enough to the adoption of the TQM philosophy to warrant their specific discussion. These include: training and retraining; eliminate fear, foster open communications; and the involvement of all DoD personnel, processes products, and services. (DoD 5000.51-G, p. 2)

a. Training and Retraining is Crucial for the Following Reasons

The cultural change involved in the TQM philosophy dictates that everyone undergo certain levels of training and periodic retraining from top management to the floor worker. "Managers and personnel at all levels must take responsibility for the quality of their processes and products." (DoD 5000.51-G, p. 2)

For this to happen, everyone will need to be trained in a wide range of areas; quality, how to assess it, statistical process control, who is the customer, what are his needs, etc. Supervisors should be trained in TQM to the level where they can explain the concept to their people. (Crosby, p. 137)

Japan's basic Quality Control (QC) course, designed by JUSE, Union of Japanese Scientists and Engineers, serves as the model for Japan QC education courses. Participants in the course study various quality concepts and then are placed back in their job for three weeks to apply what they have learned. This process is repeated for six

months. In contrast, most U.S. firms may have courses on quality and quality control which last only five to 20 days in length. Additionally, JUSE has developed specific QC programs for all job levels within an organization, including the president, directors of the company, middle management, engineers, foremen, purchasing and marketing department personnel, assembly line workers, etc. (Ishikawa, p. 38)

Management will require training in human resource issues such as leadership, understanding, and acting on the problems which can prevent the worker from carrying out his job with satisfaction. Management should commit themselves to learning thoroughly the jobs of the workers they supervise.

A man in Japanese management starts his career with a long internship (four to 12 years) on the factory floor and in other duties in the company. He knows the problems of production. He works in procurement, accounting, distribution, sales. (Deming, p. 52)

b. Eliminate Fear--Foster Open Communications

Although fear will never be totally eliminated from the workplace, management must take the appropriate actions to minimize its presence. "The economic loss from fear is appalling." (Walton, p. 72) How many good, money-saving, productive suggestions are not volunteered during meetings or one-on-ones with the boss, for fear of chastisement or future recrimination. A manager who relies on intimidation will soon be turning off the true productivity of his people and in the long run will be doing a grave disservice to his superiors and to the organization as a

whole. (Deming, p.71) Determining the truth about what is actually happening on the production floor can be most difficult. Especially, when the communication channel is usually one way...downward. Ishikawa in his book, What is Total Quality Control? The Japanese Way, maintains that a full 60 to 70 percent of the responsibility for this misinformation lies on the shoulders of middle and top management. Why? The following provides a partial list of the reasons:

- improper procedures, unclear;
- a boss who is a screamer and can't stand to hear bad news;
- superiors who don't understand their subordinates jobs, haven't made any effort to, and thus don't understand the issues; and
- spineless, inconsistent leadership. (Ishikawa, p. 134)

c. TQM Involves All DoD Personnel, Processes

TQM emphasizes the importance of the individual worker in the total process. Frequently, the technical aspects of change are focused on, at the expense of the worker. TQM requires management "ensure that employees: Receive proper training; Get feedback on their performance; And are empowered to make changes necessary to improve the process." Management will know what is required to lead their personnel in such a way as to "provide an environment in which all employees will voluntarily cooperate to achieve the organizational objectives." (DoD 5100.51-G, p. 12)

3. Understand Quality

U.S. firms are more narrow-minded and less knowledgeable than their Japanese counterparts about the concept of quality and the affect it can have on the competitive position of their firm. As was discussed in the preceding chapter, quality is frequently misconstrued as: too hard to measure, too expensive to achieve (will need more inspectors), primarily caused by workers, only a subgoal, can only be applied in repetitive manufacturing functions, and the responsibility of the quality department only. (Crosby, pp. 17-23)

TQM emphasizes continuous improvement of all processes involved in all products and services. Approximately 80-85 percent of the defects produced in the U.S. are attributed to the process which is the responsibility of management. The remaining 15 to 20 percent are in the hands of the worker. Listening to media reports of labor issues between management and the workforce, one can only conclude western management is ignorant of these statistics. (Ishikawa, p. 66)

Through an appropriate education program within the firm's TQM effort, an organization can change its thinking and attitudes towards quality; learning to employ quality improvement as the major cornerstone of its strategic plan, thereby ensuring the firm's future financial health. (Strickland, p. 18; Deming, p. 47)

4. Incorporate Suppliers into the Firm's Quality Philosophy

The relationships between buyer, seller, and customer in the U.S. have typically been of an adversarial nature. This "friction" is caused by a number of reasons: poor product quality; poor communication of the requirement; and a strong distrust of the others' sincerity concerning general business dealings such as meeting delivery dates, and prompt payment for goods delivered.

The TQM philosophy, taught by Dr. Deming, stresses developing a relationship with a single supplier. The purpose of this one-to-one relationship is to build a relationship of trust and loyalty between the buyer and seller. (Walton, p. 63) Dr. Deming identifies many other advantages a firm can realize having a long-term relationship with a single source, including: the achievement of greater economies of scale and more incentive for innovation; and the reduction of lot-to-lot variation, typical with different suppliers. Citing a recent client's comments, Dr. Deming in his book, Out of the Crisis, writes:

Ninety-two percent of [our] critical parts for three and four years ahead are now in development by teams composed of the chosen supplier, design engineer, purchasing, manufacturing, [and] sales. The price will be settled later, all books [are] open, everybody [is] working together toward a common aim,... (Deming, 1986, p. 37)

Dr. Ishikawa supports the importance of a good working relationship between the buyer and seller. In What is Total Quality Control? The Japanese Way, Dr. Ishikawa states:

One of the main factors that has supported the quality of Japanese products is the high level of quality control maintained by the suppliers. They have worked together with the purchasers to make quality possible. (Ishikawa, p. 156)

In the next section, TQM will be discussed in the context of specific issues facing DoD and its acquisition system.

F. ISSUES FACING DOD AND THE DEFENSE INDUSTRY FROM A TQM PERSPECTIVE

"Survival...The Greatest Motivator"
(Stuelpnagel, TQM, p. 57)

With DoD's purchases totaling approximately \$170 billion per year, it is by far the largest business enterprise in the world. DoD accomplishes spending at this inconceivable level by having its acquisition system award almost 15 million separate contracts per year. Understandably, many problems have developed between DoD and the defense industry over the past several decades from an increasingly bureaucratic process, which has struggled to manage this sizeable burden. (Blue Ribbon Commission, p. 44)

This chapter will discuss many of the issues surrounding the relationship between DoD's acquisition process and the defense industry. These issues include: the competitiveness of the defense industrial base, DoD budget reduction pressures, and over-regulation of the DoD acquisition process.

1. The Competitiveness of the U.S. Industrial Base

The Department of Defense can not successfully perform its mission, if many of the strategic industries that support

modern weapon system production can't compete with foreign producers. Critical industries within the U.S., such as shipbuilding, semiconductors and semiconductor equipment, machine tools, ball and roller bearings, are now feeling intense pressure by foreign sources. (Stuelpnagel, TQM, p. 57)

These pressures, primarily from Japan, Taiwan, Hong Kong, Singapore, and Korea, as well as Western Europe, are contributing to the relative decline of industries that are important to America's defense.

In a growing number of industry segments, if current trends continue, the Department of Defense will be dependent on foreign-source hardware and technology in acquisition of the technologically superior weapons systems that are fundamental to our strategy. (Costello, pp. 26-29)

Although there is no way of knowing how these developments will affect our national security, it is readily understood that our ability to obtain these critical parts, tools, and capacity to build or replace critical force components independent of foreign economic and political decisions, is essential to our national security. (Costello, p. 27)

Numerous other studies including: the 1988 MAC Group study, which was an exhaustive analysis into the cumulative impact of recent legislative and regulatory changes on the defense industrial base; the Packard Commission's Report, and the President's Report on Industrial Competitiveness, all echo

the same theme: American industry's ability to compete with foreign sources has declined over the past decade.

Central in the issues surrounding the defense industrial base's competitiveness is the perception by many that U.S. defense-related firms frequently suffer from low product quality and an anemic productivity growth rate. Quality failures in DoD can have disastrous results including reduced mission readiness and massive loss of life. "Recalls and warranties have no value on the battlefield." (Long, p. 8)

a. Quality

In November 1986, the General Accounting Office (GAO) conducted an evaluation of DoD's in-plant quality assurance program. The report was conducted at the request of Congress to "assure major weapons producers comply with contract quality assurance requirements." After examining quality-assurance programs at many defense contractor sites, the report concluded:

We believe the present in-plant quality assurance program is not as effective as it should be in ensuring that quality products are delivered to field activities. Evidence of this ineffectiveness can be found in service and DLA (Defense Logistics Agency) studies which document that many contractors are not adequately controlling quality and producing hardware which conforms with contract requirements. (GAO, p. 1)

The study looked at Air Force Contractor Operations Reviews (COR) to determine how well the contractors were performing. The COR teams stated "12 of the 24 plants

had less than satisfactory quality assurance functions." Two contractors had the dubious distinction of especially poor quality assurance practices; one contractor's defect rate was 40 percent with the existing inspection process passing 24 percent of the defects; the other contractor had a defect rate of 38 percent. (GAO, p. 2)

The Army's review of their contractor in-plant programs revealed three of the five prime contractors they visited received "fair" ratings. The Defense Logistics Agency (DLA) gave unacceptable ratings to 79 percent of the 224 contractors it reviewed in 1985. The Navy also indicated its in-plant QA program needed improvement, when the Secretary of the Navy stated in a memorandum dated November 18, 1985, to the Secretary of Defense, that many of the parts produced to support highly visible programs in the Naval Air Systems Command (NAVAIR) were found to have a defect rate of about 20 percent. (GAO, p. 6)

b. Productivity

Over the past 15 to 20 years American firms' productivity growth rate has steadily declined, especially in the defense portion of the economy. (Templin and Hendrick, p. 5) A 1980 congressional study concluded among other issues, the following:

- The productivity growth rates for the manufacturing sector of the U.S. economy are the lowest among all free world industrial nations;

- The productivity growth rate of the defense sector is lower than the overall manufacturing sector; and
- The U.S. is becoming increasingly more dependent on both critical raw material and specialized components needed in military components. (Templin and Hendrick, pp. 5-6)

DoD conducted an exhaustive study, from 1980 to 1985, into the health of the industrial base, seeking to identify weaknesses in individual defense-critical industries. Critical industries were identified as those in which DoD spent most of its money, as well as industries vital to defense production. The study revealed that 215 individual industries, accounting for about 95 percent of DoD's purchases from the manufacturing sector, fell into the critical industry category. Among its findings were:

- Rate of growth in productive capacity in the critical defense industries was down, "with only 41 percent of critical-defense industries matching or exceeding the overall manufacturing average growth in productive capacity"; and
- Capital expenditures were also in a decline. Sixty-two percent of the critical industries had lower-than-average expenditures in 1980. In 1985, this downtrend continued, when 72 percent had lower-than-average capital expenditures. (Costello, pp. 25-26)

2. Budget Reduction Pressures

Many pressures to improve productivity and improve product quality are becoming more burdensome as DoD's budget is reduced year after year. The emphasis is already changing as to how the services will maintain, modernize, and repair the numerous weapons systems they've acquired during the DoD buildup from 1980 to 1985. The Navy, for example, has

realized a 21 percent increase in deployable battleforce ships, from 479 to 577, since 1980.

The expansion has not only been "quantitative" in nature but also "qualitative" in the sense that the "new ships are far more technologically advanced, far more complicated and capable, than their predecessors." (Webber, p. 41)

To adequately support this increased number of highly sophisticated weaponry, during "increasingly stringent budget conditions," DoD must work smarter "to get the most for its acquisition dollars." (Webber, p. 42)

The Navy's emphasis on product quality has assumed a greater dimension today because its policy "is going more and more to extended operating cycles and phased maintenance." Shipyard availabilities will be shorter and intervals between overhauls will be lengthened. (Webber, p. 42) "Increased reliability, maintainability and quality clearly are required to implement these maintenance strategies. We can not afford to build in quality after the fact." (Webber, p. 42)

3. Over-Regulation

In 1983 the Grace Commission concluded the defense contracting process was severely over-regulated and inflexible, frequently preventing the use of common sense in handling purchasing problems. (Templin and Hendrick, p. 8)

Similar criticism was echoed by the June 1986, President's Blue Ribbon Commission on Defense Management, which stated in part: "people in DoD work in an environment of far too many laws, regulations and detailed instructions on

how they should do their work." (Blue Ribbon Commission p. 42)

The bureaucratic burden heaped on DoD's acquisition force and the defense industry was a direct result of Congress and DoD dictating:

...management improvements in the form of ever more detailed and extensive laws or regulations. As a result, the legal regime for defense acquisition is today impossibly cumbersome...we have identified 394 different regulatory requirements in the Federal Acquisition Regulation (FAR) and the DoD FAR supplement that are pegged to some 62 different dollar thresholds, ranging from as little as \$15 to as much as \$100 million or more.

The sheer weight of such requirements often makes well-conceived reform efforts unavailing. At operating levels within DoD, it is now virtually impossible to assimilate new legislation or regulatory refinements promptly or effectively. (Blue Ribbon Commission, p. 55)

The Blue Ribbon Commission recommended that the Administration and Congress work together to recodify Federal laws governing procurement in a "single, consistent greatly simplified procurement statute." (Blue Ribbon Commission, p. 55)

This recommendation sounds as if it should solve the problems cited above. However, unless the vehicle of change is clearly defined as to how to accomplish such an immense task, the same bureaucratic roadblocks noted above will stymie any attempt to meld the Federal laws governing procurement into a single regulation.

Another report, which decries the damaging cumulative impact of numerous pieces of legislation, was prepared by the MAC Group, an international economic consulting firm, assisted

by two Harvard professors, Robert N. Anthony and Joseph L. Bower. The study concluded that from 1984 to 1987, numerous major statutory, regulatory, and management practices were enacted by Congress and DoD in a "piecemeal fashion." Of the 15 changes that occurred during this time frame only one change, the new profit markup policy, had received a detailed analysis of its likely impact. The results of the changes included placing a significant squeeze on available capital, thereby reducing contractor funded R&D investment, and reducing investment for productivity and modernization enhancements. These, in turn, will produce a less efficient industry and one less able to compete in the world market. (NCMA Journal, pp. 38-39)

In order to intelligently and efficiently manage this over-regulation, the "customers, producers and suppliers" of this regulatory production line need to understand and execute TQM principles. Understanding that most repetitive functions can be viewed as a process, and that every process possesses some variability, is key in making any type of decision. The criticality of the decision increases dramatically when the decision determines major policy, which may very well impact entire industries, affecting the economic welfare of tens of thousands of workers and ultimately, the ability of DoD to carry out its mission.

Many of Deming's 14 principles stress improved communications and commitment. Top management which controls the DoD

acquisition system, includes: Congress; top DoD leaders; as well as senior leadership in the defense industry. All members of "top management" must be made aware of the benefits of TQM and the need to start improving the various communication processes between these three entities. For example, the process of defense procurement policy development could be examined to ensure that various policies have the appropriate industry input, are adequately supported by valid research, and are examined in the context of other past and pending policies.

Application of TQM at the DoD level will have a powerful effect in increasing the understanding by Congress and the administration in how best this country can repair its overall industrial competitiveness. Other shortcuts...like industry subsidy and import protection will only mask the real problem and delay its correction. (Stuelpnagel, TQM, p. 62)

The former Under Secretary of Defense for Acquisition (USD(A)), Dr. Robert Costello, in his report to the Secretary of Defense entitled, Bolstering Defense Industrial Competitiveness, echoed similar concerns about protectionism. "Neither the nation nor the Department of Defense can afford policies which do nothing but protect industries or firms." (Costello, p. 27)

Dr. Costello further stressed in his report that protectionism policy would: Exacerbate the existing weapons systems cost-growth problems; undermine attempts by DoD to improve the competitiveness of the defense industry; and

threaten cooperative production agreements with our allies.
(Costello, p. 27)

Although the obstacles are formidable: that of maintaining a competitive industrial base in the face of a decreasing DoD budget, while at the same time, the acquisition process and the industrial base suffers from poorly-drafted Congressional statutes and DoD policy; DoD has selected TQM as the "proven management philosophy powerful enough and universal enough in scope to effectively manage these issues".
(Strickland, p. 17)

G. EXAMPLES OF A QUALITY-ORIENTED MANAGEMENT PHILOSOPHY

One of TQM's basic operative concepts is that through continuous process improvement, product quality will increase; costs of quality, such as, scrap, rework, warranty work, will decrease, enabling the firm successfully "practicing" TQM, to capture an ever-increasing market share, thereby increasing its competitive position. "In the commercial world, the cost and time to produce a product can be cut in half when the company is expert in the use of TQM." (Stuelpnagel, Improved U.S. Defense, p. 43)

Numerous examples exist, within industry, as well as in DoD, of firms and organizations improving their economic and competitive positions through the successful implementation of TQM or equivalent quality philosophies.

Three such companies: Globe Metallurgical Inc.; Westinghouse Electric Corporation's Commercial Nuclear Fuel Division; and Motorola, Inc., were recognized November 1988 for their quality achievements, by receiving the first Annual Malcolm Baldrige National Quality Award during a White House ceremony. This award, named after the late former Secretary of Commerce, Malcolm Baldrige, was presented to the winning corporations as "inspiring examples of what can be accomplished in improving quality, strength and market position." Although each winner took different routes to the top of their fields, basic ingredients of TQM were present in all three, including a strong dedicated leadership, well-defined goals and stated purpose, and most importantly, a company-wide commitment by all employees to strive for perfection. (Bacon, p. 32)

Globe Metallurgical, like many U.S. manufacturers of ferroalloys, was steadily losing market share to a rising tide of low-cost imported metal. Deciding to compete, the company committed itself to improving the quality of its products through such methods as: SPC; improved communications, "whose workers hash out issues in their daily own 'quality circles'"; and top-management involvement in quality issues.

Westinghouse adopted the "Total Quality" strategy when they found themselves less and less competitive in the world market. At one point Westinghouse felt that a 95% perfect product was good enough and that anything beyond that would

cost too much. "Today, the (Commercial Nuclear Fuel) division boasts its fuel rods are the best in the world and that its customers can be 99.995 percent certain that each of the thousands of rods supplied will perform flawlessly." (Bacon, p. 32)

This translates into a tenfold increase in product reliability, and greatly reduced the time from conception to market introduction of a new product. (Bacon, p. 32)

Motorola has achieved over a 100-fold decrease in their defect rate for semiconductors since they embarked on their efforts to implement "total quality" into their organization in 1981. Customer complaints have declined and market share, both at home and abroad, even in Japan, are up. (Bacon, p. 33)

Two TQM success stories involving DoD include Control Data's AYK-14 mission computer and the Naval Aviation Depot (NADEP), North Island, San Diego, California.

The AYK-14 mission computer is a vital "black box" that is required equipment in most naval aircraft. Due primarily to Control Data's "Total Quality" program launched in 1982, their AYK-14 computers are,

...demonstrating in rigorous acceptance testing a "mean-time-between-failure" of 1100 to 1800 hours, compared to a contractual requirement of only 250 hours. Even better, AYK-14 costs have fallen 40 percent over the past five years. (Morrison, p. 31)

Control Data's emphasis on quality is called Total Quality Management Process (TQMP), and reflects many of the same

tenets of product improvement as DoD's TQM philosophy. In the introduction to Control Data's TQMP handbook called, Quality Management in Control Data, the company's commitment to product quality is unmistakable:

Quality improvement is fundamental to the future success of Control Data. The message is clear: Companies that are willing to meet the quality challenge will survive--and we intend to be one of them! (Quality Management, p. 1)

Control Data efforts to reduce the costs of quality have not only benefited the Navy, and the taxpayer, but also Control Data itself. When the Navy placed the production of the AYK-14 into competition with another firm, Control Data was awarded 80 percent of the contract, the maximum share allowed under DoD's "second sourcing" policy. (Morrison, p. 31)

The NADEP at North Island, San Diego, California, started implementing TQM in 1980 and is considered one of the first DoD activities to adopt the philosophy. Unfortunately, the NADEP experienced a period of slow-down in the TQM adoption process from 1980 to 1984, partly due to "the reluctance of management to believe the present system actually needed fixing." (Warmington, p. 24)

Subsequent to 1984, NADEP had "shown productivity gains in almost every area where implementation occurred." (Warmington, p. 32) The F-14 (aircraft) provides an example of the savings realized: The labor hours decreased by 3050 hours and the material savings averaged \$100,000 per F-14

(aircraft) overhaul. As a result of NADEP's TQM efforts, the F-14 overhaul process alone has netted an estimated savings of \$673,000 in fiscal year 1988. (Warmington, p. 32)

The next chapter will discuss various aspects of DoD's source selection process including: formal and informal source selection, evaluation criteria, and Congressional influence.

III. DOD'S SOURCE SELECTION PROCESS

A. INTRODUCTION

The Federal Acquisition Regulation (FAR) provides the basic policy for DoD's source selection process. This basic policy is further defined by various FAR supplements, department directives and instructions. Additionally, Government procurement is subject to change through the passage of Federal laws. Two of the major laws that impact source selection are the Competition in Contracting Act (CICA) of 1984 and the Buy American Act. CICA significantly influenced the procurement process by making certain procedures a statutory requirement instead of a regulation. The second example is the Buy American Act, which essentially favors U.S. domestic companies over foreign sources of supply by allowing for adjustments to foreign proposals based on a predetermined formula. The focus of this chapter will be the specific supplier selection guidance provided by these laws, regulations, and policies.

According to the FAR, the purpose of source selection is to: maximize competition; minimize the complexity of the solicitations, evaluation, and the selection discussion; ensure all offerors' proposals receive an impartial and comprehensive evaluation; and ensure the source is selected that can provide the highest degree of realism and best meet

the stated requirements. Procurement involving high cost or high interest, as determined by the Secretary of Defense, require the use of a formal source selection process, as outlined in DoD Directive 4105.62 and the FAR 15.612.

B. DOD'S SOURCE SELECTION PROCESS

There are two basic types of contracting that determine source selection procedures within DoD: sealed bid and competitive negotiations. The following paragraphs will discuss each of these methods.

1. Sealed Bid

The sealed bid method should be used when the following conditions are met:

- Adequate time exists to solicit, receive, and evaluate the sealed bids;
- Award will be made on the basis of price and other price-related factors;
- The Government's invitation for bid must be able to describe the requirements of the Government to the point where it will not be necessary to conduct further communications with the prospective offerors beyond the information offered in the invitation for bid;
- The Government expects to receive more than one sealed bid. (FAR 6.401)

The process originates with the preparation of the invitation for bid (IFB). This solicitation must communicate clearly the Government's needs without requiring further discussion with offerors. If any of the above sealed-bid criteria are missing, the competitive negotiations method is required for source selection. The Government must then

publicize the IFB for a sufficient amount of time to allow prospective bidders to prepare their bids. After the bidders have prepared their sealed bids, they submit them by a designated date, time, and location. An award will be made after the bids are publicly opened based on the requirements stated in the IFB. Source selection will be based on price and the price-related factors above. (FAR 14.101)

2. Competitive Negotiation

The Government's competitive negotiation procedures involve two types--formal and informal. This section will: First, describe the organization involved in each process; secondly, discuss the role of the source selection evaluation criteria in the process; and lastly, describe the sequence of events in an informal source-selection process.

The formal source-selection procedure is generally used in high-cost acquisitions and other acquisitions as directed by the various Federal agencies.

The organization developed for the formal source selection process is usually made up of a source selection evaluation board (SSEB), a source selection advisory council (SSAC), and a source selection authority (SSA), at a managerial level senior to the contracting officer. The following is a description of the formal source selection organization as outlined in DoD Directive 4105.62.

The SSA is responsible for the overall conduct of the source selection process to include ensuring that:

- The source selection plan and evaluation criteria are consistent with the solicitation's requirements; and
- Adequate personnel with the requisite skills are available for assignment to the SSAC and the SSEB.

The SSA is also responsible for making the final source selection decision and ensuring the decision is adequately documented. (DoD 4105.62, p. 3)

The SSAC's primary duty is to provide staff support and to advise the SSA. Other duties include:

- Reviewing and approving the Source Selection Plan (SSP);
- Developing evaluation and selection criteria, to include assigning numeric weights to the evaluation factors; and
- Making source selection recommendations to the SSA.

The SSEB is made up of Government contracting, technical, administrative, and management personnel. Their duties involve evaluating each proposal against the technical, operational, and selection criteria of the Government's request for proposal (RFP) to ensure they meet the minimum specifications and requirements of the solicitation. This includes schedules, logistics support, and productivity factors. The SSEB then makes its recommendations to the SSAC. Although the SSEB is aware of the relative ranking of the evaluation factors, as is the prospective offeror submitting his or her proposal, the board does not have access to the actual numerical weighting assigned to each evaluation factor. This information is considered privileged information and is held only by the SSA and the SSAC.

In an informal source selection, the contracting officer is the SSA and is tasked with the most of the responsibilities that normally would be assigned the SSEB and SSAC under the formal process including:

- Issuing the solicitation (IFB or RFP);
- Conducting or coordinating price analysis (IFB) or cost analysis (RFP);
- Conducting or controlling all aspects of the negotiation process including price, and technical requirements; and
- Selecting the source for contract award, provided no other person is designated as the SSA. (FAR 15.604)

3. Evaluation Factors

The evaluation factors used to determine who is awarded the contract are identified in the Government's RFP. The purpose of including the factors in the RFP is to inform "offerors of the [relative] importance the Government attaches to various aspects of the proposal." (DoD 4105.62, p. 5) The FAR specifically states: "The solicitation shall clearly state the evaluation factors, including price or cost and any significant sub-factors, that will be considered in making the source selection and their relative importance." (FAR 15.605)

The evaluation factors identified in a RFP, and their relative importance, are determined between the Government agency requiring the good or service and the contracting officer, or in the case of a large purchase, the SSAC and approved by the SSA. The typical evaluation factors which may be included in any Government RFP are as follows:

- price or cost;
- quality;
- technical excellence;
- management capability;
- schedule compliance;
- personnel qualifications;
- past performance;
- prior experience; and
- any other relevant factor, such as, cost realism, may also be included. (FAR 15.606)

C. SEQUENCE OF EVENTS

The source selection process starts with the Government's dissemination of a solicitation (IFB or RFP). For purposes of discussion, the competitive negotiation process will be discussed as it relates to the source selection process. The solicitation is based on the user-defined needs. In the case of complicated negotiations, draft RFPs are often used to obtain information that the Government is lacking, or to improve Government specifications. Draft RFPs include the general and specific statement of work, specifications, data requirements, evaluation criteria, and are sent out to potential offerors for their review and feedback. This industry feedback can be most helpful in clarifying complex issues, and should then be incorporated in the final RFP as deemed appropriate by the contracting officer.

The RFP should contain any information that will enable prospective contractors to adequately prepare proposals. RFPs are prepared using a "standard uniform contract format" outlined in Table 3-1. This format enhances the contracting officer's assembly of the RFP, preparation of proposals by prospective offerors, and the source selection process. (FAR 15.406-1)

The quality of the RFPs has been a sore point between Government and industry for many years. Problems such as overspecification, and non-definitive, poorly-worded requirements, have resulted in the Government initiating acquisition streamlining programs, such as specification tailoring and efforts to use more off-the-shelf commercial products. The Navy's Specification Control Advocate, Gerard Hoffmann, recently highlighted the seriousness of overspecification in Government contracts.

I am convinced that [overspecification] is one of the main contributors to the lack of competition, particularly at the equipment and component level. Many manufacturers have chosen to stay out or withdraw from Navy contract competition because of the myriad of specification requirements. (Hoffmann, p. 24)

Use of draft RFPs, pre-solicitation conferences with potential offerors, and other methods which can foster early sharing of information between Government and industry, will help alleviate the communication problems inherent in the current Government method of procurement.

TABLE 3-1

UNIFORM CONTRACT FORMAT

<u>Section</u>	<u>Title</u>
	<u>Part I--The Schedule</u>
A	Solicitation/contract form
B	Supplies or services and prices/costs
C	Description/specifications/work statement
D	Packaging and marking
E	Inspection and acceptance
F	Deliveries or performance
G	Contract administration data
	<u>Part II--Contract Clauses</u>
H	Contract clauses
	<u>Part III--List of Documents, Exhibits and Other Attachments</u>
I	List of attachments
	<u>Part IV--Representations and Instructions</u>
J	Representations, certifications and other statements of offerors or quoters
K	Instructions, conditions and notices to offerors or quoters
L	Evaluation factor for award

Source: (FAR 15.406)

After the solicitation has been published, proposals are submitted for review, whether a formal or informal source selection process is undertaken. Proposal teams are formed to evaluate the solicitation and create technical and cost proposals. Prospective offerors must submit joint technical and cost proposals as indicated in the Government solicitation. The contracting officer reviews each proposal for apparent problems. The contracting officer can clarify issues, however, no discussions can take place which would create an unfair advantage for any of the offerors. After clarification of any issues, the contracting officer establishes a competitive range. This competitive range is "determined on the basis of cost or price and other factors that were stated in the solicitation and shall include all proposals that have a reasonable chance of being selected for award." (FAR 15.609)

At this point, after the competitive range is established, the contracting officer will hold discussions with those offerors in the competitive range. Care must be taken by the contracting officer to ensure no information is given out which would result in any offeror having an unfair advantage over the others.

Upon completion of discussions, the contracting officer requests submission of the offerors' "Best and Final Offer." The offers are then evaluated using the established evaluation

criteria and a proposal is selected that is most advantageous to the Government.

D. STATUTES AFFECTING THE DOD PROCUREMENT PROCESS

In recent years, Congress has focused a considerable amount of attention on the DoD acquisition process. In the 98th Congress alone, over 150 separate procurement-related bills were introduced during its sessions. Two major pieces of legislation, which eventually became law, are the Competition and Contracting Act (CICA) and the Buy American Act. These two laws will be discussed below.

1. Competition in Contracting Act (CICA)

Congress drafted CICA in 1984 as a result of its growing concern that Federal procurement dollars were not being spent wisely. As a result, the law stresses competitive procurement from among multiple sources over single source procurement. (Sherman, p. 118)

The FAR, in implementing CICA, states: "contracting officers shall promote and provide for full and open competition in soliciting offers and awarding Government contracts." (FAR 6.101)

A frequent misunderstanding of DoD's competition effort is that it seeks the lowest cost without regard to other selection factors. The Navy's competition program is used to reach several objectives including:

- Improving product/service quality and reliability;
- Enhancing the industrial base; and
- Improving delivery schedules. (Navy Competition Handbook, pp. 4-5)

This policy of "Best Value" was recently placed in statute, and an upcoming change to the FAR will provide that quality may be expressed in terms such as past performance. The Navy's Competition Advocate General's recent guidance in the Navy Competition Handbook appears to support this move from low cost to best value procurement.

Do not hesitate in applying "Best Value" competition practices in those procurements where contracts have historically been awarded based on price alone....Your extra effort will establish the environment for competitive prices and focus increased supplier attention on responsive delivery time and quality assurance standards. (Navy Competition Handbook, p. 5)

2. Buy American Act

As stated in the FAR, the Buy American Act requires domestic products be purchased for public use except:

- for use outside the United States;
- when its cost is determined to be "unreasonable";
- when the agency head determines it is not in the public interest;
- when determined by one or more agencies that is not available in sufficient quantity and quality in the United States; and
- when purchased for commissary resale. (FAR 25.102)

The offered price of a domestic product is considered unreasonable when it exceeds the offered price of a foreign offer, including duty, by:

- more than six percent, providing the offer was from a large U.S. firm not located in a labor surplus area; and
- more than 12 percent, providing the offeror was a small business or any labor surplus area business. (FAR 25.105)

Source selection is just one example of procedures that are determined by law and expanded in regulation and policy directives. The existing rules and regulations provide the DoD contracting officer specific guidance on how to carry out procurements, from relatively straightforward small purchase procedures to the lengthy, extremely complex procedures for high dollar value procurements. The large number of congressional statutes and DoD policies which control the DoD procurement process has caused concern of possible over-regulation. Many procurement officials and industry leaders point to lengthy studies and reports which strongly suggest more effort should be applied to:

- reviewing the proposed legislation in the context of existing policy;
- conducting research to ensure adequate data is available to support the proposed policy; and
- soliciting input from the key players, such as industry, DoD, and Congress. (Costello, pp. 50-60; Blue Ribbon Commission, pp. 52-71)

The next chapter will discuss the researcher's findings based on his examination of Hewlett-Packard's and Motorola's efforts to mandate their supplier base adopt a quality-oriented management philosophy.

IV. FINDINGS

Hewlett-Packard and Motorola, Inc., the two firms examined during this research effort, were chosen for two reasons. First, both were well-established firms; with a large number of employees, 100,000 and 83,000 respectively. Secondly, both companies had developed, relatively speaking, a more modern quality-oriented management philosophy equivalent, in most respects, to DoD's TQM effort.

The researcher has examined the two companies by focusing on the following two areas:

- How have these companies incorporated their quality efforts into their supplier selection process?
- How successful have they been in their efforts to have suppliers adopt a similar quality philosophy?

A. HEWLETT-PACKARD

1. Background

Hewlett-Packard (H-P) is known world-wide as a manufacturer of high quality electronic devices and business computers. Consisting of 54 divisions and employing approximately 83,000 people, H-P's organizational structure is highly decentralized, allowing its line managers substantial flexibility in initiating and directing new products.

In 1979 John Young, president and CEO of H-P, directed his manufacturing divisions to strive for a "stretch

objective," which amounted to a ten-fold improvement in quality over the next decade, or more specifically, a decrease in field failure rates to a factor of "one-tenth their current levels by the end of the '80s." Although he admits it was a formidable challenge, any challenge less difficult could have resulted in business as usual. "They [management and workers] wouldn't have been forced to radically rethink their operating procedures. They would have continued in what we call the 'same old way'." (Young, pp. 30-34)

The stretch-objective was issued to help H-P manage three problems. First, product cost was becoming a more significant issue with H-P's customer as they moved more and more into the computer industry. Secondly, competition from the Pacific Rim countries, especially Japan, was becoming very intense. Lastly, H-P's customers were expecting more from them in the way of quality. (Young, p. 31)

Based on Mr. Young's direction, H-P adopted Total Quality Control (TQC) in 1980. TQC can be defined as a management philosophy which incorporates many of the same central principles and techniques as DoD's TQM initiative. Basic elements of the TQC philosophy include: total commitment to improving quality; universal participation; continuous process improvement using tools, such as statistical process control (SPC); and the use of various diagrams and statistical charts. Table 4-1 provides a list

of TQC's principles, tools, and a brief step-by-step approach of the improvement process. (Sepehri and Walleigh, p. 47)

TABLE 4-1

HEWLETT-PACKARD'S
TOTAL QUALITY CONTROL

Principles

Total commitment to quality

Focuses on customer needs and expectations (internal and external customers)

Views all activities as processes

All processes can be continually improved through the use of scientific methods

Requires universal participation (everyone, everywhere, teamwork)

Seeks perfection as goal

Tools

Process flow diagrams

Cause and effect diagrams

Statistical process control (SPC) charts

Statistically designed experiments

Time series plots

Process

1. Select a process improvement opportunity
2. Determine the intended result
3. Analyze the process through process flow charting
4. Select process performance measures
5. Determine possible causes of imperfection
6. Develop a data collection strategy
7. Collect data on probable causes
8. Decide on appropriate corrective action
9. Take corrective action
10. Evaluate the results and verify process improvement
11. Document and standardize solutions

Source: (Hewlett-Packard's Quest for Total Quality Booklet)

Since TQC's implementation, H-P has realized substantial improvement in many of its performance parameters, such as:

- Overall field failure rate has decreased more than 20 percent per year;
- The inventory has decreased in size, from 20 to 17 percent of sales, which translates into a \$200 million smaller inventory; and
- Outstanding accounts receivable decreased 13 percent, from 62 to 54 days outstanding. This represents a \$100 million in savings. (Young, p. 32)

Within the H-P's Computer Systems Division the following noteworthy quality improvements occurred:

- Work in process units decreased from 670,000 units to 20,000;
- Wave solder defects were reduced from 5000 parts per million (ppm) to an average of three ppm; and
- Automatic [circuit card] insertion-related problems dropped from 30,000 ppm to 5600 ppm. (Sepehri and Walleigh, pp. 44-50)

H-P initially involved its suppliers in its TQC effort in the early 1980's, realizing the crucial role suppliers would play in H-P's marketing of a high-quality, cost-competitive product line. This first step taken by H-P involved offering TQC awareness seminars to their supplier base. These seminars included the basic principles of TQC, the tools used in its implementation, and the results H-P was expecting to achieve through its adoption of TQC. (McGowan)

When H-P first started discussing TQC with their supplier base, many suppliers perceived it as the standard

quality lip service. To counter this erroneous perception, H-P, in 1985, revised their seminars to include supplier evaluation criteria. Although only a few criteria existed at that time, suppliers quickly became aware of H-P's commitment to TQC and the role H-P wanted their suppliers to take. H-P also stressed the new supplier-buyer direction should be considered that of a partnership, a close working relationship, whereby both parties would benefit. The supplier would realize a one-to-three year contract with H-P versus having to face competition every six months. Both H-P and the qualified supplier would benefit by realizing the substantial efficiencies gained by developing a productive long-term working relationship.

Initially, some suppliers objected to H-P's requirement for them to adopt TQC. However, the number of suppliers who refused to accept the mandate was negligible, and in most cases, the suppliers who were producing superior quality products displayed an attitude of striving for continuous improvement in their processes and products. As a result, the better suppliers stayed with H-P and have reaped the rewards of the TQC supplier-buyer relationship.

At this same time, H-P was undergoing cultural changes internally, caused by their ongoing implementation of TQC. These massive changes in organizational values resulted in a gradual strengthening of the supplier expectations from 1985 to present. (McGowan)

H-P felt the key issue of tracking supplier performance needed to be resolved before TQC could be made mandatory for its suppliers. This resulted in the development of an extremely capable quality tracking system which permits any H-P division to access any supplier performance history. A supplier's history is updated continuously on a near real-time basis, typically within 48 hours. This information is automatically fed back to the division responsible for developing/procuring it, for correction.

Currently, all suppliers are required to fully adhere to H-P's latest supplier policy which stresses the suppliers' adoption of TQC or an equivalent quality effort. Although H-P has required supplier adoption of a quality-focused management philosophy since only 1985-6, H-P has witnessed substantial improvements in supplier product quality. This is evidenced by the large number of suppliers no longer requiring any type of incoming inspection. To reach this level of trust, a supplier must exhibit extremely high product quality. To assist the supplier in achieving this level of performance, suppliers are required to use SPC and other TQC techniques. Numerous other criteria, centering on the supplier's adoption of a TQC philosophy, are specified in the current Hewlett-Packard Supplier Performance Expectations booklet. These criteria will be discussed in detail in the following paragraphs. (McGowan)

2. Current Supplier Performance Expectations

In June 1989, H-P announced to its supplier base that it would "Maintain a competitive advantage by providing materials of the highest quality and lowest cost, with the best delivery, responsiveness, and technology available by selecting fewer but better suppliers." (H-P Supplier Performance Expectations, p. 1)

H-P's strategy for product improvement involved establishing "mutual performance expectations and measures, feeding the results back to the suppliers and together initiating corrective actions to ensure continuous performance improvements." H-P would then award their best suppliers with more business. (H-P Supplier Performance Expectations, p. 1)

H-P's goals were clearly stated:

- maximize customer satisfaction;
- maximize profitability for all contributors to the system;
- maximize responsiveness to change; and
- provide a framework for effective communication. (H-P Supplier Performance Expectations, p. 1)

3. Initial Selection of the Buyer

Prospective suppliers are actively sought when a new requirement arises or when an existing supplier can no longer perform satisfactorily. Typically, a small team of five to ten quality control analysts review certain predetermined areas. The details of the review are coordinated ahead of time to minimize any disruption. It usually takes two to four

days to complete the process. The evaluation criteria involve six general areas, with many sub-elements under each area. The six general areas are: technology, quality and reliability, responsiveness, delivery, cost, and financial stability. These "mutual performance expectations and measures" are assessed by various methods, such as: a Technology, Quality, Responsiveness, Delivery and Cost (TQRDC) Supplier Performance Survey; Manufacturing Technology Audit; analysis of investment in R&D; Quality Systems Audit; Process Quality Index, etc. The review teams complete out the various audits and surveys and provide them to the division's procurement manager or material manager for final scoring and supplier selection. The following paragraphs will discuss each mutual performance expectation individually. (McGowan)

a. Technology

H-P breaks down the element of technology into five sub-elements. Those sub-elements highlight critical technology related issues, such as teamwork in defining and selling specifications, solving technical problems, and collaborating on technological advances. These sub-elements are the following.

(1) Provide Leading Edge Technology. The supplier should represent the current state-of-the-art and should, as standard procedure, be constantly seeking innovative solutions.

(2) Introduce New Products in a Timely Fashion.

Suppliers are required to demonstrate efficient new product and process introduction. After the supplier is selected, H-P holds the supplier accountable for meeting their announced new product introduction schedule. Due to the intensely competitive market of electronics and computers, this time-to-market sub-element is considered "extremely critical."

(3) Mutual Engineering. Suppliers are required to be full participants in mutual engineering projects.

(4) Design and Application Assistance. Suppliers are expected to fully cooperate in the early stages of design. This applies not only to new products, but existing ones as well, as they are constantly undergoing redesign to improve performance.

(5) Strong Commitment to R&D. Suppliers are required to demonstrate their strong commitment to R&D. (Hewlett-Packard Supplier Performance Expectations, pp. 1-16)

b. Quality/Reliability

This element clearly states that the supplier is expected to provide H-P with 100% quality parts. At a minimum, the supplier should be able:

- To qualify the process to H-P's quality and reliability specifications;
- Once qualified, the process quality will be continuously improved through Statistical Quality Control (SQC). SQC uses Statistical Process Control (SPC) as well as various forms of reliability testing. Lot-to-lot variance will not be allowed;

- Verify out-going product quality through use of histograms and distribution data;
- Meet or exceed H-P's expectation everytime;
- Provide documentation supporting their manufacturing processes; including certifying operators for specific tasks as well as special tooling requirements;
- Ensure H-P is consulted before any documented processes are altered; and
- Work closely with H-P to resolve quality problems. (Hewlett-Packard Supplier Performance Expectations, p. 9)

c. Responsiveness

This criterion stresses supplier flexibility in meeting swings in demand that frequently occur in the very competitive electronics and computer markets.

H-P, through a number of quantitative measures, determines the supplier responsiveness rating based on the following:

- Responsiveness to changing needs. Suppliers must be able to react quickly and positively to changes;
- Communicate potential problems. Suppliers are required to initiate communications on any perceived problems, as soon as they occur. This proactive stance will increase the chances for the supplier and H-P to develop successful alternate plans;

H-P also acknowledges specific responsibilities in this criterion, specifically, providing suppliers with accurate parts forecasts with mutually agreed upon minimum and maximum levels of order activity.

d. Delivery

Suppliers are held to a 100 percent on-time delivery within a window of three days early and no days late.

As stated above, the supplier can expect forecasts from H-P to be accurate and acceptable.

In addition to 100 percent on-time delivery suppliers are required to:

- Decrease lead times over time. Suppliers, using SQC methods, should constantly decrease this criterion over time;
- Progressively shorten manufacturing cycle times. SQC methods, together with other TQC principles will assist suppliers in continuously improving manufacturing processes;
- Progressively reduce order processing times. The main thrust of this criterion is to make the supplier aware of the time savings that can be found in this process;
- Package parts to meet requirements. This includes specific packaging and kitting requirements and bar coding;
- Develop a mutually agreeable back up shipment plan. This plan should be documented and available for review.

e. Cost of Ownership

Due to material being the major component of H-P's manufacturing cost, expenditures for parts are based on "best value." In supporting this best value, suppliers must be willing to enter into cost analysis discussions, with the purpose of developing a mutually beneficial price for both the supplier and H-P. Once a price is agreed to, any increase must be justified, mutually agreed on and substantiated in writing.

Additionally, the supplier is graded on the following:

- Continuously reducing price through SQC;
- Two-way communication of process improving information. Suppliers should be willing to provide process improving ideas, as well as be willing to consider H-P's ideas;
- Standardization of parts and process. Supplier's should take leadership roles in reducing the need for unnecessary features and inefficient processes.

f. Financial Stability

The supplier's financial health is analyzed by reviewing Dun and Bradstreet credit ratings, financial questionnaires, and the use of various financial stability models. The financial health of the supplier has greatly increased in importance as the emphasis on long-term relationship has evolved.

With the emphasis on long-term partnership, H-P states its willingness to work to resolve any specific supplier problem. This attitude appears to provide a more honest, straightforward business relationship than the standard historic adversarial relationship between buyer and seller. (McGowan)

When H-P first suggested SQC as a means to continuously improve processes, two suppliers in Spokane, Washington wanted to be taught SQC, but no schools offered it locally. A quality engineer from H-P ended up teaching the SQC course for the suppliers at a local community college in the evenings. One of the contractors that attended those courses has improved his processes substantially, elevating

his company from a marginal business to a world-class exporter of sheet metal. (McGowan)

By fully adopting TQC and realizing the improvements in quality, productivity, and competitive position, H-P's suppliers are assured of their supplier status for a minimum of one year and frequently for longer periods of time.

B. MOTOROLA, INC.

1. Background

Motorola is one of the world's leading manufacturers of electronic equipment, systems, and components. Its product line includes two-way radios, pagers, cellular radio phones, integrated circuits, and defense and aerospace electronics. Communication systems, primarily two-way radios and pagers, account for 36 percent of annual sales while semiconductors account for 32 percent. With approximately 100,000 employees worldwide, Motorola, now 60 years old, is ranked among the 100 largest industrial companies in the U.S. Sales in 1988 totaled \$8.25 billion.

Motorola's organizational makeup is highly decentralized, with business operations structured based on size. There are currently two sectors, the Communications Sector and the Semiconductor Products Sector, plus numerous groups and divisions headquartered primarily in Arizona and Illinois.

In response to increasing foreign competition in electronics and components, Motorola set out in 1981 to achieve a tenfold reduction in the level of defects in all facets of the organization, such as products, administrative work load, and other areas of the business within five years. For example, if the defect rate had been 5000 parts per million (ppm), Motorola's tenfold reduction in defects program required no more than 500 bad chips per million. (Bacon, p. 33)

In order to become better informed about quality and the various methods used by leading firms, Motorola sent teams on scouting missions to a total of 77 manufacturing plants, including leading Japanese firms, to learn their methods of quality improvement. Based on their research, Motorola developed key operational initiatives focusing on quality improvement. These initiatives will be discussed below.

2. Quality Initiatives

In a short two years, some segments of Motorola began reaching the goal of tenfold improvement, whereas a good majority of the identified processes reached a tenfold improvement within the targeted five-year period.

After realizing the tenfold improvement in quality, it became apparent to Motorola's leadership that to remain competitive they would have to continuously seek quality improvement. Accordingly, in January 1987, Motorola's Chief

Executive Officer (CEO), George Fisher, provided a new goal for Motorola:

Improve product and services quality ten times by 1989 and at least one hundred fold by 1991. Achieve six sigma capability by 1992. With a deep sense of urgency, spread dedication to quality to every facet of the corporation, and achieve a culture of continued improvement to assure total customer satisfaction. There is only one ultimate goal: Zero defects in everything we do. (Executive Summary, p. 1)

To bring about change of this magnitude, a cultural change needed to occur within Motorola. This was initiated by Motorola identifying Total Customer Satisfaction as their fundamental objective and the following major operational initiatives to carry out this customer-driven strategy.

a. Six Sigma Quality

The Six Sigma Quality initiative translates into a target of no more than 3.4 defects per million products or 99.99966 percent conformance to specifications. Approximately ten years ago, three sigma performance was the standard in electronics manufacturing. At three sigma, approximately 2700 ppm will fall outside the normal variation of $\pm$ three sigma. Looking at three sigma from a broader perspective, such as that of building a product that may contain 1200 parts/steps, results of 3.24 defects per unit ($1200 \times .0027$) on average can be expected. "This will result in a rolled yield of less than four percent," which means fewer than four units out of every hundred would go through the entire manufacturing process without a defect (see Table 4-2).

TABLE 4-2

ROLLED THROUGH PUT YIELD

<u>Total Defects Per Unit</u>	<u>Rolled Through Put Yield (%)</u>
5.30	0.5
4.60	1.0
3.90	2.0
3.20	4.0
3.00	5.0
2.30	10.0
1.60	20.0
0.90	40.0
0.51	60.0
0.36	90.0
0.05	95.0
0.00	100.0

Source: (Motorola Six Sigma Training Booklet)

In order to improve the rolled yield, the product must be designed to accept characteristics which are much greater than $\pm$ three sigma away from the Mean. (Six Sigma Training Booklet, p. 6)

A product design which accepts twice the normal variation of the process, of $\pm$ six sigma, will produce on the average 3.4 ppm defective for each characteristic, even if the process Mean were to shift $\pm$ 1.5 sigma. Using the same case as above, with a product containing 1200 parts/steps, only 0.0041 defects per unit would result (1200×0.0000034). This would mean only four units out of 1000 would experience any

defect through the entire manufacturing process (see Table 4-3).

TABLE 4-3

OVERALL YIELD VS SIGMA
(Distribution Shifted +/- 1.5 Sigma)

<u>Number of Parts/Steps</u>	<u>± 3 Sigma</u>	<u>±6 Sigma</u>
1	93.32%	99.99966%
7	61.63	99.99760
10	50.08	99.99660
20	25.08	99.99320
100	00.10	99.96600
500	-	99.83000
800	-	99.72900
1200	-	99.59300
17,000	-	94.38400

Source: (Motorola Six Sigma Training Booklet)

b. Total Cycle Time Reduction

Another key operational initiative under the Total Customer Satisfaction effort is the Total Cycle Time Reduction. A cycle is defined in two different ways: First, it is defined as the elapsed time from when the customer places an order for an existing product to the time it takes for them to receive it; and secondly, in the case of a new product, it is the time from when the product is conceived to the time it is received by the customer. In this process the total system is examined, including design, manufacturing,

marketing, and administration. Typically, unnecessary loops and bottlenecks are discovered during this mapping the system-out process, such as too much or too little inventory waiting to be used on the production line.

c. Participative Management Program

The Participative Management Program (PMP) encourages non-executive employees to become directly involved in problem solving. PMP also has additional objectives which include: generating improved two-way communication; stimulating recommendations leading to the best possible product and service, delivered on time, at the lowest possible cost; and rewarding people financially when improved business performance results. Composed of employees who usually work in the same area or have a similar goal, PMP teams meet frequently to assess progress of ongoing efforts and identify new quality initiatives. To reward high-quality work and to promote teamwork, savings resulting from group efforts are shared. PMP bonuses over the past four years have averaged approximately three percent of Motorola's payroll.

3. Requirements of the "Total Consumer Satisfaction" Process

Motorola developed six "requirements" of the "Total Customer Satisfaction" process. These were developed primarily through Motorola's team efforts in the early 1980's to determine the methods and underlying principles practiced

by the world's most competitive companies. Each of the six requirements will be discussed below.

a. Top-Down Commitment and Involvement

Top management's commitment to quality is reflected in its corporate operating and policy meetings which are held eight times a year. Where quality was once relegated to the bottom of the schedule, it is now the first topic on the agenda, followed by finance, operations and other topics.

When we have thoroughly examined all quality issues, the chairman usually leaves the meeting. Quite simply, if we succeed at quality, then every other item on the agenda will fall into place. (Buetow, p. 1)

Other examples of commitment by management are: systematic customer and supplier visits by the CEO; spending in excess of \$170 million in worker education between 1983 and 1987; and requiring all officers of Motorola to take part in a formal program of customer visits, as well as conduct frequent Quality System Reviews (QSR). QSRs are in-depth studies covering the various areas of quality performance. (Executive Summary, p. 1)

b. Measurement System to Track Progress

Through the use of statistical process control (SPC) and other statistical analysis methods, such as its Six Sigma Quality initiative, Motorola has provided the processes to provide documentation for adequate benchmarking and process improvement.

c. Tough Goal Setting

Motorola actively seeks full involvement of its employees in the goal-setting process. In its quality planning effort, input is provided by the customer via CEO and officer visits, field return data, and marketing surveys. An additional input into Motorola's extensive quality planning effort is the benchmarking analysis which serves to quantify needed product improvements. (Buetow, pp. 1-2)

d. Provide the Required Education

Motorola has invested more than \$45 million each year for training of its employees with 40 percent of it devoted to training in quality related issues, such as training in PMP, Six Sigma, and SPC. (Annual Report, p. 4) This equates to about \$450 per employee per year or about 2.4 percent of Motorola's payroll. "[T]hat training base, which is currently probably the most significant lever in the institution, is giving us the basis of individually...being competitive." (Galvin, p. 2)

e. Spread the Success Stories

In its efforts to publicize its success stories, Motorola presents numerous quality awards including ten annual corporate CEO awards, Motorola's highest internal quality accolade. Additionally, the CEO and officer visits to customers and suppliers extend Motorola's influence and underlay its commitment to quality.

f. Share Financial Improvement Gains With Those Who Contributed

Motorola's PMP has enhanced contributions by non-executive U.S. employees. Bonus payments averaging between three to 4.5 percent of total payroll have been paid over the last four years under PMP. (Executive Summary, p. 2)

4. Success Stories

Since starting its emphasis on quality with its Total Customer Satisfaction effort, Motorola has experienced steady increase in revenues and net income since 1985, with 1988 being a record year for both. Specific success stories follow.

Cellular telephone operations achieved a 30 to 1 reduction in factory cycle time. This was partly due to suppliers cooperating with Motorola's quality efforts, eliminating the need to inspect incoming parts. Now it takes only four hours to build their Mini-TAC model cellular telephone versus the several weeks it had taken before the Total Customer Satisfaction effort had been implemented. (Alster, p. 64)

Other improvements with the Mini-TAC phone included: a parts count reduction from 1378 to 523; a four to one reduction in defects per unit; and a ten to one improvement in reliability. (Alster, p. 64)

Motorola successfully competed against other Japanese electronics manufacturers and was awarded a major contract

with NTT, the Japanese telephone company. With exceptionally high quality, which translates into a mean time between failure of over 100 years, Motorola's pager easily exceeded NTT's quality and reliability standards. (Fisher, p. 2)

Numerous process improvement measures were instituted in one of Motorola's order processing operations. As a result, "entry errors dropped from 525 to 63" with a corresponding cost reduction from \$1.8 million to \$132,000. (Buetow, p. 11)

5. "Total Customer Satisfaction" Supplier Initiatives--
Partnership for Growth

Motorola first started involving its suppliers in its quality effort in 1983, with its Certified Supplier Program (CSP). Prior to CPS, all Motorola Divisions were performing "double" quality testing. The double testing describes the outgoing testing the product receives as it leaves the manufacturing plant, and the incoming inspection testing it receives at its user division. This redundant testing added significant time delays and cost to the product.

In 1988, Motorola's CEO, Bob Galvin, expanded the formal customer visit program, started in 1986, to include suppliers. The logic was:

If our customers could teach us how to be good suppliers, perhaps our suppliers could teach us how to be good customers....Our goal is simple: We wish to earn the position of being your best customer, and you must be willing to tell us where and how we fall short. (Tooker, p. 2)

Realizing it would never achieve six sigma by 1992 (in all of its key processes) without the active participation of its suppliers, Motorola initiated an intensive supplier/customer training program. This program involves offering one-to-two day classes in four different locations throughout the year. These classes cover the following topics: practical implementation of statistical process control (SPC); design for manufacturability; and manufacturing cycle management.

In 1983-4, Motorola initiated a comprehensive Supplier Quality Assurance Program, which included as a requirement, a Supplier Quality System Survey (see Appendix B). This detailed survey is divided into eight elements, with each element broken further down into specific sub-elements. The whole process attempts to quantify the supplier's quality system and, based on the results, the supplier may find himself ranked from outstanding to unacceptable (no system) (see Appendix B-1).

The survey highlights Motorola's priority on quality improvement, SPC, training programs, departmental communication and interaction, relationship of suppliers, documentation of processes, cost of quality, and other Total Customer Satisfaction principles.

On 6 February 1989, Motorola sent a letter to its suppliers asking for their commitment to compete for the Malcolm Baldrige National Quality Award.

We are now asking, and in fact obliging, that all of our suppliers compete for it also....Any eligible supplier who does not wish to compete and so notifies us, or any supplier who fails to file their notice by June 30, will be disqualified as a supplier by December 31, 1989. (Stork)

This aggressive posture was taken by Motorola based on its own beneficial experiences it realized during its preparations to compete for the Malcolm Baldrige Award. The preparations for the award allowed Motorola to reassess its quality efforts using criteria other than its own. This proved helpful in shaping its long-term quality plan. One such finding indicated: "We wouldn't be around in the 1990's unless we achieved our Six Sigma quality goal, and we wouldn't get there with four sigma suppliers." (Tooker, p. 4)

The next chapter will analyze the researcher's findings, outlined in this chapter, in the context of DoD's efforts to motivate defense contractors to adopt TQM or an equivalent quality effort.

V. ANALYSIS OF DATA

A. OVERVIEW

The purpose of this thesis was to answer the primary research question: Can DoD successfully mandate its suppliers, the defense industry, adopt TQM or an equivalent quality-oriented management philosophy through its source selection process?

In pursuit of this objective, the researcher will analyze the data in the preceding chapters in the context of the following subsidiary questions:

- What issues, facing DoD and the defense industry, can TQM or an equivalent management philosophy address?
- Can a business/organization successfully mandate their suppliers to adopt TQM or an equivalent quality-oriented management philosophy?
- Which essential element(s) of TQM might be incorporated into DoD's source selection process?

B. ANSWERS TO THE RESEARCH QUESTIONS

1. Can DoD Successfully Mandate its Supplier Base to Adopt TQM or an Equivalent Quality-oriented Management Philosophy?

Based on the researcher's efforts, the data, although inconclusive and open to interpretation, indicate DoD can successfully mandate its supplier base to adopt TQM or an equivalent quality-oriented management philosophy, provided the mandate not occur until DoD has undertaken certain efforts

within its own organization. These efforts would provide the infrastructure needed to enable DoD to administer, nurture, train, and help solve the myriad problems that will arise once the mandate has been issued. The above question will be answered in two parts: First, two viewpoints concerning the issue will be discussed in light of H-P and Motorola's experiences; and secondly, an analysis of needed organizational requirements will be presented and discussed.

It is a common belief, in DoD as well as in private industry, that a supplier cannot be mandated to adopt TQM or an equivalent quality-oriented management philosophy. (Strickland, TQM, p. 12) The reasons given for this view center around the massive cultural change that must occur within the organization that undergoes adoption of the TQM philosophy. This change of management principles, methods, and values is so radically different that simply mandating such a change via a military clause or military standard in a contract would undoubtedly result in the prospective offeror being confused and frustrated, inevitably resulting in the best situation; a partially successful TQM implementation and in the worst case, a very costly, failed effort.

The other viewpoint represents a more aggressive approach towards supplier management. From this perspective, suppliers can be exposed to the philosophy through awareness sessions, support provided in terms of training and assist visits, and over time, the supplier can be "nurtured" to the

point where they are required to either commit to the stated principles and methods of a quality-management philosophy or be terminated as the supplier. In the case of H-P, this nurturing process involved approximately four to six years, and in Motorola's case, two to six years.

H-P first started its quality-oriented management push in 1980, however, it did not formally involve its suppliers until 1983-4. It was at that time suppliers were asked to start instituting statistical quality control techniques into their manufacturing processes. Over the following five to six years, H-P continually revised its supplier requirements to reflect a greater emphasis on the H-P TQC management philosophy, which was undergoing evolutionary development within H-P. This is evidenced by H-P's current Supplier Performance Expectations which emphasizes the "correct selection of suppliers, and then working with them in specific areas to improve quality and productivity." Specific TQC principles stressed in H-P's current Supplier Performance Expectations handbook are:

- long term mutual commitment;
- use of continuous improvement and measures;
- close "partnership" relationship, emphasizing effective two-way communication and win-win strategy;
- collaborative design efforts;
- strong commitment to R&D;

- use of SPC and other TQC techniques for process control and improvement; and
- high level commitment to H-P and TQC.

Chapter IV provides a more in-depth discussion of H-P's Supplier Performance Expectations.

Motorola initiated its quality efforts in 1981, when it set out to achieve its tenfold reduction in the level of defects. The suppliers were then included in Motorola's efforts in 1983, at which time Motorola introduced their Certified Supplier Program (CSP). The CSP allowed certified suppliers products to bypass the standard receipt inspection process. The program underwent modification in 1985-6, when suppliers were complaining of receiving mixed signals from different Motorola divisions. One division would certify the suppliers, while another division using a different part supplied by the same company, would not recommend it for CSP status. Now the CSP status is awarded by part only.

The evolutionary nature of the suppliers' involvement in Motorola's Total Customer Satisfaction is further demonstrated by the gradual development of what used to be in 1982-3, a simple, one page requirement for suppliers to start using quantitative methods in process improvement, and has now expanded to an extensive nine page quality audit procedure consisting of eight primary elements and ten sub-elements for each primary element (see Appendix B).

It is this researcher's opinion that the following requirements should be met prior to DoD mandating suppliers adopt TQM or other equivalent quality-oriented management philosophy.

a. Adequate In-house Experience and Expertise

Three factors are important concerning the issue of in-house DoD talent: First, the issue of possessing the requisite talent in-house is crucial for obvious reasons; secondly, DoD's general lack of knowledge concerning the complex manufacturing and production techniques commonly practiced in private industry; and thirdly, the large number of DoD projects involving current state-of-the-art technology. In analyzing this issue, the researcher will refer to his findings involving H-P and Motorola.

Both H-P and Motorola accumulated considerable in-house experience and expertise concerning their respective quality-oriented management philosophies before mandating their suppliers adopt their respective quality oriented philosophies.

In H-P's case, three to four years passed before H-P initially involved their suppliers in a very limited role, and a full six to eight years before H-P mandated their suppliers adopt the principles and practices of Total Customer Satisfaction or an acceptable quality effort or find business elsewhere. Throughout those eight years, H-P's Total Customer Satisfaction effort was also continually evolving.

Only two years passed before Motorola involved their suppliers in their quality efforts, however, it wasn't until 6 February 1989, eight years after their initial quality push, that Motorola mandated their suppliers to sign up to compete for the Malcolm Baldrige National Quality Award or be "disqualified as a [Motorola] supplier by December 31, 1989." (Stork)

The issue here is not whether an organization should possess adequate in-house skill and historical data before it initiates a "program," but more accurately, when does an organization have the requisite knowledge and expertise to mandate such a requirement. This, of course, depends on the business/organization's environment, such as the complexity of processes, size of the supplier base, technical background of in-house people, and the organization's familiarity with the processes of its supplier base. For each business/organization, these environmental conditions will indicate the correct point in time.

A second factor, which may be a larger issue within DoD than in the private sector, is the problem of familiarity with the various design, tooling, manufacturing, and testing processes used by many of the defense contractors. In the case of H-P and Motorola, and others within private industry, there is a greater understanding and appreciation for the various processes involved in manufacturing.

A third factor, related to expertise and experience of the in-house workforce, may also complicate this issue. DoD's acquisitions frequently involve state-of-the-art technology, which include complex processes and concomitant quality problems. DoD's in-house talent may fall far short of the skills needed to provide their suppliers with assistance. Because of DoD's dearth of talent in the areas of design, manufacturing, tooling and testing, especially in the area of current state-of-the-art technology, a greater reliance on quality and production consultants may be required.

b. Comprehensive Supplier Training Program

The quality of this training is crucial and should cover the wide range of quality related topics such as those offered by Motorola. The quality of the awareness seminars may also play a vital role in the degree of supplier acceptance of the mandate. In order to share the "cost" of such a training effort DoD could form a coalition with academic leaders across the country and convince them to help shoulder some of the responsibility of educating the suppliers, and possibly even DoD personnel, by offering basic courses in practical statistics, SPC, TQM, etc.

H-P offers basic quality awareness briefings for its suppliers, however, they do not provide formal training classes. H-P typically refers an interested supplier to a source for the required training, such as a quality consultant, local school, or seminar.

Motorola appears to have an extensive awareness and training program available for suppliers for a moderate fee. The one-to-two-day classes are offered in four locations around the country throughout the year and cover subjects such as: statistical process control, design for manufacturing, and manufacturing cycle management. The classes are geared towards manufacturers, purchasing, quality, engineering, and sales personnel. (Motorola Training)

c. Supplier Performance Tracking Capability

Although both H-P and Motorola agreed that this was critical prior to mandating suppliers adopt a quality-oriented philosophy, only H-P has a state of the art, near real-time supplier performance tracking system. This system is capable of making available to any of H-P's 54 geographically dispersed divisions, any serious supplier deficiency within 48 hours of its occurrence. Motorola is currently working on a state of the art system, that would give it a similar capability currently enjoyed by H-P.

Past performance is a critical factor in evaluating any supplier, but it achieves even a higher degree of criticality when mandating a quality-oriented philosophy to the supplier base. During this process, the organization is attempting to develop long-term partnerships with the "best" of the suppliers. If past performance can't be accurately tracked in a near real-time basis, needless, costly errors will be made.

This requirement is key to DoD's successful mandate. This capability would indeed be expensive to place into operation, however, the technology is in use today by H-P.

d. Comprehensive Supplier Quality Audit Procedure

A supplier quality audit that adequately addresses quality-oriented management philosophies, such as TQM, are currently in use today by H-P and Motorola. This process should be extensive in scope, and periodically be applied to ensure quality-oriented efforts are ongoing.

H-P and Motorola both use a detailed, comprehensive quality audit procedure that addresses key elements of each firm's respective quality-oriented effort. Both firms' audit procedures were quantitative in nature, stressing continuous improvement of processes through SPC and other methods.

e. A Formal Joint DoD-Industry TQM Council

This council should be made up of senior- and middle-ranking representatives from DoD and industry to provide a greater perspective on TQM-related issues. Additionally, members from industry associations should be included to ensure a larger audience is participating. This council could also serve as the springboard for the eventual DoD mandate.

f. Congressional Support

An intense effort should be initiated, perhaps through the joint DoD-Industry council on TQM, to carefully foster congressional support. High quality awareness briefings for key congressmen and their staffs, as well as expert testimony from key quality experts and recognized successful leaders in business, such as, John Young, President and CEO of H-P, or Robert Galvin, Chairman of Motorola, could help develop congressional support.

Currently, DoD's Total Quality Management Master Plan lists "Congressional understanding of and support for TQM" as a long-range goal (seven years). (DoD TQM Master Plan, p. 4) This goal should be moved up to a mid-range goal (three years) to ensure that poorly-informed congressmen do not develop premature and damaging positions on the issue.

2. What Issues, Facing DoD and the Defense Industry, Can TQM or an Equivalent Management Philosophy Address?

This researcher found no shortage of printed matter, including numerous studies, reports, periodicals, speeches, and books, many cited in Chapter II, expounding on the numerous deficiencies existing in the current DoD-defense industry acquisition relationship. A full discussion of these deficiencies is provided in Chapter II, however, the key issues will be recapped below.

a. The Competitiveness of the U.S. Industrial Base

From a broad perspective, the U.S. industrial base's competitiveness had been on the decline for a number of years, and, if the trend continues, DoD may find itself in the unthinkable position of being dependent on foreign sources for critical design technology, manufacturing ability, and logistics support.

Product quality plays a key role in the ability of a U.S. manufacturer to compete with foreign sources. Although there is no conclusive evidence which states that products purchased for DoD's use are any lower in quality than what is available to private industry, there is evidence, as cited in the November 1986 GAO report entitled, "Quality Assurance, Efforts to Strengthen DoD's Program," that the current in-plant quality assurance programs controlled by all of the Services and DLA are "not as effective as [they] should be in ensuring that quality products are delivered to field activities." (GAO, p. 1) This almost sounds like an understatement compared to the GAO's findings which indicate over 50 percent of the 24 Air Force contractor plants included in the study "had less than satisfactory quality assurance functions." The report also cited Defense Logistics Agency's (DLA) own findings which indicate only 21 percent of the 224 contractors DLA reviewed in 1985 earned "acceptable" ratings. (GAO, p. 2) Chapter II discusses the GAO report in greater detail.

Noted quality experts, such as W. Edwards Deming, Philip B. Crosby, Genichi Taguchi, and Joseph M. Juran all agree that substantial savings, typically five to 20 percent, can be realized by a business that successfully adopts a quality-oriented management philosophy, which stresses, among other things, continuous process improvement, use of quantitative methods, such as statistical process control, and a top management dedicated to the pursuit of quality. With the majority of defense contractors still practicing traditional western management practices versus a quality-oriented management, it is safe to suspect the Government is paying five to 20 percent more for the majority of the supplies and services it purchases, as well as receiving an inferior quality product.

The blame for such inefficiency is shared. Current DoD procurement policies, such as full and open competition, arms-length relationship with suppliers, and emphasis on low cost versus "best value," discourage the development of Government supplier "partnerships" which have proven successful in private industry.

An additional stumbling block hindering DoD's receiving of quality goods and services is in the area of its quality assurance policies. Here, DoD's guidance centers around outdated military standards, such as military standard 105D, which stresses costly end-of-line inspection techniques and average quality limit (AQL) measurement.

Healthy customer-supplier "partnerships" in a quality-oriented environment has produced a number of benefits including: early integration of suppliers and customers into the design process, teamwork approach by all (customer, manufacturer, and suppliers) to continuously improve the process, schedule flexibility, shared start-up costs and less inspection. (Stuelpnagel, p. 7)

Another key element of the U.S. industrial base's poor competitiveness posture is its anemic productivity growth rate over the past ten years. Two studies, which are cited in Chapter II's discussion of this issue, point to a steady decline in the overall productivity of the defense industry. One study, entitled "Bolstering Defense Industrial Competitiveness," focused on capital expenditures of "critical defense industries." The last year of the report, 1985, "72 percent [critical industries] had lower than average capital expenditures." (Costello, p. 26) This, of course, can easily translate into poor future performance due to aging plants and equipment.

b. DoD Budget Cuts

Another major issue facing DoD and the defense industry, which TQM can help in addressing, is the continued massive defense budget cuts that may total \$200 billion over the next four years. This unprecedented funding cut will place an ever-mounting pressure for DoD to find ways to improve productivity and product quality. This pressure will

undoubtedly be felt by all "players" in the acquisition system: The sailor or soldier who, as an end user, relies on being supplied with a high quality weapon; DoD, as the buying organization, must meet its mission with an ever-decreasing budget; the contractor, who will face increasing competition from foreign sources; and the sub-contractor, who may face even more difficult financial constraints, as well as competitive forces from abroad.

c. Over-Regulation of the Defense Acquisition Process

Applying TQM principles and methodologies to the policy process could take form by DoD establishing a Quality Management Board or Process Action Team with industry, to adequately address policy concerns from this supplier-customer relationship. As was stated in Chapter II, too frequently, poorly-drafted, poorly-researched, and in some cases contradictory policy, is promulgated by Congress and DoD, with the end result being further frustration by all concerned, greater inefficiency in the procurement process, and additional cost to be shouldered by the taxpayer through an already depleted DoD budget.

3. Can a Business/organization Successfully Mandate a Supplier Adopt TQM or an Equivalent Quality-oriented Management Philosophy?

Based on this researcher's efforts, the data, although inconclusive, indicate that a business/organization can successfully mandate a supplier to adopt TQM or an equivalent quality-oriented management philosophy, provided the mandate

not occur until the business/organization has undertaken certain efforts within its own organization to be able to administer, nurture, train, and help solve the myriad of problems that will arise once the mandate has been promulgated.

It is this researcher's opinion that the following requirements should be met prior to a business/organization mandating a supplier base adopt TQM or other quality-oriented management philosophy.

a. Adequate In-house Experience and Expertise

The same issue of knowing when the business/organization has the requisite talents, as discussed above in Question 1, applies here also.

b. Comprehensive Supplier Training Program

Due to the paucity of formal classes being offered by local community colleges, adult education programs, or even colleges and universities in these specific areas of quality improvement, an in-house training program would provide these required classes on a flexible schedule to allow maximum attendance by interested suppliers. Without a formal training program providing the mandatory training, effort will be less likely to succeed.

As was discussed in Question 1 above, H-P and Motorola strongly believe in supplier training, however, only Motorola had an existing formal supplier training program.

c. Supplier Performance Tracking Capability

The importance of an adequate supplier performance tracking system is crucial. Past performance can not be accurately tracked without one. H-P and Motorola agreed that this requirement was crucial before considering mandating a quality effort. A discussion of H-P and Motorola's position is located in Question 1 above.

d. Comprehensive Supplier Quality Audit Procedures

An in-depth, comprehensive quality audit is essential in aiding the buying organization in its assessment of the suppliers' quality program. Additionally, a percentage of the supplier base may pay "lip service" to the quality commitment the buying organization is calling for. Thus, it is crucial these suppliers are discovered as early as possible in the process. Both H-P and Motorola have extensive quality audit procedures currently in practice, as was discussed in Chapter IV and in Question 1 above.

3. Which Essential Element(s) of TOM Might be Incorporated Into DoD's Source Selection Process?

A criterion addressing the supplier's commitment to continuous quality improvement should be included in all Government contracts. This researcher concludes that this criterion, called Quality Management, should be mandatory in all source selections. The following specific areas should be addressed under this criterion by the prospective offeror:

- Describe your company's continuous quality improvement effort. Describe in detail the following, including how long each has been operational:
 - (a) Quality training program (what percent of payroll)
 - (1) Describe training courses offered to your employees.
 - (2) Describe training courses offered to your suppliers.
 - (b) Describe methods used to control your different processes: administrative; manufacturing; design, etc. For example, statistical process control (SPC). How extensively is it used?
 - (c) Provide a written copy of your firm's stated position on quality.

For large contracts of an on-going nature, DoD should utilize an in-depth quality audit procedure to more accurately determine the true state of the firm's quality efforts. This audit should become a standard part of every pre-award survey. The audit would be structured similarly to Motorola's current effort, which includes a 3-10 man team of highly-trained quality analysts. Using the detailed quantitative format located in Appendix B, the audit team visits the firm and conducts a thorough survey. The score is then factored in with the other traditional source selection criteria to determine the awardee.

This researcher does not, however, recommend that DoD specifically prescribe a standard source selection scoring system for TQM, as each procurement is unique and requires flexibility on the part of the contractor.

C. SUMMARY

The researcher conducted interviews with: Both senior Government personnel in contracting, as well as in TQM policy making and implementation; and senior executives within H-P and Motorola. Based on those interviews and extensive reading, the following summarizes his findings.

DoD can successfully mandate its supplier base adopt TQM or an equivalent quality-oriented management philosophy. This is predicated on the following being in place and well established at the time of mandate:

- adequate in-house experience and expertise;
- comprehensive supplier training program;
- supplier performance tracking capability;
- comprehensive supplier quality audit procedure;
- a formal joint DoD-Industry TQM council; and
- congressional support.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis investigates: TQM and equivalent quality-oriented management philosophies; current issues facing DoD and the defense industry, as they pertain to TQM; and DoD's ability to mandate its supplier base adopt TQM or an equivalent quality-oriented management philosophy. The following conclusions and recommendations were reached:

1. DoD Can Successfully Mandate its Supplier Base Adopt TQM or an Equivalent Quality-oriented Management Philosophy Providing the Following Requirements are in Place and Well-established at the Time of Mandate

- a. Adequate In-House Experience and Expertise

DoD may have to heavily rely on quality and manufacturing consultants due to the highly complex nature of many of the manufacturing processes involving state-of-the-art technology. Appropriate time and effort should be expended to ensure the Government can understand and provide assistance to its suppliers.

- b. Comprehensive Supplier Training Program

This training program should provide a wide range of training, from basic awareness training through more advanced forms of quantitative analysis.

Due to the paucity of classes offered in the area of statistical process control (SPC), and continuous quality

improvement by conventional schools, such as colleges, universities, and community colleges; DoD must develop a plan to offer a comprehensive training program in the above areas for prospective suppliers.

c. Supplier Performance Tracking System

It makes good business sense that DoD should want to develop long-range partnerships with top quality suppliers. A crucial factor in determining the supplier's competence is its past performance. Without an accurate, near real-time supplier performance tracking system, DoD could enter into some very costly partnerships.

d. Comprehensive Supplier Quality Audit Procedure

A supplier quality audit procedure is necessary to determine the validity of a firm's quality efforts. Both H-P and Motorola use such a procedure with excellent results.

e. A Formal Joint DoD-Industry TQM Council

A formal working group needs to be established to manage the numerous issues that are quickly going to surface as the time approaches for DoD to mandate the suppliers adopt TQM or an equivalent quality-oriented philosophy.

f. Congressional Support

Fostering congressional support should be a top priority to ensure TQM's institutional integrity is established and maintained.

2. There is Evidence that Supports TQM or an Equivalent Quality-oriented Management Philosophy is Superior in Terms of Productivity and Productivity Growth Rate than the More Traditional Western Management Style

TQM principles and techniques stress: Continuous process improvement through quantitative measurement; a strong commitment to quality by all, open communication and involvement; and a long-range commitment to staying in business and providing jobs. Many Japanese companies, as well as U.S. companies have successfully implemented TQM or an equivalent quality-oriented effort, and as a result, have realized improvements in productivity, competitive position, and market share.

3. There is a Strong Compelling Need to Effectively Address the Major Issues that Exist Between DoD, Industry, and Congress

Major problems exist between DoD, industry, and Congress. These include: the declining competitiveness of the defense industrial base; the need to maintain an effective deterrent against armed conflict in an increasing fiscally-constrained environment; and a severely over-regulated and inflexible DoD acquisition process. Through the effective implementation of TQM within DoD, and the carefully orchestrated mandate to the supplier base that TQM or an equivalent quality-oriented management philosophy be adopted, DoD, working with industry and Congress, can positively impact the issues stated above.

B. RECOMMENDATIONS

Through evaluation and analysis of the findings, the researcher has formulated the following recommendations:

1. Dod Should Develop a Plan to Eventually Mandate its Supplier Base Adopt TQM or an Equivalent Quality-oriented Management Philosophy

This plan should have in place the following infrastructure prior to the mandate:

- adequate in-house experience and expertise;
- comprehensive supplier training program;
- supplier performance tracking system;
- comprehensive supplier quality audit procedure;
- formal joint Dod-Industry TQM council is established; and
- congressional support.

2. DoD Should Develop Formal Procedures, to Include industry Input, for the Following Purposes:

- a. Identify the Critical Industries that Will be Required to Ensure a Viable Industrial Base is Maintained; and
- b. Based on This Assessment, DoD Should Target Those Selected Industries to be Mandated to Adopt TQM or an Equivalent Quality-oriented System on a Priority Basis

Due to the rapidly declining competitiveness of certain sectors of the industrial base, it is critical that these industries be identified, and their competitive position be enhanced through the implementation of TQM or an equivalent quality-oriented effort. The only other viable alternative is the undesirable use of protectionism policy. This process should be an on-going effort, analyzing both the immediate and

future defense industrial base requirements needed to ensure DoD is maintained as a viable deterrent.

3. DoD Should Modify Its Total Quality Management Master Plan

The current DoD TQM Master Plan, dated August 1988, identifies the goal of obtaining "Congressional understanding and support for TQM" as a long-range goal (seven years). The effective implementation of TQM within DoD, as well as the eventual DoD mandate to its supplier base to adopt TQM, relies strongly on congressional support in the near-term. Accordingly, DoD should modify the goal of obtaining congressional support, to a mid-range goal (three year), for purposes of enhancing TQM's long-term institutional integrity and effectiveness.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

Research conducted for this thesis has revealed the following areas for further research:

- Develop a methodology for identifying critical industries needed to provide a viable industrial base for DoD's present and long-term needs;
- Identify the specific Government rules and regulations which prevent DoD from mandating its supplier base to adopt TQM or an equivalent quality-oriented management philosophy;
- Perform a benefit analysis of the existing Government rules and regulations preventing the mandate of TQM or an equivalent quality-oriented effort, versus those benefits that would be realized by mandating TQM.

APPENDIX A

CONTRAST BETWEEN WESTERN MANAGEMENT AND TOTAL QUALITY MANAGEMENT

WESTERN MANAGEMENT STYLE

Top management emphasis:

-Financial (ROI)

-Marketing--sell what you make

Divisions work toward individual goals.

Volume orientation

Goal: Cost minimization

Products are made to be sold.

Products too often had planned obsolescence.

Quality is a manufacturing problem.

CEO rarely gets involved in quality.

Quality is a sub-goal.

Quality is the responsibility of the quality control division.

Quality control is oriented to inspection/correction of defects.

Q.C. staff is trained in statistics.

TOTAL QUALITY MANAGEMENT

Top management emphasis:

-Technical--improving the product

-Humanistic--participative management

All divisions work to support a common company goal.

Quality orientation

Goal: Maximize quality

Products made to have long, trouble-free lives and to meet customer needs/expectations.

Quality is a company-wide concern.

CEO takes an active role in leading the quality effort.

Quality is the goal.

Quality is everyone's responsibility.

Quality management is oriented to defect prevention.

Everyone is trained in basic SPC and quality management.

Supplies bought from lowest bidder. Vendor relationship is adversarial and short-term.

Inspection of incoming vendor material can prevent rejects down the line.

Workers are a part of the production process and must be "policed" to ensure worker compliance with standards.

Acceptable quality level (AQL) governs output of acceptable quality.

Quality of product is ensured with adequate inspection but quality of process is poor.

Supplies from vendor which can provide proof of SPC of his production process. Vendor relationship is cooperative and long-term.

Vendor material is bought with proof of SPC control attached and used without inspection.

Workers are the greatest source of improvements. Workers inspect their own work and product quality.

Continuous improvement leads to defect level measured in parts per million (ppm).

Quality of process creates quality of product.

APPENDIX B

MOTOROLA'S CORPORATE SUPPLIER QUALITY SYSTEM SURVEY

This survey procedure provides Motorola a broad, in-depth look at a prospective supplier's quality management efforts. The procedure attempts to quantify and measure numerous aspects of a supplier's corporate commitment to quality. The goal of the process is to help select a supplier genuinely dedicated to continuous quality improvement.

MOTOROLA CORPORATE SUPPLIER QUALITY SYSTEM SURVEY

SUPPLIER NAME: DATE: SURVEY TEAM LEADER:	SCORE (%)	SUBSYSTEMS RATINGS					WEIGHT	WEIGHTED TOTAL
		NO SYSTEM	SIGNIFICANT DEFICIENCY	IMPROVEMENT NEEDED	SATISFACTORY	OUTSTANDING		
		20	40	70	85	100		
SUBSYSTEMS		0	21	41	71	86		
1 Quality System Management							0.2	
2 Design Information							0.1	
3 Procurement							0.1	
4 Manufacturing and Material Control							0.1	
5 Final Acceptance							0.1	
6 Calibration							0.1	
7 Quality Information							0.1	
8 Statistical Process Control							0.2	
SYSTEM RATING								
PREVIOUS SYSTEM RATING (DATE:)								

SYSTEM RATING:

86 - 100	OUTSTANDING
71 - 85	SATISFACTORY
41 - 70	IMPROVEMENT NEEDED
21 - 40	SIGNIFICANT DEFICIENCY
0 - 20	NO SYSTEM

COMPANY : _____ DATE : _____ SURVEYOR : _____		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
ELEMENT # 1 : QUALITY MANAGEMENT		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	Are Quality Objectives and responsibility clearly stated, widely distributed, and understood through the company ?							
2.	To what extent are Quality Objectives used to guide planning ?							
3.	Do all support organizations understand their role in achieving Total Customer Satisfaction ?							
4.	Are the quality procedures and policies current and available at the point of application ?							
5.	Are Statistical Process Control (SPC) principles understood by all levels of management ?							
6.	To what extent does management solicit and accept feedback from the work force ?							
7.	Does a comprehensive training program exist?							
8.	Are the quality and reliability goals aggressive relative to customer expectations and targeted at zero defects?							
9.	How technically informed are the people who are responsible for administering the Quality Assurance function ?							
10.	Does Management have a "defect prevention" attitude to achieve continuous quality improvement targetted at zero defects ?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____ DATE : _____ SURVEYOR : _____ ELEMENT # 2 : DESIGN		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	To what extent are manufacturing, product, process and configuration documents under issue control ?							
2.	To what extent are 'preliminary' and 'special product' specifications controlled ?							
3.	How well does the system ensure that the most current customer specifications are available to the manufacturing personnel ?							
4.	To what extent does the system ensure that the most current material specifications are available to the procurement function ?							
5.	To what extent are incoming orders reviewed for revisions and issue changes ?							
6.	How well is conformance to customer specifications assured before an order is accepted ?							
7.	To what extent are critical characteristics classified ?							
8.	To what extent are customers informed of changes made to products controlled by customer drawings or specifications ?							
9.	Is there an effective internal deviation control procedure and are customer requested deviations documented and followed ?							
10.	Do new product development procedures exist and are they followed in the design process ?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____ DATE : _____ SURVEYOR : _____ ELEMENT # 3 : PROCUREMENT		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	To what extent is quality history considered along with price, delivery, and service when making sourcing decisions?							
2.	Are purchased material requirements adequately specified?							
3.	Are suppliers expected to conform exactly to requirements and is MPC used in supplier control?							
4.	To what extent does the company have appropriate technical communications with its suppliers?							
5.	Does an effective procured material and services quality improvement program exist including sub-suppliers?							
6.	Are receiving inspection facilities and equipment adequate and properly maintained?							
7.	How well are receiving inspection procedures documented and followed?							
8.	Are receiving inspection results used for corrective and preventive action?							
9.	How effective are the procedures for storage and timely disposition of discrepant purchased material?							
10.	Is there an effective supplier certification program and is it verified by independent checking?							
TOTAL AVAILABLE POINTS								

COMPANY : _____ DATE : _____ SURVEYOR : _____ ELEMENT # 4 : MANUFACTURING AND MATERIAL CONTROL		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	Are process capabilities established and maintained on all major processes?							
2.	Are in-process inspections, test operations, and processes properly specified and performed?							
3.	How adequate are inspection facilities and equipment ?							
4.	Are the results of in-process inspection used in the promotion of effective corrective and preventive action ?							
5.	To what extent is preventative maintenance performed on the equipment and facilities ?							
6.	Are housekeeping procedures adequate and how well are they followed ?							
7.	Are procedures and facilities for storage, release, and control of material adequate?							
8.	Are in-stores and in-process materials properly identified and controlled?							
9.	Are material and finished goods protected from corrosion, ESD, EOS, deterioration, or damage?							
10.	Is non-conforming material properly identified and segregated from regular production and dispositioned?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
DATE : _____		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
SURVEYOR : _____								
ELEMENT # 5 : FINAL ACCEPTANCE								
No.	DESCRIPTION	0	1	2	3	4		
1.	How well are statistical techniques used in determining the acceptability of finished goods to customer requirements?							
2.	Are certifications and in-process inspection results used in making final acceptance decisions properly ?							
3.	How adequate are final acceptance facilities and equipment ?							
4.	Are final product acceptance procedures documented and followed ?							
5.	Are final acceptance inspection results used for corrective and preventive action ?							
6.	To what extent are packing and order checking procedures documented and followed ?							
7.	Are periodic tests conducted to audit the reliability and environmental performance of the final product?							
8.	Is Cpk tracking performed on customer's critical characteristics with plans to achieve Cpk = 2.0 (Six Sigma capability)?							
9.	Is root cause failure analysis performed on internal and external failures and appropriate corrective action implemented?							
10.	Are test/inspection personnel adequately trained in the procedures of their operations and are those procedures being followed?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
DATE : _____		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
SURVEYOR : _____								
ELEMENT # 6 : CALIBRATION								
No.	DESCRIPTION	0	1	2	3	4		
1.	Are calibration and maintenance facilities adequate?							
2.	Are calibration and preventive maintenance programs fully documented?							
3.	Are calibration and maintenance personnel fully qualified and in sufficient quantity?							
4.	To what extent is traceability to NBS maintained ?							
5.	Is quality measurement and control equipment up-to-date, effective, and sufficiently integrated with production equipment?							
6.	Is all quality measurement and control equipment properly documented?							
7.	Are all tools and fixtures that are used as media of inspection fully qualified and identified?							
8.	Has repeatability of measuring devices and inspection or testing processes been established and is it monitored ? Note: Are gauge capability studies conducted and are P/T ratios acceptable (<10%)?							
9.	Are calibration and preventive maintenance cycles on schedule?							
10.	Is the use of non-calibrated equipment for design and production purposes prohibited?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____ DATE : _____ SURVEYOR : _____ ELEMENT #7 : QUALITY INFORMATION		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	Are records of inspection and process control maintained ?							
2.	Is the record and sample retention program adequate?							
3.	How well are quality data used as a basis for action ?							
4.	How well are quality data used in reporting performance and trends to management ?							
5.	To what extent are quality records used in supporting certifications of quality furnished to customers ?							
6.	How well is field information used for corrective action ?							
7.	Does a Cost of Quality measurement system exist?							
8.	Are customer reported quality problems properly responded to within two weeks and resolved on a timely basis?							
9.	Is quality information on production material rejects provided to sub-suppliers with effective corrective action obtained?							
10.	To what extent are computers used to collect and analyze quality data?							
		TOTAL AVAILABLE POINTS						

COMPANY : _____ DATE : _____ SURVEYOR : _____ ELEMENT # 8 : STATISTICAL PROCESS CONTROL		FACTOR RATING (R)					AVAILABLE POINTS (0 OR 4 POINTS)	SCORE
		NO SYSTEM	SIGNIFICANT DEFICIENCY	NEEDS IMPROVEMENT	SATISFACTORY	OUTSTANDING		
No.	DESCRIPTION	0	1	2	3	4		
1.	How qualified are the people who are responsible for guiding the implementation of SPC ?							
2.	To what extent are statistical techniques used to reduce variation in the design process - before the start of production ?							
3.	To what extent is the quality system dependent upon process rather than product controls ?							
4.	How well is the capability of critical processes and machines measured and monitored with Cpk's > 1.5 and targeted at 2.0 ?							
5.	Are incapable processes or machines targeted for improvement or replacement?							
6.	To what extent are process controls in place for ALL products and ALL customers (% of SPC implementation)?							
7.	Are the procedures that control the reaction to process and product out of control situations adequate and effective?							
8.	Are operators trained in the use of appropriate statistical techniques and are they properly applying them?							
9.	Are advanced problem solving techniques used by engineers to solve problems? (Design of Experiments, Planned Experimentation, Advanced Diagnostic Tools, etc.)							
10.	Are control charts and other process controls properly implemented. Examples: Capability studies performed, proper sample sizes and frequency, control limits recalculated, analysis for runs, monitored on a real time basis, and readily accessible to operators.							
TOTAL AVAILABLE POINTS								

RATING GUIDELINES

<u>RATING</u>	<u>DEFINITION</u>
N/A	Not Applicable - Indicate Available Points = 0.
0	The item/procedure is NOT included in the suppliers quality system.
1	The item/procedure is included in the quality system but planning and execution both require SUBSTANTIAL improvement.
2	The item/procedure is Included in the quality system and is generally acceptable. However, the level of planning or execution still requires SOME improvement.
3	The item/procedure is included in the quality system. Planning and execution MEETS requirements.
4	The item/procedure is included in the quality system. Planning and execution is thorough and outstanding.

.....

SUPPLIER CORRECTIVE ACTION RESPONSE: All questions with a 0 or 1 score require a written C/A plan withing 30 days of the survey date.

.....

SUBSYSTEM AND ELEMENT SCORING

ELEMENT RATING (%) = $\frac{\text{TOTAL SCORE POINTS}}{\text{TOTAL AVAILABLE POINTS}}$

SUBSYSTEM RATING = ELEMENT SCORE (%) X WEIGHT

SYSTEM RATING = SUBSYSTEMS 1 - 8 TOTALS

APPENDIX C

LIST OF TERMS

CSP	Certified Supplier Program
IFB	Invitation for Bid
PMP	Participative Management Program
QC	Quality Control
RFP	Request for Proposal
SPC	Statistical Process Control
SQC	Statistical Quality Control
TQC	Total Quality Control
TQM	Total Quality Management
TQMP	Total Quality Management Process
TQRDC	Technology, Quality, Responsiveness, Delivery, and Cost

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