AEROSPACE QUALITY PROCESS TRAINING

IN OKLAHOMA

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NOMENCLATURE

AFLC	Air Force Logistics Command
AFMC	Air Force Material Command
ALC	Air Logistics Center
ANSI	American National Standards Institute
ASQ	American Society of Quality
ASQC	American Society of Quality Control
CATT	Computer Assisted Technology Transfer
CICA	Competition in Contracts Act
DOC	Department of Commerce
DOD	Department of Defense
EC	Electronic Commerce
EDI	Electronic Data Interchange
FAA	Federal Aviation Administration
FAR	Federal Acquisition Regulation
FEDLOG	Federal Logistics Database
FPL	Florida Power and Light
FQI	Federal Quality Institute
GNP	Gross National Profit
ISO	International Standards Organization

MIL	Military
MIT	Massachusetts Institute of Technology
MMAC	Mike Monroney Aeronautical Center
NASA	National Aeronautics and Space Administration
OC	Oklahoma City
OEM	Original Equipment Manufacturer
OSU	Oklahoma State University
RFP	Request for Proposals
SAC	Supplier Audit Confirmation
SIC	Standard Industrial Classification
SOO	Statement of Objective
SOW	Statement of Work

CHAPTER I

INTRODUCTION

As organizations change from a centralized tightly-controlled style to a more open style, oftentimes the infrastructure and processes needed to effectively meet the requirements that are a consequence of day-to-day operations and those that are change related are not readily available to meet the needs of the organization's transition. At the conclusion of the cold war, the United States military and the defense industry began a period of downsizing, decentralization, and reorganization. Many of the processes and methods of operation that were in place during the height of the cold war were no longer practical nor effective with the new organizational relationships the downsizing had caused. In particular, the body of military standards and military instructions that the United States government used to acquire weapon systems were becoming difficult to keep current with the rapid technological advances in industry and declining numbers of government employees and technical staff resources necessary to maintain the body of standards and instructions. Since the end of World War II, the United States military had relied upon government oversight of industry to ensure that reliable, high-quality components were provided at a reasonable cost.

Because the government is a major consumer of goods and services, much of the early work in developing scientific manufacturing processes and in business oversight can

be attributed to the government's procurement policy. According to Cartlin (1993) the work of Frederick W. Taylor is the foundation of industrial engineering. Quality Engineering began to take form in the late 1920s. By the early 1940s quality engineering had become a stand alone discipline. Quality luminaries of our time–Deming, Feigenbaum, and Juran–trace their basic work to Shewhart. Initially, the emphasis was on inspection with some use of Walter A. Shewhart's–the statistician who taught Dr. Deming his methods–statistical process control methods. The emphasis was to "catch bad quality" (Cartlin, 1993, p. xi). Dr. Armand V. Feigenbaum, a contemporary of Dr. Deming and Dr. J. M. Juran, also provides a brief history of the United States quality experience. Feigenbaum's (1991) research states that although there have been changes in the past, we are now on the verge of a major shift in the market place. The days of *caveat emptor* (buyer beware) are being replaced by a new way of thinking: "producer beware" (p. 5). With industrial nations spending 7% to 10% of their GNP on the cost of quality, Feigenbaum believes the shift in the market that places quality equal with price as a determinant of value is here to stay. Cartlin (1993) noted that industrial consumers are also placing more emphasis on quality: at General Motors, the new cost model is "Existing Price – Costs = Profits, instead of Cost + Desired Profits = Price" (p. 5).

There are many similarities and differences in how the individual military departments have traditionally approached quality. For instance, both the Navy and Air Force focus heavily upon contractors' manufacturing processes. The Navy even developed a *Best Practices* (MIL-STD-1528A) for United States Navy personnel and their industry counterparts to use in developing manufacturing processes for new weapon systems. Both services also differ in many of their approaches. For instance, the Navy

requires a special soldering specification (MIL-S-45743E) for weapon system electronic components, whereas the Air Force does not. The Air Force focus on Reliability and Maintainability under the R&M 2000 Initiative was not fully accepted by the other military departments. Still, the basic philosophy of all the military departments, the Department of Defense (DOD) and the United States government in general, is toward oversight of critical process. This has been the preferred method of doing business. Military Quality Standard MIL-Q-9858A and Military Quality Instruction MIL-I-44208 were the governing documents that controlled an elaborate system of government inspection and oversight. The Standards required a contractor doing business with the DOD to have a quality process in place that the government could selectively audit to determine how well the contractor was doing in meeting the government's need for error-free products. *Handbook 50* and *Handbook 51* were provided to assist government inspectors in auditing contractor plants. The two handbooks use the information in MIL-Q-9858A and MIL-I-45208 to guide inspectors in their inspection effort. The Standards, Handbooks, and the government inspectors provided an oversight infrastructure that supported the government's procurement process in purchasing goods and services from the commercial sector.

In 1994, William J. Perry, Secretary of Defense, mandated a policy change affecting virtually every segment of the defense industry. By 1997, the Department of the Air Force, in compliance with Secretary Perry's mandate, had purged its requirement process of military standards. The change Secretary Perry called for was both comprehensive and far-reaching in nature. In fact, no other decision in recent years is likely to have the impact of the United States Department of Defense Memorandum,

Specifications & Standards–A New Way of Doing Business (1994), especially in the aerospace industry. Since the DOD was formed in 1947, it has developed and promulgated an extensive body of military standards. Many of these standards are used by commercial industry as a base line for their own internal standards. The large aerospace firms–Boeing now being virtually preeminent in that market–have a body of standards and specifications that parallel and implement the military standards into their manufacturing processes. McDonnell Douglas, before being merged with Boeing, separated commercial work from military business. However, the same philosophy for McDonnell Douglas processes was found in both sides of this aerospace firm. With the current dynamics of change in the aerospace industry ongoing, some of those processes will not be revised to include the basic knowledge found in the underlying military specification.

Of larger importance is the fact that the entire aerospace industry is going to rely on the ISO-9000 series controls to ensure that the proper processes are in place and are being followed by aerospace vendors.

ISO-9000 is a series of quality standards that were initially published in 1987. Most of the industrialized nations have accepted these international standards and according to Gerald Smith (1995), over 40,000 suppliers worldwide are now ISO qualified. Smith also states that ISO-9000 has five parts:

- ISO-9000 Quality Management and Quality Assurance Standards – guidelines for the selection and use of a standard.
- ISO-9001 Quality Systems – The model for quality assurance design, development, production, installation, and servicing–this is the most inclusive of the external quality assurance standards as it incorporates 9002, and 9003.

- ISO-9002 Quality Systems – The model for quality assurance in production, installation, and servicing.
- ISO-9003 Quality Systems – The model for quality assurance in the final inspection and testing. A company may start by registering as a 9003 or a 9002 and then work toward the more inclusive 9001 registration as it builds quality into its other functions.
- ISO-9004 Provided guidelines for quality management and quality system elements that assist an organization in developing and implementing a quality system–it also helps determining if 9001, 9002, or 9003 is applicable. (pp. 33-34)

Statement of the Problem

The United States Defense Department policy of eliminating standards as a way of doing business has in effect transferred the responsibility for quality oversight to the commercial sector. Although efforts are underway to develop a commercial infrastructure to support quality oversight, the fast pace of change in the industry has placed many segments of the industry in a "catch up" mode of operation. This is the situation found in the Oklahoma-based Aerospace Industry (C. L. "Larry" Vache, personal communication, April 23, 1998).

Need for the Study

Although one could make a case that what happens in Oklahoma is not that important to the overall aerospace industry, the author postulates that quite the opposite is true. First, Oklahoma is in the center of what is called the aerospace belt. The aerospace belt starts in Wichita, Kansas, and runs along I-35 to Dallas, Texas. Much of the

manufacturing infrastructure that supports this portion of the aerospace economy is along that corridor.

Secondly, the trend in manufacturing as well as other segments of the economy is outsourcing–not just outsourcing of services, but also of some of the processes used to manufacture a part. The just-in-time experience popularized by the Japanese and being used successfully with their suppliers in the United States points out how vendor relationships can be streamlined to provide the optimum value for the manufacturer (Taguchi, 1990). According to Gunn (1992), with the market place becoming more global in nature, there are three critical factors in manufacturing–factors that overlap into other segments of the economy: "(1) cost must be lower, (2) quality must be the highest possible, and (3) time the least in all aspects of a company's business practices" (p. 20). In other words, to succeed in the world market place: goods and services must be produced more cheaply, be of the highest quality, and be provided more quickly than the competition. These factors hold true in rural Oklahoma or rural California. Recent manufacturing trends indicate that much of the work being done internally before is being outsourced to more specialized and thus more efficient vendors. The just-in-time concept is founded on that principle: use responsive vendors to do what they can do more efficiently than can be done internally. The extreme of that phenomenon is the virtual factory where a part migrates to the vendor with the most efficient processes in place to add the optimum value to the part. Oklahoma is pioneering in the use of virtual enterprises with Oklahoma State University (OSU) providing some of the seed money through federal grants to enterprises within the state that desire to participate in that manufacturing format.

Thirdly, the presence of three rather large users (customers) of aerospace product are within Oklahoma. Tinker Air Force Base is one of the three Air Logistics Centers (ALC) that will remain after the ongoing consolidation efforts are completed. The ALC at Tinker employs 11,729, which represents a decrease in staff since 1987. However, the ALC still purchased $229 million of goods and services from within the state of Oklahoma, exclusive of salaries paid to civilian and military personnel assigned to the ALC (Alger, 1998). This represents a small yet important portion of the ALC's annual budget–$3.49 billion supporting a $21 billion inventory (Holcombe, 1999).

Federal Aviation Administration (FAA) has a subordinate headquarters, a training center, and its medical research facility in Oklahoma City. Although the direct purchase of goods and services within the state is small in comparison to the ALC, it is quite large as measured against other commercial enterprises. According to its brochure, the FAA receives, stocks, stores, and ships (issues) over 95,000 types of items each year from its Logistics Center (Shephard, Bakula, Teufel, 1995).

Until 1994 when it closed its large production facility, McDonnell Douglas was the preeminent employer in Tulsa. Now, Boeing and Rockwell are the two large aerospace contractors with a presence in Tulsa. To speculate that within five years the most prominent employer in Tulsa would be aerospace-related would not only be arguable, it would be supported by Tulsa's chamber of commerce and the existing industrial infrastructure found in the Tulsa region.

Fourthly, the fact that many of the processes that produce parts for the aerospace industry are by definition "flight critical" makes this research important. If the procedures

and processes are not in place to ensure safe hardware (and software) is installed on operational aircraft, the credibility of the aerospace support infrastructure is in jeopardy.

Finally, the loss of any customer can be extremely expensive. Carl Sewell, operator of one of the most successful automobile dealerships in the United States, popularized the notion of customers for life. Sewell calculates that a customer is worth over $300,000 in revenue. The formula for calculating the present value of future income follows:

> The lifetime value of a customer can be calculated using different formulas. The objective, however, is to get as close as possible to an evaluation of the net present value of all future profits from a particular customer. The profit from any single customer can be thought of as the profit margin on sales to that customer, less the cost of maintaining a relationship with the customer, plus any nonsales oriented, but quantifiable, benefits (new customer references, collaborative benefits, and so forth).
>
> One formula for an individual customer's lifetime value (LTV) would be:
>
> $$LTV = \sum_{i=1}^{n} (1 + d)^{-i} \pi_i$$
>
> where π_i = sales from profit this customer in period *i*, plus any non-sales benefit (customer references, collaborative value, etc.) in period *i*, less cost of maintaining customer relationship in period *i*
> d = discount rate
> *n* = final period, estimated lifetime horizon of this customer. (Peppers, 1993, p. 41)

Purpose of the Study

The purpose of this study was to determine the impact of the government's policy change which transferred quality oversight to the commercial sector upon the Oklahoma-based aerospace industry. A determination was made as to the impact of the decision on

Oklahoma-based aerospace industry ability to provide parts (goods and services) to the government. A description of the existing quality situation found in Oklahoma was the outcome of the research.

Research Question

Does the Oklahoma Aerospace Industry That Successfully Operated under MIL-Q-9858a and MIL-I-45208 Have the Training, Education, and Academic Infrastructure in Place to Effectively Operate under ISO-9000?

Having the rigor of an internationally recognized set of procedures and processes in place seems to be a prudent approach to the ongoing decentralization in the defense and aerospace industry. However, the training to implement such an approach may or may not be available. Further, the typical parts producer in the industry who the aerospace industry, through decentralization, has come to rely upon for parts support may not be able to afford ISO- 9000 training. Certification, which was once the responsibility of the United States government, has now transitioned to the commercial sector without an attendant affordable, available, and reputable infrastructure in place to meet the needs for military and commercial aerospace parts vendors, especially among the rural aerospace-manufacturing firms within Oklahoma. In essence, by changing from MIL-Q to an ISO environment, the DOD has caused a reduction in Oklahoma Aerospace Industries' ability to provide products to the United States military. This research will describe the state of quality certification existing in Oklahoma today.

Constraints

This research was conducted within the state of Oklahoma. Although there may be significant comparisons with other areas of the United States, the level of correlation was not explored by this study. Key factors that may impact application outside of Oklahoma include: the demographics of Oklahoma Aerospace Industry, the network of technical schools in Oklahoma, and the culture and work ethic found within the state. Additionally, the close proximity of military, FAA, and large aerospace contractors could impact the motivation for industries becoming ISO-9000 certified. Many of the industries included in this study are located in rural areas without a nearby network of other manufacturing or support industries.

To use the results of this research with some level of confidence in another state or region, the key factors mentioned above should be compared and contrasted to those same factors found within the state of Oklahoma.

Definitions

Conducting research on a topic that touches on such a broad area as quality merits some clarification and amplification of traditional word usage. The following definitions are the usage found in this research.

ALC – An acronym for Air Logistics Center. The Air Force operates five Air Logistics Centers, sometimes referred to as depots. Two of the five are scheduled to close. The ALCs are responsible for the wholesale logistics support for their assigned weapon systems. Oklahoma City Air Logistics Center at Tinker Air Force Base provides

engine support for most of the Air Force aircraft. It also manages the B-1, B-2, and B-52 Bomber, KC-135 Tanker/Cargo Aircraft, the E-3 Sentry, and the Contractor Logistics Support Aircraft fleets including the KC-10 and Air Force One. Two of the Air Force ALCs, San Antonio and Sacramento, are scheduled for closure as a part of defense force restructuring.

CATT (Computer Assisted Technology Transfer) – An ongoing research project managed by Oklahoma State University. CATT is an outgrowth of the Computer Aided Logistics System (CALS) project begun by the DOD in the early 1980s. The specific research in CATT is geared toward improving the Oklahoma-based industrial infrastructure to support the Department of Defense need for parts production. Electronic transfer is a key portion of the CATT Project.

FAA – The acronym for the Federal Aviation Administration. The Mike Monroney Aeronautical Center (MMAC) is its primary presence within Oklahoma, providing training, logistics, research, and services. According to its brochure (Shepard, Bakula, & Teufel, 1995), MMAC stocks, stores, and receives over 94,000 types of items and ships over 200,000 shipments each year.

Military Standards and Instructions – The body of reference documents employed by the United States military to provide guidance to the commercial sector. Military Standard for Quality, MIL-Q-9858A and MIL I 45208 are the two primary standards discussed in this research. Both are no longer in print. Secretary of Defense Perry mandated the reduction of standard usage in 1994. The result was a virtual elimination of most standards and instructions. In compliance with Secretary Perry's mandate, by 1997,

the Air Logistics Center had purged the requirement for military standards from virtually all their procurement actions.

Oklahoma-Based Aerospace Firm (or company) – Limited to those businesses owned and primarily operated within the state of Oklahoma. At least a portion of their annual sales are to the aerospace industry and over 50% of their revenues are generated from within the state. Companies that are not Oklahoma-based, but are subsidiaries of companies based outside the state, will not be included.

Quality – As defined by various luminaries in the industry can mean different things (United States Department of the Air Force, 1989). For example: Dr. Juran says it is "fitness for use" (Ch. 2, p. 3), Phillip Crosby states that it is "conformance to requirements" (Ch. 2, p. 3), Dr. Deming calls it a "predictable degree of uniformity and dependability at low cost and suited to the market" (Ch. 2, p. 3), and Dr. Taguchi says it is "the minimum loss imparted by the product to society from the time the product is shipped" (Ch. 2, p. 3). And Dr. Figenbaum calls it

> the total composite product and service characteristics of marketing, engineering, manufacturing, and maintenance through which the product and service in use will meet the expectations of the customer. (Ch. 2, p. 3)

For purposes of this research, it is a composite of all of these factors. *Quality is providing a predictable, uniform product or service, fit for use in meeting multiple customer requirements, with minimum loss, through all the disciplines the customer or producer may use in developing and in using the product or service.*

Right Part Right Place Right Time – A logistics theory popularized by Oscar Goldfarb, an Air Force Senior Executive and leader in the Society of Logistics Engineers, in the early 1980s.

Service – Refers to a maintenance function that prolongs the life of a system. Servicing typically involves such things as lubrication or time change of filters or other parts on a predictable wear cycle.

Time Change Item – An item or component scheduled for replacement based upon calendar or use time.

CHAPTER II

REVIEW OF THE LITERATURE

Overview

The review of the literature is presented in six parts. Because of the paucity of written material available on ISO-9000–a relatively new method of doing business–interviews with selected officials were done to lay the foundation for this research.

1. As a backdrop to the ISO-9000 movement some of this review focused on leading works on the quality movement that parallel or serve as precursor to ISO-9000.
2. A review of the current journal articles and books was done to determine the direction of the ISO-9000 movement. From that review the overall course the ISO-9000 movement seemed to be taking was determined.
3. A review of journal articles and books was also done to outline the demographics for the Oklahoma Aerospace Industry.
4. A review of the CATT project was done to determine what foundational research had already been accomplished on this topic. CATT is a four-phase project led by OSU that is examining the health of the aerospace industry within Oklahoma.

5. Interviews with key members of the CATT research team were done to help develop any areas not covered in the literature research, and
6. Interviews with key State of Oklahoma officials and United States Government officials were conducted to determine further background information .

Key Quality Books and Articles

One key facet of the quality initiative–the apparent ability to turn around a problem area–should not be overlooked. The C-17 according to the commander of Defense Contract Management Command, Major General Timothy Malishenko, United States Air Force, using total quality management brought the C-17 Program from the "brink of cancellation to Baldridge National Quality Award Winner." To reach that level of quality McDonnell Douglas used an integrated product team structure to align corporate goals and objectives so that problems could be solved completely with all parties involved working on the solution (Malishenko, 1999).

Malishenko also stated that the military standard (MIL-Q-9858A) was deleted from the contractor's requirements when they implemented ANSI/ASQC 9001 quality program. The initiatives begun in winning the quality award had paved the way for McDonnell Douglas to become an IS0 certified operation (Malishenko, 1999).

Producing a high quality product may not be a panacea and it may not always be fulfillment within and of itself. John Hudiberg, chairman and former CEO of Florida Power and Light, found this out when he lost favor with his board of directors and retired as a result. Mr. Hudiberg's retirement was shortly after Florida Power and Light (FPL)

Company, the fourth largest electric power company in the United States, became the first non-Japanese firm to ever win the prestigious Deming Award for Quality (Creech, 1994). FPL successes under Hudiberg included a 70% reduction in customer complaints; errors in customer billing were reduced to only eight per million. Power outages were cut in half– a point well below the national average despite the arduous climate in Florida (Creech, 1994).

Further, upgrading an organization's output quality can become counter productive. Japan's improved industrial capacity has led to that country experiencing its first contraction in gross domestic product. The upgrade in quality at an almost fanatical pace has finally overtaken the world's second largest economy according to leading economists. Japan, refusing to look at the larger picture as to how production fits with the market share and who is now taking over some of that market, has placed many of its small to midsize companies in jeopardy (*Economist,* 1998).

The importance of producing a quality product or providing a quality service will become even more important according to Peppers and Rogers (1993). "Without a satisfactory product and an acceptable level of service, no customer will be willing to continue a relationship with you for long" (p. 17). In the past quality was considered to be king; in the future it will be, "somewhat between an ayatollah and a demigod" (p. 254).

Florida Power and Light Company, the first non-Japanese organization to win the Deming Award, traces the modern quality movement to Walter A. Shewhart, a statistician who worked with the Wright Brothers in their first production aircraft effort. W. Edwards Deming, J. M. Juran, and Peter F. Drucker were all students of Shewhert (QUAL TECH, 1988).

According to Cartlin (1993), the work of Frederick W. Taylor is the foundation of industrial engineering (IE) and quality engineering, a subset of IE, began in the late 1920s and took form in the 1940s. Cartlin also states that Walter A. Shewhart's use of statistics led to the development of statistical process control. Shewart taught Doctors W. Edwards Deming and J. M. Juran his statistical methods. Deming and Juran helped the Japanese rebuild their industrial base after World War II. According to Cartlin (1993), the emphasis was to "catch bad quality" (p. xi). Drucker states that the statistical process control concept is based upon statistical theory developed by Sir Ronald Fisher and Walter Shewhart at Bell Laboratories. Both Juran and Deming worked with Shewhart (Drucker, 1990).

Dr. Armand V. Feigenbaum (1991), a contemporary of Dr. Deming and Dr. J.M. Juran, also provides a brief history of the United States quality experience. Feigenbaun initially pioneered the idea of the hidden factory. His early work documented that many firms spend as much in rework as they do in final production. Later, Feigenbaum's research states that although there have been changes in the past, we are now on the verge of a major shift in the market place. The days of *caveat emptor* (buyer beware) are being replaced by a new way of thinking: "producer beware" (p. 5). With industrial nations spending 7% to 10% of their GNP on the cost of quality, Feigenbaum believes the shift in the market that places quality equal with price as a determinant of value is here to stay.

J. M. Juran traces the inception of quality to the Egyptian pyramid builder who had to have exact product–stone quarried to a very fine tolerance–in order to assemble the pyramids. Juran also places considerable emphasis on the total aspects of quality. He looks at the requirement and then determines the suitability of the processes involved to

consistently produce that requirement. Dr. Frank Gryna takes Dr. Juran's "fitness for use" definition of quality to the next level and subdivides it into five components:

1. Structural–length, frequency, and viscosity,
2. Sensory–taste and beauty,
3. Time-oriented reliability and maintainability,
4. Commercial–warranty, and
5. Ethical–courtesy and honesty.

Gryna and Juran also go on to say that quality failures can and do result in serious human inconvenience, economic waste, and sometimes loss of life (Juran & Gryna, 1970).

An article in the *Washington Post* captures the problem of disastrous quality. The National Aeronautics and Space Administration had cut their quality oversight force in the mid-1970s by 71%. The number of people at Marshall Space Flight Center had gone down even further from 615 people to 88–an 86% reduction. Marshall was responsible for oversight of the propulsion component of the space shuttle. In January 1986 the *Challenger* was destroyed because of a rocket booster seal failure. Senator (at that time) Albert Gore, Jr. attributed NASA's problems to their cuts in quality oversight (Sawyer, 1986).

Both Juran and Deming are credited with providing the Japanese their initial approach to quality. Later, Kaoru Ishikawa and Genichi Taguchi made their own contributions to Japanese quality management. Ishikawa focused on the human dynamic of convincing workers that producing a quality product was in their best interest. He is also credited with developing the "fishbone diagram," a means of graphically tying all the

elements of production, management, and process together. An example of a fishbone diagram follows in Figure 1:

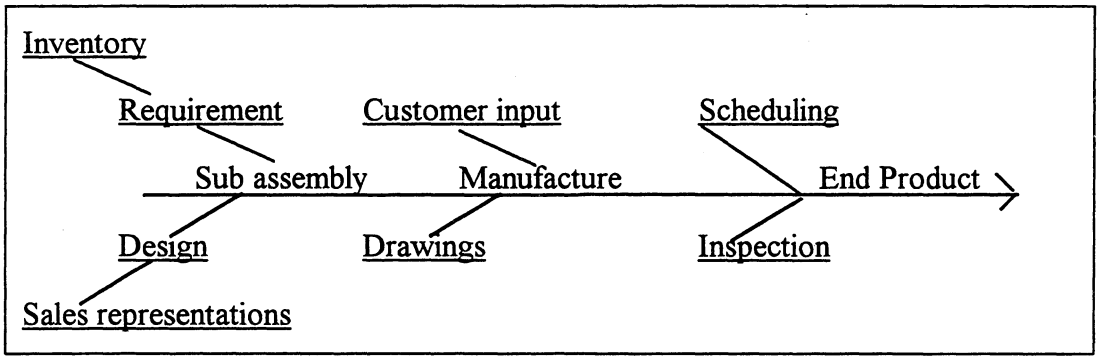


Figure 1. Fishbone Diagram.

Genichi Taguchi developed the Taguchi design method. Basically, Taguchi moves the center of the design closer to the center of the customer's requirement. Thus any design elements that fall close to the extremes of the design envelope still remain within the customer's requirement (Creech, 1994). In an article in the *Harvard Business Review*, Genichi Taguchi and Don Clausing (1990) describe the Taguchi design method. They liken it to shooting at a target. The closer you can consistently get to the bull's eye, the better shot you are. The same is true with engineering; the closer you can consistently get to the center of the requirement, the better the design. Consistency is the key.

Peter F. Drucker was also involved in the Japanese quality movement. However, his approach was more on the productivity–reason for a company to exist–than his counterparts. Drucker attributes J.M. Juran with developing "just in time" inventory

practices–a concept Juran had developed for use by the American armed forces in World War II. He attributes Deming with teaching them statistical process control (Drucker, 1986).

Dr. Lester Thurow (1992), former Dean of Massachusetts Institute of Technology's (MIT) Sloan Business School of Management, takes the position that increased productivity is the only real way to increase the quality of life in an area. With quality being a key facet of productivity, it seems only appropriate that more efficient methods–higher quality production–be at the forefront of economic development for a region and organization, or as Thurow suggests, a nation.

Kepner and Tregoe (1965) focused on problem solving techniques that focused on quality issues, but often went beyond the quality function. Their systematic approach first eliminated what the problem was not and through a series of trials finally found the true causal relationship. The Kepner Tregoe method was taught at the Air Force Institute of Technology in the early to late 1970s. In the late 1980s, the Air Force also pursued the "theory of constraints" as a management strategy. Although using a different approach, "theory of constraints," like Kepner and Tregoe, focused the effort on the most likely cause and effect relationship (Goldratt, 1990).

Carl Sewell (1996) is considered to be one of the most gifted automobile dealers in the United States–in 1990 his dealerships were valued at over $250 million versus $10 million in 1968. That represents a 15.75% annual growth rate sustained for 22 years. His approach to quality is in the service element. Basically, Sewell follows the principles described in Crosby and Juran. He takes responsibility for quality to the very top, a Crosby approach. Sewell tinkers with different facets of the process to make it better–an approach used by Juran. Sewell's ethical standard for running the business is simple:

"How would this look on page one in the morning newspaper?" Sewell also practices some of Deming–do it right the first time (although all three [Crosby, Juran, and Deming] teach this concept).

Philip Crosby (1979) in *Quality Is Free* popularized that quality in fact does not cost, but "un-quality," the failure to follow correct processes, does cost. Crosby's early background was in the "zero defect" initiative used by the Department of Defense in the mid-1960s. Crosby also places strong emphasis on the structure of the organization's quality department. Much of Crosby's emphasis is on getting the quality information out of the production department and into the hands of the corporate senior decision makers. To accomplish this, Crosby advocates firms have a senior executive assigned to lead their quality effort.

Quality came into the forefront of American industry with the shift in market share to Japanese industries beginning with the automobile in the early 1970s. Although the importance of producing a quality product should not be overlooked, Maryann Kelner (1989), Wall Street analyst, suggests there were multiple factors causing the loss of market share by the American automobile industry. Soaring gasoline prices after the OPEC embargo and poor organizational structures, Kelner states, were also causal in the shift by American consumers to Japanese cars. Wright (1970) shares Kelner's view but does attribute quality as the key factor in the loss of market share.

Problems with the C5 acquisition and stories in the press about government waste and abuse led to several government initiatives to combat waste and abuse. Willis J. Willoughby, at the request of Admiral Isaac Kidd, Chief of Naval Material Command,

developed *Best Practices* (MIL-STD-1528A) for United States Navy personnel and their industry counterparts to use in developing manufacturing processes (Rahl, 1989).

The Air Force R&M 2000 initiative closely paralled Willoughby's *Best Practices* except it was more inclusive. R&M 2000 focused on the design and *Best Practices* focused on ability of industry to manufacture a system. Some key aspects derived from R&M 2000 research which led to improved reliabilty and maintainablity include:

1. Derating electronic parts,
2. Reducing parts count on complex items, and
3. Looking closely at service intervals and time-change items.

According to Brigadier General Frank S. Goodell, the Air Force head of the R&M 2000 office, the F-16 acquisition increased reliability and enhanced maintainability to such a degree that it was equivalent to having another squadron of F-16s (21 aircraft) available to the Air Force without buying a single additional aircraft (SAF/AQ, 1988).

In 1991, Air Force Logistics Command (AFLC) won the Baldridge National Quality Award for Public Sector entrants. A command responsible for approximately 40% of the Air Force annual expenditures, with over 90,000 personnel assigned worldwide (including those assigned to the Oklahoma Air Logistics Center) had put into place the processes and controls necessary to ensure sound product quality and to sustain an arduous audit with the competing entrants. General Charles C. McDonald, Commander of AFLC, stated that "quality is people, process, performance, and product" (AFLC Application, 1991).

As a part of the Air Force downsizing, in 1991 Air Force Logistics Command was combined with Air Force Systems Command to form Air Force Material Command (AFMC).

The first AFMC Commander, General Ron Yates, set the quality agenda for the new Command. General Yates put the emphasis upon measurement with what he called metrics. A metric was a measure of a process input and output. By using measures the command would be able to continue the initiative begun when Logistics Command won the Baldridge Award and the Air Force acquired the F-16 using the R&M 2000 initiative. General Yates outlined eleven steps in developing metrics:

1. Identify the purpose,
2. Develop an operational definition–a requirement–starting with your customer,
3. Define what you want to measure–theory of constraints and quality function deployment were used in this step,
4. Identify and examine existing measurement systems–no need in duplicating a metric that already exists,
5. Generate the new metric (if needed),
6. Rate your metric against the eight attributes of a good metric,
7. Select the appropriate measurement tools to analyze and display the data,
8. Baseline the progress,
9. Collect and analyze metric data over time,
10. Finalize the metric presentation, and
11. Initiate process improvements the metric reveals (AFMC Command Guide, 1993).

Tom Peters described the success that General Bill Creech had as Commander of Tactical Air Command. Peters credits Creech with "perhaps the single most impressive corporate revolution witnessed this century." When General Creech retired in 1984 he left

a legacy for those who followed to use in maintaining the course he had set. Creech's Laws include:

1. Have a set of overarching principles and philosophies–a theme and purpose,
2. Use goals throughout–goals at every level,
3. Measure productivity at several levels,
4. Create leaders at many levels,
5. Match authority with responsibility,
6. Set up internal competition and comparison–reward success,
7. Create a climate of pride,
8. Create a climate of professionalism,
9. Educate, educate, educate–use regular feedback,
10. Communicate, communicate,–communicate, do not depend upon the hierarchy; skip down several levels,
11. Create organizational discipline and loyalty,
12. Provide everyone with a stake in the outcome–make each job meaningful and reward (lavishly) good performance in all areas,
13. Make it better,
14. Make it happen, and
15. Make it last (Peters, pp. 240-241).

In a later work, *Thriving on Chaos*, Peters (1987) suggests 12 attributes of a quality revolution.

1. Management obsessed with quality,

2. Pick a system or ideology–Deming, Crosby, Juran, Feigenbaum, or invent your own,
3. Measure the results,
4. Reward quality,
5. Train in quality assessment,
6. Involve multiple functions/systems,
7. Keep it small,
8. Constantly stimulate–an endless "Hawthorne Effect,"
9. Develop a quality improvement organization,
10. Have everyone play,
11. Acknowledge the cost reductions quality improvements make, and
12. Make it a never ending journey (pp. 70-81).

The Air Force Material Command's QP4 Program established its own quality program. They drew on the work of three leading quality experts: Deming, Juran, and Crosby. Using the Shewhart cycle to effect continuous improvement was the focal point of QP4 training. An example of a Shewart cycle follows in Figure 2.

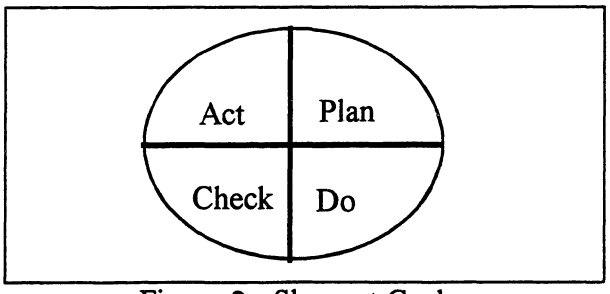


Figure 2. Shewart Cycle.

QP4 used a four step approach to develop their plan:

1. Define the goal (strategy),
2. Determine the present situation (tactical),
3. Determine obstacles (tactical), and
4. Develop the plan for reaching the goal (tactical and strategic elements included).

Tools QP4 suggest be used in the planning phase include:

1. Setting up a process action team–members from each function affected is best and
2. Use a flow chart to identify how the process is working and to find key bottlenecks.

QP4 suggested Kaoru Ishikawa's cause and effect or "fishbone diagram" in the "do" phase of the Shewart cycle. QP4's version of the diagram typically considered four elements:

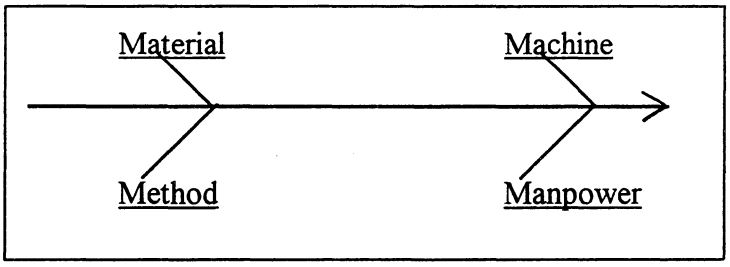


Figure 3. QP4 Diagram.

From these four elements the rest of the "fishbone" could be filled in to separate the various functions of a process.

QP4 also used data collection sheets in the "do" phase of the process. An example used by the QP4 text follows in Table I.

TABLE I

REASONS FOR BEING LATE TO WORK

Reasons	Jan	Feb	Mar	Total
Iron Clothes	llll llll l	llll lll		20
Get Gas	llll llll	lll	lll	15
Accident	ll	llll		6
Train	lll		ll	5
Car Trouble	1	ll		3
Spouse	1			1
Total	28	17	5	50

In QP4's check phase, Pareto analysis and charts, histograms, run charts, and bar charts were recommended. In conducting a Pareto analysis–determining which cause was the most significant–ironing clothes would be the result taken from the data in the data collection sheet example. That factor contributed to being late 40% of the time. A Praeto chart is simply a bar chart with the number of occurrences and percent of the total

occurrences represented in the vertical axis. The type of event is represented in the horizontal axis.

The "Act" phase of QP4 continued with measurement. Run charts and control charts were of particular use. The act phase was also a period of comparison where the decision maker continued checking on the process to see that he had in fact improved it in some fashion: better, faster, cheaper, or simply an easier way to accomplish a requirement.

In QP4's description of W. Edward Deming's approach, they determined that he focused on statistical process control. His objective was to reduce uncertainty and variability in the design and manufacture, test and sales followed by market surveys. Deming provided a 14 point quality management philosophy.

1. Create constancy of purpose toward improvement of product and service,
2. Adopt the new philosophy that we are in a new economic age created by Japan–no longer accept delays, mistakes, and defective products (as the norm),
3. Cease dependence on inspection to achieve quality–build quality in,
4. Minimize total cost–don't just buy the cheapest,
5. Improve constantly,
6. Institute on the job training,
7. Institute supervision with the goal of helping people do a better job,
8. Drive out fear in the work place,
9. Break down department barriers–use a team approach,
10. Eliminate slogans and targets,

11. Eliminate work standards that prescribe numerical quotas for the day,
12. Remove barriers that rob the hourly worker of his right to pride of workmanship–the same for managers,
13. Institute a vigorous program of education and retraining, and
14. Put everyone in the company to work to accomplish the transformation.

The QP4 Text said that Juran defines quality as "fitness for use" and he divides the quality management process into three key areas:

1. Quality Control and the Control Sequence,
2. Quality Improvement and the Breakthrough Sequence, and
3. Quality Planning and the Annual Quality Program.

Juran advocates a project by project approach with three key steps involved in quality improvement:

1. Study the symptoms,
2. Diagnose the causes, and
3. Apply remedies.

Juran says that top managers should be involved in selecting those areas where the greatest return on investment will occur if quality is improved.

QP4 notes that Crosby approaches quality with four absolutes.

1. He defines quality as "conformance to requirements."
2. The system for causing quality is prevention,
3. The performance standard is zero defects, and
4. The measurement of quality is the price of nonconformance.

Crosby also has 14 points for Quality Management:

1. Management commitment,
2. Quality Improvement Team,
3. Quality measurement,
4. Cost of quality evaluation,
5. Quality awareness,
6. Corrective action,
7. Zero defect planning,
8. Quality education,
9. Zero Defects Day,
10. Goal setting,
11. Error cause removal,
12. Recognition,
13. Quality control, and
14. Do it over again.

In contrast to Deming and Juran, Crosby places very little emphasis on statistical quality control (United States Department of the Air Force, QP4 Text, 1989).

On September 29, 1989, President George Bush stated that, "Reasserting our leadership position will require a firm commitment to Total Quality Management and the principle of continuous quality improvement." As a result of renewed top level interest in quality, the Federal Quality Institute (FQI) was established under the leadership of Jack Strickland, Senior Executive System (Federal Quality Institute Briefing, 1989). FQI's mission was to get the word out to federal government agencies on the latest quality practices. Included in FQI's briefing were illustrations of problem solving tools: flow

chart, brainstorming, six-word diagram, cause and effect (fishbone) diagram, Pareto chart, scatter diagram, histogram, run chart, and control chart.

In 1993, the Air Force published *The Quality Approach* which used criteria from the Malcolm Baldridge National Quality Award as the basic roadmap on how to improve the Air Force. As a result of force downsizing the Air Force needed to adopt a new set of guiding principles, not just refine (whittle down) those used during the height of the cold war build-up. The mission, size of the force structure, and the likely enemy had all changed. General McPeak, Air Force Chief of Staff, stated that the quality approach afforded the Air Force the best opportunity to use scarce resources.

ISO Journal Articles

The author's review of the ISO-9000 literature revealed that 80 articles had been published on this topic since 1995. Looking at the abstracts only for each article to determine the general nature of the topic covered indicated that four recurring trends were found in this top-level portion of the literature review. Six articles discussed the overlap of ISO with another body of standards, that is, FAA Standards or the Malcolm Baldridge Award Criteria. Five articles detailed the benefits of ISO while two detailed the negative aspects of ISO certification. Four articles discussed the international aspects of ISO and how it would become imperative to be ISO-9000 certified to be a viable world class supplier.

After the top-level review of the abstracts, a more detailed review of key articles was done. That review revealed four key themes:

1. That much of the commercial sector is moving toward ISO-9000 certification. In fact, one article stated that in 1998 around 17,000 United States firms are ISO-9000 certified (Meyer, 1998) versus only 2,232 firms in 1993.

2. Industry segments are tailoring ISO-9000 to meet specific industry needs. The automotive industry seems to be the pioneer in tailoring ISOs to meet specific automotive needs (Brown, 1997). According to the American Society of Quality (ASQ) there are 5,778 companies certified under QS-9000 (the automotive variant to the ISO). ASQ, formerly the American Society of Quality Control (ASQC), maintains a data base of QS certified companies, and American National Standards Institute (ANSI) is the overall certifying authority for ISO according to Mr. Dan Dougherty, Customer Service Representative for ASQ (Dan Dougherty, personal communication, April 23, 1998). Other industries mentioned that had made progress in tailoring include construction and software development.

3. Some suppliers are challenging third-party certification as wasteful. "Hewlett-Packard Co. and Motorola lead 37 electronic companies in promoting supplier audit confirmation (SAC)" in lieu of actual certification (Zuckerman, 1995, p. 1). Their rationale is that it is more efficient, less costly for their suppliers, and takes advantage of work already being done. Because they have developed a "supplier declaration of conformity," they also have the support of the American National Standards Institute which

certifies ISO-9000 and the United States Registrar Accreditation Board which certifies academic institutions to teach ISO-9000 certification; and

4. The primary criticisms of ISO certification are price and bureaucracy (paperwork) (Zuckerman, 1996).

Boeing Aerospace, the largest private sector aerospace employer in Oklahoma, has adopted Dupont's ISO-9000 quality training. The course syllabus Boeing employees use consists of video presentations and handouts. Dupont (1993) describes ISO-9000 as a process that puts rigor into the internal processes the company follows. In deciding upon whether to register for ISO certification, Dupont suggests a business consider

1. Customers' needs,
2. Market conditions,
3. Amount of export business, and
4. Amount of domestic business.

Once a decision is made about ISO 9000 certification, a strategic plan is recommended to get this done in an efficient manner. Decide which ISO-9000 standard is appropriate: 01, 02, or 03? Define functions that will need to be reviewed (perhaps revised) to meet certification standards. Dupont suggests a cross reference matrix to help with this portion of the effort. Now, evaluate where the function currently is and where it needs to be to become certified. Now, refine the time table (schedule) for making the changes needed for certification. Assign resources to the effort and adjust the strategic plan. Dupont suggests a nine step, 18-month program for ISO-9000 certification. The time line is notional depending upon organizational size and the initial status of their quality system (Dupont, 1993). Appendix F depicts Dupont's Roadmap to ISO-9000.

Oklahoma Aerospace Research

The University of Oklahoma Library maintains a database of Oklahoma industry. There are currently 1502 data files maintained in that data base. The firms range in size from Fleming Companies, Inc., with annual revenues of $16,487,000, to Gales and Brock, which reported no annual revenue. There are 468 manufacturing firms in the database. Unfortunately, the database is not programmed to sort by industry type such as aerospace. A quick review of the corporate titles indicates that the database includes many of the well-known Oklahoma aerospace firms such as Frontier Engineering and Nordam. The database proved to be useful in the next phase of the research as it lists current chief executive officers and their phone numbers.

Other databases that exist which would serve as a basic pool of companies doing business with the government in Oklahoma also include: the *Thomas Regional North Texas-Oklahoma Regional Buying Guide*; the FEDLOG–an automated procurement data base which lists government suppliers; and data bases published by agencies within Oklahoma such as Francis Tuttle Vocational and Technical and Chamber of Commerce publications. Tinker does not provide access to their database of contractors, but through the Freedom of Information Act, a list of contractors with access to the base may be obtained from the Security Police Group at Tinker. An Oklahoma database of 250 firms that have "SIC" codes that indicate they do or have done business with the federal government was selected for this research. The rationale for selecting that data base is simple:

1. The FEDLOG, although the most comprehensive, was not easy to manipulate to pull out Oklahoma-based firms,
2. The chamber of commerce data bases did not always include non-chamber members, and
3. The Oklahoma Data Base eliminated both problems associated with the FEDLOG and chamber data bases.

Two articles in the *Tinker Take Off* are instructive in pointing out the Oklahoma City Air Logistics Center's focus on quality. In October 1999, Major General Michael E. Zettler is quoted,

> Yes, we are providing a quality product to our customers, but our internal production quality is lacking. We need to tighten that up . . . (we need to ensure that our managers and craftsmen) are properly trained and certified. (Zettler, 1999)

In the second article, Tinker's Propulsion Business Area celebrated its certification as an ISO-9002 supplier. According to General Zettler, more than 4,000 people are involved in this business area which has just been registered for ISO-9002. "The registration covers all processes regarding the overhaul, repair, modification and manufacture of engines and accessories" (Fletcher, 1999).

CATT Project Review

The Computer Assisted Technology Transfer (CATT) project grew out of a 1987 Assistant Secretary of Defense Program called Logistics 2010. In July 1995, under the leadership of Oklahoma State University, the first CATT projects were completed. The project had three goals:

1. To upgrade the Oklahoma-based aerospace industry,
2. To provide affordable parts to the military, in particular the Air Force and the Defense Logistics Agency at Tinker Air Force Base, and
3. To enhance the use of electronic commerce and electronic data interchange (EC/EDI) to reduce the paperwork involved in the DOD procurement process.

The Department of Defense, Defense Logistics Agency sponsored the CATT research. According to the Executive Summary, CATT Team 1 & Team 4 Final Reports Phase I (1995), the preliminary research covered in Phase I looked into these areas:

- The Procurement Process
- Bid Package Development
- EDI Modes
- Bid Receiving and Transmission
- Bid Review and Approval
- Manufacturing
- Test and Acceptance
- Validation and Verification
- Education and Training

Team Three's Report focused on the Bid Process. A portion of that report covered the difference between ISO-9000 and MIL-Q-9858A. The following key points about ISO and MIL Q were documented in the United States Department of Defense, Defense Logistics Agency Team Three Report (1995, p. 9):

- ISO-9001 will adequately replace MIL-Q-9858A

- Flow Down of ISO-9001 requirements to sub vendors was considered the weak link in the ISOs
- Companies producing parts that are ISO-9001 certified should provide satisfactory hardware that would meet the requirments in MIL-Q-9858A.

CATT Project Key Personnel Interviews

Mr. Mike Lee, of SBIR Engineering, Inc., has been working on CATT since its inception. Mr. Lee is under contract with OSU to provide oversight of the CATT project. The following interview with Mr. Lee provides his insight into the findings and directions of the CATT project. In particular, the effect of ISO-9000 on Oklahoma Aerospace Industry was discussed (M. Lee, personal communication, April 24, 1998).

Question: How aware of ISO-9000 are the companies you work with through the CATT Program?

Response: Most are aware; however, they are getting compliant with ISO-9000 instead of becoming certified.

Question: Why is that?

Response: The cost of certification is prohibitive. It costs $25,000 just to be audited and if you fail, you're still out the $25,000. To become fully compliant with ISO-9000 can cost a moderate size business up to $250,000 to get all their processes and divisions fully certified at the highest level.

Question: Who verifies compliance?

Response: The customer audits their suppliers. In many cases it's the original equipment manufacturer (OEM). In Oklahoma Boeing and Rockwell audit their suppliers to determine they are compliant with the ISOs.

Question: How many ISO certified industries are there in Oklahoma?

Response: Within the aerospace industry, only the OEMs are fully certified. Frontier Engineering has a department that is certified. The biomedical industry is the predominant industry within Oklahoma that has ISO certified firms.

Question: How many aerospace industries are in the state?

Response: Approximately 400.

Question: How many do you think will become ISO-9000 certified or compliant?

Response: Only half of them (200) are big enough to have a quality system. You must have a system to become certified. Of the 200 probably half will eventually become certified and the other half will become compliant.

Question: Of the current aerospace industries in Oklahoma, how many were qualified under either MIL Q 9858A or MIL I 45208?

Response: All 400 could have qualified under MIL I 45208. About 200 would have qualified under MIL Q 9858A. It, too, requires you have a system to be qualified as a MIL Q producer.

Mr. Todd McFarland, an OSU employee, is the engineer in charge of CATT day-to-day operations and administration. He, too, has been with the project from the inception and is still employed to administer the CATT project. The following interview with Mr. McFarland provides his insight into the findings thus far and what he views as the likely direction of future CATT Phases. In particular, the effect of ISO-9000 on Oklahoma

Aerospace Industry was discussed (T. McFarland, personal communication, April 23, 1998).

Question: How is the CATT project going?

Response: CATT Phase IV is scheduled to complete 30 June 1998.

Question: Was the research begun in Phase I on ISO-9000 continued during later project phases?

Response: Yes, it was. In fact, OSU Okmulgee, a CATT Deployment Site, is now using state of Oklahoma funding to continue that effort. Their purpose is to assist Oklahoma small to medium enterprises in achieving ISO-9000 compliance. It costs too much for some of them to become certified.

Question: How much does it cost?

Response: Approximately $25,000 is the minimum. Many of the small firms would rather invest that amount into machinery than certification.

Interviews With Selected State of Oklahoma Officials

An interview with Mr. Larry Vache, Program Manager Procurement/Technical Assistance Small Business Development for the Oklahoma Department of Vocational and Technical Education, was held to determine the level of effort underway in teaching ISO-9000 methods (C.L. "Larry" Vache, personal communication, April 23, 1998). Mr. Vache was aware of the ISO initiative and the state of ISO-9000 training in the state. The results of the interview follow:

Question: Are you aware of any VoTechs that are training ISO-9000?

Response: Yes, Moore Norman has been training ISO-9000 for about eight years and Tulsa Tech just got started about a year ago.

Question: Is the training for ISO-9000 adequate for the demand?

Response: Yes, at this time it is. There hasn't been a stampede of small businesses getting ISO certification. The government has just recently begun getting the word out that ISO-9000 is needed. The government has a requirement for quality inspectors to do oversight, but no longer has the inspection staff assigned to accomplish the task. The government now needs ISO to do the job.

Question: In the ISO world there are vendors who are certified and those who say they are compliant. What problem do you see with this approach?

Response: Who is determining that a vendor is compliant? The federal government does not have the resources assigned to verify compliance.

Question: How much does it cost to become ISO-9000 certified?

Response: I took the training at Moore-Norman VoTech to become a certifying official five years ago. At that time, it cost between $10,000 and $30,000 to become ISO-9000 certified (C.L. (Larry) Vache, personal communication, April 23, 1998).

Interviews With Selected Federal Government Officials

United States Air Force Procurement Official–Mr. James E. Smith, Contracting Officer

Question: Briefly describe your job and how you fit in with getting quality products and services for the government?

Response: I am the point of contact for implementing ISO 9000 within the PK (contracting) Directorate.

Question: How long have you been procuring goods and services for the government?

Response: 36 years.

Question: Since the shift from using government standards to using commercial standards occurred, what change have you noticed in the procurement process?

Response: There have not been any significant changes.

Question: With the government becoming more dependent upon commercial certification, has there been an increase in government oversight activity?

Response: No, increase. In fact, there is probably less. Some of that is attributed to the DOD downsizing and to acquisition reform.

Question: What problems (if any) do you believe will occur as a result of this shift in policy?

Response: With the large contractors very little. With the small ones it would be a real hardship for them to have to become certified. The cost would be relatively high. It cost the propulsion business area approximately one-half million dollars to become certified.

Question: What has been your experience getting the ALC Contracting Directorate certified?

Response: The paperwork required is enormous. An operating instruction is required at every decision point. Mr. Blair, the former Director, rejected that idea. The Federal Acquisition Regulation is our operating instruction. The certification authority

bought that. Another problem area is that ISO 9002 requires you to have your suppliers be ISO certified. We cannot do that. The FAR takes precedence and to preclude competition by requiring every vendor to be ISO certified would not be acceptable. Remember that contracting does not generate the requirement. That is the user and engineers' responsibility. In fact, we became ISO 9002 certified because it was required by San Antonio Air Logistics Center–something not done by any other ALC. The C-5 work San Antonio required at Warner Robbins (the ALC in Georgia) is not required to be ISO 9002 compliant. Only the engine work here is required. Now that we have the engine work certified, we will move on to all the aircraft work. That should be done by June 2000. LI (parts production) should be more of a challenge but it too will be certified by 2001. By then the ALC will be ISO 9000 certified.

Question: Who determines if the parts provided are acceptable.

Response: We still have DCAA audits of contractors' plants. If the using activity generating the requirement asks for ISO certification, we would have to require it (James E. Smith, personal communication, October 22, 1999).

United States Air Force Engineering Official– Mr. Wayne Jones, Chief Engineer OC-ALC

Question: Briefly describe your job and how you fit in with obtaining quality products and services for the government.

Response: My primary job is to support the Air Logistics Center. I have a staff of about 150 people who provide engineering and technological insertion expertise to those buying goods and services for the center.

Question: How long have you been involved in procuring goods and services for the government?

Response: Nineteen years.

Question: Since the shift from using government standards to using commercial standards occurred, what change have you noticed in the procurement process?

Response: We are a bit uncomfortable with the shift to commercial standards. We had grown accustom to using military standards in our business dealings with contractors. Going totally commercial was something new to us. We now take a closer look at the goods and services provided.

Question: With the government becoming more dependent upon commercial certification, has there been an increase in government oversight activity?

Response: No, the oversight is about the same. The difference is that we used to have a more direct relationship in the contractors' plant and now we look more closely at what they provide.

Question: What problems (if any) do you believe will occur as a result of this shift in policy?

Response: Integration of commercial products into a military system is always a challenge. Also, meeting some of the needs for ruggedness that are somewhat unique to the military can be a challenge for a contractor with a commercial orientation (Wayne Jones, personal communication, October 21, 1999).

United States. Air Force Office Responsible for Deleting Standards– Mr. Morgan Scott, Engineer

Question: Briefly describe your job and how you fit in with obtaining quality products and services for the government.

Response: Currently, I run one of the Engineering Divisions within the Engineering Directorate. In October 1994, I was assigned the responsibility of deleting the military standards and instructions from the Air Force system. I spent the first year working with Air Force Material Command Engineering's Headquarters focal point, Mr. Jim Blair. Clark Feister, the Air Force Focal Point, was killed in an aircraft crash during the year–that slowed things down a bit. Darlene Drulyn replaced Clark. She had acquisition reform legislation to implement and this was a part of that effort. In December 1994 we met with her at Boston. She decided that every RFP, SOW, or SOO over $10,000 had to have her personal review (to make sure we had taken the standards out of the contracting process). We hired ARINC, a defense contractor, to convert all of our standards to performance specifications. When I left in 1996, Jerry Mesander took over the project.

Question: How long have you been involved in procuring goods and services for the government?

Response: Nineteen years with the Air Force. Before that I worked for Bell Telephone eight years right after I graduated from OSU.

Question: Since the shift from using government standards to using commercial standards occurred, what change have you noticed in the procurement process?

Response: The contractors' reaction was strong. We had just made a total change in the way they do business. At the same time the contracting process was reformed. The use of "request for proposals (RFP)" was replaced with "statement of operational objectives" and the later had much less information on what we actually wanted than the RFP. The government engineers also had problems. In the past, they had simply called out the standard they wanted. Engineers used them as boiler plate. Now, they had to actually delve into the requirement. Also the lessons learned from previous mistakes went away. That was quite a loss in corporate knowledge (Morgan Scott, personal communication, October 22, 1999).

United States Air Force Office Responsible for Deleting Standards– Mr. Jerry Mesander, Engineer

Question: Briefly describe your job and how you fit in with obtaining quality products and services for the government?

Response: At the time of standards deletion, I worked with Morgan Scott–we kind of co-produced the reduction in standards. My office was in OC-ALC/LIIRC, the commodities engineering shop. Morgan left in the summer of 1996 and I continued the effort we had begun.

Question: How long have you been involved in procuring goods and services for the government?

Response: At the time, twelve and one half years. Since then, I left the government and went to work for a defense contractor.

Question: How long after the mandate to abolish the standards was it before MIL Q 9858A was removed from government requirements?

Response: By 1997 that was gone. In fact, MIL Q was what was referred to as the "Willoughby 10" which in reality was about 80 standards that were arbitrarily deleted with no performance specification replacements developed.

Question: What is your opinion of ISO 9000?

Response: It is an outstanding system. However, it is easy for the system to get out of hand, bogged down in meaningless paperwork. As the certifying official calls for you to generate a lot of forms you may have a process in a state of flux–expensive and hard to control. Many thought that ISO would make things simpler. It didn't. Mil Q was much simpler to use. You only had one set of standards. With ISO you now have a moving target. The audits and certification are really burdensome on smaller companies (Jerry Mesander, personal communication November 2, 1999).

Summary

The review of the literature determined there was a paucity of written material available for research. To supplement the written materials, original research was done through interviews with selected officials responsible for some facet of ISO implementation. These interviews are separate and distinct from the survey of industry.

Some common themes found include:

1. Much of the commercial sector is moving toward ISO certification,
2. ISO is being tailored to fit various industry needs, and
3. ISO certification is considered both bureaucratic and expensive.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

This chapter provides insight into the type of research conducted, the research method, including key elements of the design used to conduct the study, the instrument selected to conduct the study, and the statistical application used to analyze the results.

Type of Research

The research type is descriptive. The research describes the effect of the government's change from Military Standard 9858A to ISO-9000 for Oklahoma Aerospace Industry's ability to provide government goods and services (including military hardware) to its government customers.

Research Method

Five data bases that capture all the companies doing business within Oklahoma were examined to determine which would:

1. Offer an accurate random sample of Oklahoma-based businesses doing business with the United States Government,

2. Be feasible to manipulate for purposes of this study. (In other words, a database that contained non-Oklahoma based companies would have to be refined to eliminate them), and
3. Be of sufficient size to provide a statistically accurate picture of Oklahoma-based industry. No database was found which was devoted exclusively to aerospace. However, the Oklahoma Air Logistics Center is the largest government customer in the state.

The Federal Logistics Database or FEDLOG is by far the most robust database available for research of this nature. However, there are limits to using the FEDLOG. It is not arranged by location (company origin). Thus, it would require significant manipulation to develop a list of candidate companies to interview. By using a random number table such as found in Gay's text (1996) one could eventually obtain a random data base which met the needs of this study. However, some of the randomness of the study would be lost because the data would have to be screened for business origin. Also the FEDLOG has an inherent limitation–if you have not done business recently with the Government, the company name is dropped from the FEDLOG. Statistically, this is called *mortality* of the database (Gay, 1996). Thus the FEDLOG was not used for this study.

Other databases considered but not used include the *Thomas Regional Buyers Guide* and the databases of individual city chambers of commerce. The problem with using either of these databases was the registration requirements. In both cases, registration was voluntary. However, the chamber products sometimes included a fee to become registered. That negated the randomness of those instruments.

The University of Oklahoma maintains a database of 1500 Oklahoma-based firms. Because it is electronically available, it was initially considered for this research. However, the data was not focused on product, service, or customer. Thus, an intensive manual effort would have been required to use that data. Additionally, the loss of randomness would have been impacted.

The Oklahoma Department of Commerce (DOC) database listed 5,000 companies that are Oklahoma-based. This database, unlike the FEDLOG, contained companies that existed before the government's policy change. Further, because this database includes virtually all Oklahoma-based companies, it is in essence a census of Oklahoma-based industry. The listing was somewhat easy to manipulate relative to size and location. However, the listing was not easy to use in selecting those companies with a level of participation in either providing services to the government or that were aerospace related.

The CATT Project had created a database using random inputs from the larger Oklahoma DOC database which according to their Standard Industrial Classification (SIC) code had produced parts for the Department of Defense. The CATT database contains over 250 Oklahoma-based companies. It is a record of industry within the state which does (and has done) business with the United States government–the primary focus is aerospace. Thus, the CATT database proved to be the most useful in developing a meaningful sample of Oklahoma-based industry involved in producing articles or services for the United States government.

After reviewing Key's text (1997, pp. 78-79), a determination that a sample size of 30 companies would provide sufficient accuracy for this research. The population in

database used contained 250 Oklahoma-based firms. The formula for determining appropriate sample size follows:

$$S = \frac{X^2 NP (1-P)}{D^2 (N-1) + X^2 P (1-P)}$$

S = required sample size

N = the given population

P = population proportion for the table (Key, 1997, p. 79)

D = degree of accuracy

X^2 = table value of chi square for one degree of freedom (e.g., 3.841 for .95 confidence level)

A random sample of 30 companies was made from that list of Oklahoma-based companies. Telephone interviews were conducted with responsible officials in those firms to determine:

1. Their level of federal government business in 1995 and 1999,
2. Their use of ISO-9000 today,
3. Problems they have had getting ISO-9000 certification, and
4. Their opinions as to the impact of the change to ISO-9000 on their market niche.

Instrument

A survey was developed with questions targeted toward each of the four interest areas. The questions were structured so that an incremental and/or ratio assessment of interest areas one and four was possible. An expert-panel-review of the questions was conducted before the test was administered to assure survey validity. Approval to administer the survey was obtained from OSU Institutional Review Board (IRB) before the interview (survey) was administered. That IRB approval is found in Appendix C. A prototype of the survey was administered to industry leaders from firms outside the random sample to further refine the survey instrument. The interview questions are found in Appendix A.

Part I, interview questions 1 through 6, deal with general demographic posture of the respondent and industry. The experience of the interviewee, the size of the company–number of employees, and the distance from either Tulsa or Oklahoma City of their plant–is determined in this section. Questions about the level of sales, the level of government sales–including any changes seen or anticipated–are also in the first section of the survey instrument.

Part II, questions 7 to 13, relates to their knowledge of quality. How much they estimate they have spent on quality certification and how important they view ISO-9000 certification are included. A question in Section II relates to their perception of the government's seriousness about ISO-9000 certification. A final question in Section II relates to their perception about any changes in government sales volume that ISO-9000 certification may cause.

The final part of the survey instrument questions 14 to 16, determines availability and use of ISO-9000 training. The availability of training, their preference as to who should offer ISO-9000 training, and whether the interviewees think tax incentives are merited for ISO-9000 certification are covered in the final section.

Interview Structure

Only one person, Ms. Sharene Anderson, conducted the interviews. The interviews were conducted by telephone. The time, date, and person being interviewed and the level of responsibility of the person interviewed were annotated. A facsimile (letter) was sent to each from selected to be interviewed. Appendix B has an example of that letter. Once the information from the interviews was documented, the cover sheet that depicts who was interviewed was destroyed. The actual interview sheets were kept for future research projects. Although the types of study are different and Dr. Kutz did in-person interviews, whereas these interviews were done exclusively by telephone, the approach described by Dr. Mary Kutz (1998) in conducting the interviews was extremely helpful.

Statistics Used for Assessment

A statistical review–range, median, mode, and mean–of the results was accomplished to determine:

1. What is the current demographic picture of Oklahoma-based aerospace industry relative to ISO-9000 and has it changed much since the mandate?

2. The demographic information about population surveyed was further examined to determine if size of company or distance from a major city had any impact on ISO-9000 usage. The attitude of key executives toward ISO-9000 was captured by the questionnaire. How did that attitude balance with the attitude senior government and state officials involved in ISO-9000 applications had expressed? ISO-9000 training was a key metric examined in the questions asked–who should do the training, is there ample training available, and should tax incentives be offered to companies becoming ISO-9000 certified?
3. The variability of the results found within the data collected was examined to further refine the quality picture of Oklahoma-based industry, and
4. Other areas meriting further study are described.

To determine the results of the research: did the change to ISO-9000 requirements impact the Oklahoma-based aerospace industry, groups that were MIL Q or MIL I certified before the policy change were evaluated as to their level of sales to the United States government. Questions in interest area one were evaluated to determine if a difference had occurred. These questions were incremental in nature, that is:

> Which best depicts changes in your business you have seen in the last three years? Our government business increased by 10%, our government business increased by 10 to 20% . . .

Research Validity

It should be noted that to validate internal validity of the questions directed toward the level of business being done by the company, the level of government business being

done within the state was compared between 1995 and 1999. Additionally, U.S. Department of Defense, FAA, and Oklahoma Department of Commerce statistics were examined to ensure there was not a significant change in business level between the two periods. Gay (1996) states that internal validity is the

> degree to which observed differences on the dependent variable are a direct result of the manipulation of the independent variable, not some other variable. (p. 621)

In this situation the "other variable" could be an unforeseen change in government buying activity. Although the government has gone through an extensive acquisition reform process (Appendix C lists the acquisition reform initiative that occurred from 1965 to 1995), there has not been much change in aggregate spending by the Oklahoma Air Logistics Center–the primary government purchasing activity within the state (AFMC, May 1999).

Rationale for Statistics Used

Statistics used throughout this research are descriptive in nature. For instance, the mean, mode, median, and range are used to describe the current Oklahoma quality landscape. The works of Dr. Key in *AGED 5980* (1997), Meier and Brudney (1979), and two statistic handbooks (Graham, 1993; Spiegel, 1996) were very beneficial in determining sample size, and which statistic to use to accurately portray Oklahoma-based industry's quality picture.

Statistics applied to interest area one, question 1, rely on nominal scale, that is naming the title of the interviewee. According to Gay (1996) the "mode is the only available measure of central tendency" suitable for nominal-type analysis (p. 434). Each

response was counted to determine the most likely level within the organization of the person being interviewed. All were senior decision-makers within their organizations.

Some of the questions were structured in similar fashion (interval and ratio in nature). Thus, the same type of statistical analysis can be accomplished concerning owner-perception of the future of ISO-9000 certification on their business niche. According to Gay (1996), ratio-type information is the most accurate. An example of a ratio-type question is:

> Since ISO-9000 is being mandated by various governmental agencies as the way to do business, how much business do you think you will gain if you become certified: 10% more, 20% more, 30% more, 50% more, 75% more or 100% more?

Note: During peer review, this question was abbreviated, but the rank order remained. Initially in developing the instrument, consideration was given to asking the converse of that question to preclude question bias influencing the outcome of the research: "Do you think you will lose business if you do not become certified?" However, that question was rejected during the peer review as being redundant with little if any value added.

CHAPTER IV

FINDINGS

Introduction

This chapter presents the results of the research. Insight into demographics of the Oklahoma-based aerospace industry, the application or concern for ISO-9000, ISO-9000 training options available, and an overall perspective on Oklahoma-based industries perceptions of ISO-9000 are provided in this chapter. The overall results of the study are found in Appendix D.

Demographics

Characteristics of the Interviewee

Question one responses indicate that all 30 of the interviewees were corporate leaders with significant roles in strategic planning. Twelve were senior managers with profit and loss responsibility. Four were senior executives with corporate officer level authority. All had significant input into the direction the company would be taking in regard to quality certification. Three owners were interviewed. Eleven Presidents or Vice Presidents were interviewed. All but two of the interviewees were involved in a technical

function. The remaining two came from human resources or sales. Figure 4 displays who responded to the survey.

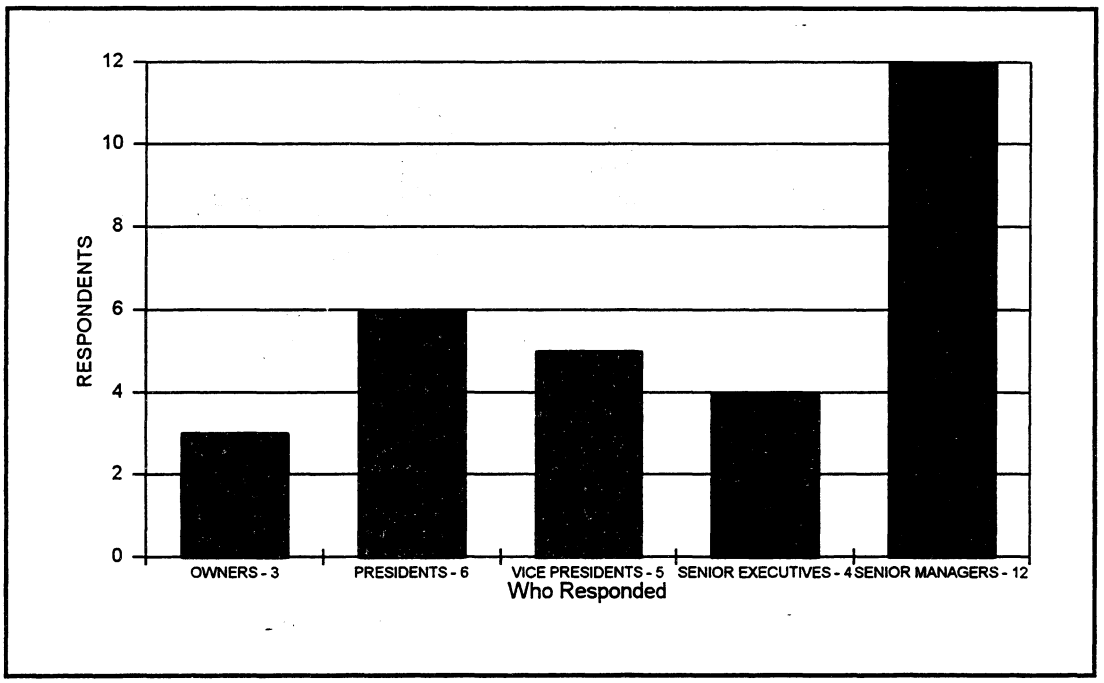


Figure 4. Respondents' Roles.

Responses to question one also revealed the level of experience of the interviewees ranged from less than two years to more than ten years. Over half of the respondents had more than ten years experience with the company. Only two had less than two years. The graph of the experience of the respondents is depicted in Figure 5.

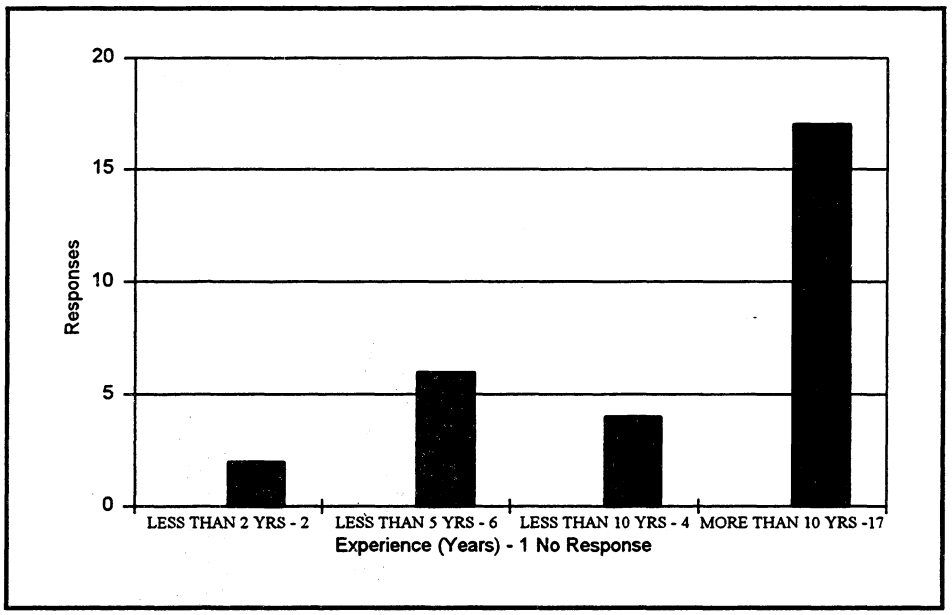


Figure 5. Respondents' Experience.

Demographics of the Companies

Question three responses provide the number of employees found in each firm interviewed and indicates that 73% (22) had less than 50 employees and ten of those companies had less than ten. Figure 6 depicts the number of employees in each company in the interview sample.

Question four responses indicates 86% of the companies interviewed were close to either Oklahoma City or Tulsa. This was not surprising as the preponderance of the aerospace industry–the companies' likely customers–is located in one of these two metropolitan areas. During the CATT Phase I research both rural Western Oklahoma and rural Eastern Oklahoma had more difficulty understanding and adapting to the United

States government procurement process than either CATT project in Oklahoma City or in Tulsa (CATT Report # 10, 1995).

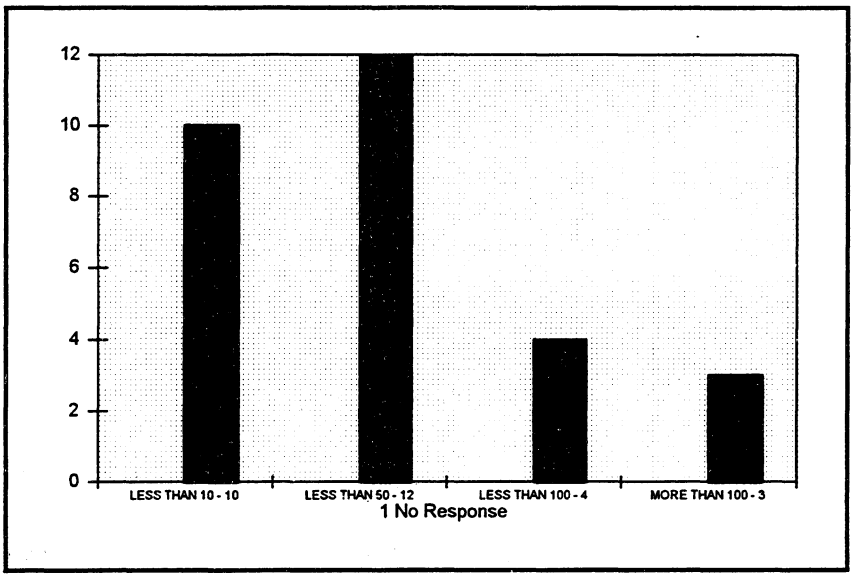


Figure 6. Number of Employees.

Question four responses indicate 83% of the companies–25 of 30–attributed less than 10% of their sales to the government. Only one of the companies interviewed attributed over 50% of their sales to the government.

Question five asked about the stability of government work over the past three years. Twenty-four of 30 respondents (80%) found the business to be very stable with no change noticed. Two of the industries (6%) had noticed a drop in government business, none reported any positive growth. Four (13%) declined to answer the question.

According to question six responses, the business people interviewed were optimistic about the future of government work for their companies. Eighteen (60%) predict a greater than 10% increase in government sales. Three (10%) predict no sales expansion, and one (3%) predicted a decrease in their companies' sales.

Quality Picture of Oklahoma-Based Aerospace Companies

Question seven responses revealed that representatives of the Oklahoma-based companies interviewed were almost equally divided as to their awareness of government's mandate on ISO-9000 and whether to take action toward certification. Only three (1%) had no opinion. Ten (33%) were fully aware and taking action, and ten (33%) were not fully aware but were taking action to learn more about the mandate. Seven (23%) were aware of the mandate but were not taking any action to become certified under ISO-9000 criteria.

The next question dealt with industry expenditures in becoming certified. Only 2 companies (6%) had spent more than $15,000 on ISO-9000 certification, whereas 23 (76%) of 30 had spent less than $5,000.

Question nine responses were in line with the response to ISO expenditures, nine (30% of the) respondents–the greatest number of respondents or mode–indicated that ISO-9000 did not measure up to its cost. They ranked ISO-9000 certification as neither affordable nor valuable.

Responses to question ten, the mode–strongest area of distribution–indicates that 42% of the companies think ISO-9000 certification is not important to their industry. The distribution for this question was more evenly dispersed than the two predecessors, but

still indicated a bias away from ISO-9000. Figure 7 shows the responses to whether the respondents consider ISO-9000 important.

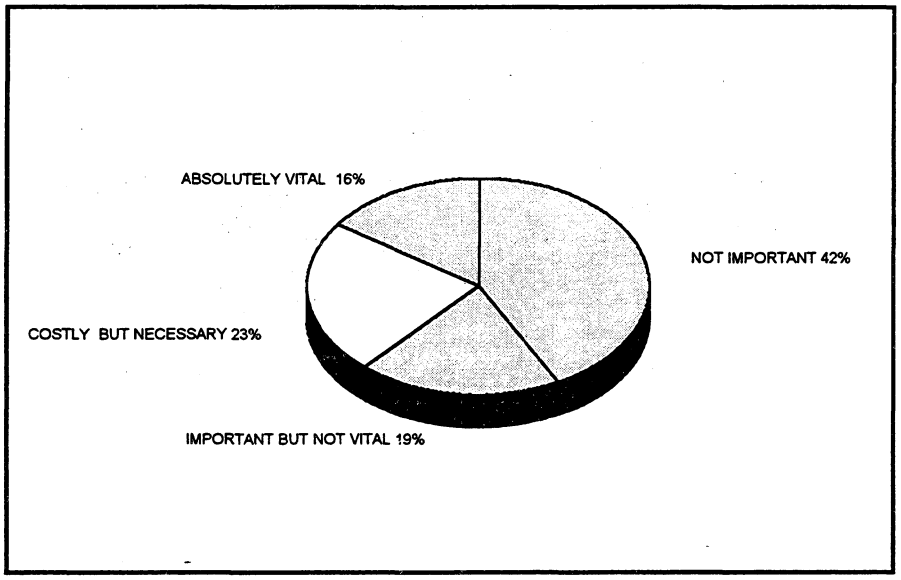


Figure 7. ISO-9000 Certification Importance.

Most (11 or 36%) had no opinion on certification versus compliance and of those who did there was an almost equal distribution among each choice. Figure 8 depicts the responses on certification versus compliance.

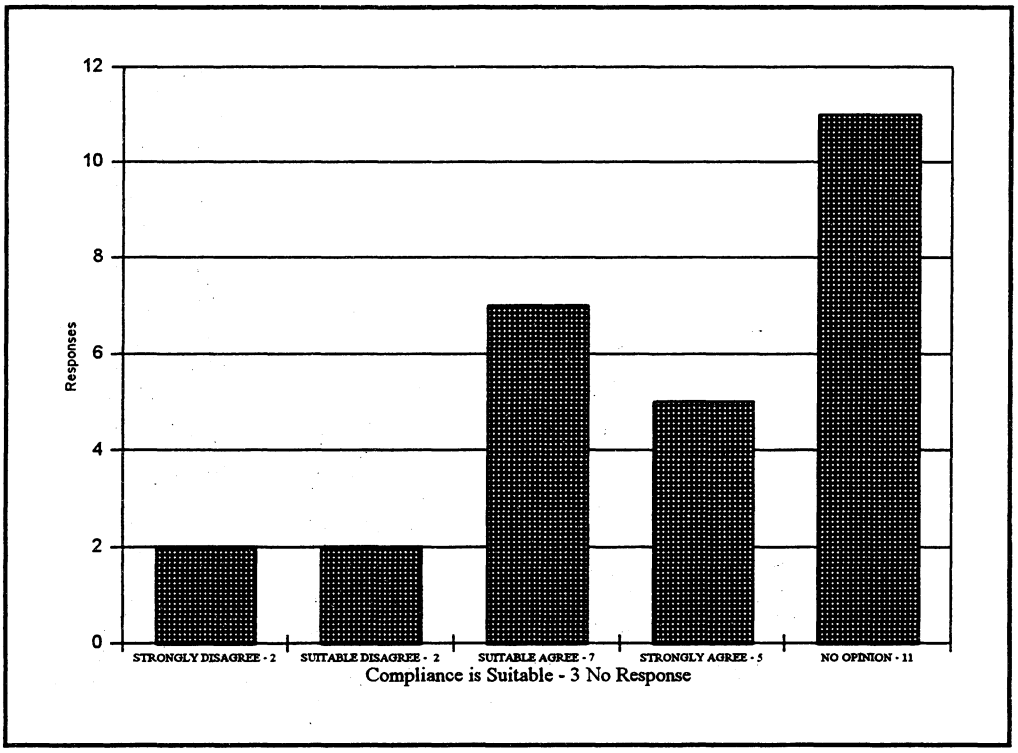


Figure 8. ISO-9000 Certification Versus Compliance.

Industry perspective on whether the government is serious about ISO-9000 certification is revealed in Figure 9.

The industry perspective of ISO-9000 certification on their government sales indicates that 23 out of 30 (76%) respondents do not foresee any change in sales as a result of ISO-9000 certification. Only one company representative (3%) predicted an impact of greater than 10%.

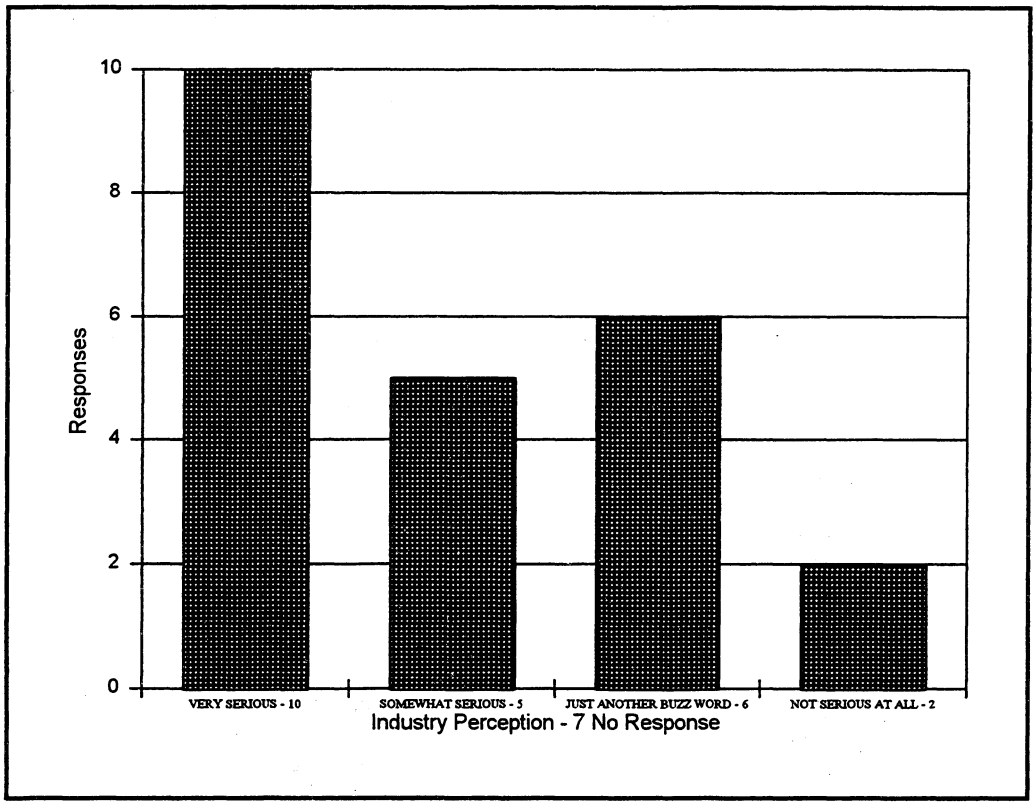


Figure 9. Industry Perception of Government Seriousness.

ISO-9000 Training

Fourteen–the mode of distribution–respondents (46%) indicate that there is sufficient ISO-9000 training nearby. The author did not observe any relationship between size of the respondent's company or its location near a major city (Tulsa or Oklahoma City) in regards to ISO training. In fact, only one respondent (33%) indicated that ISO-9000 training was only available in the big city. Four respondents (13%) were not satisfied with the amount of training available to them locally.

As to who should offer training, this question received a wide distribution of answers. Figure 10 depicts the responses.

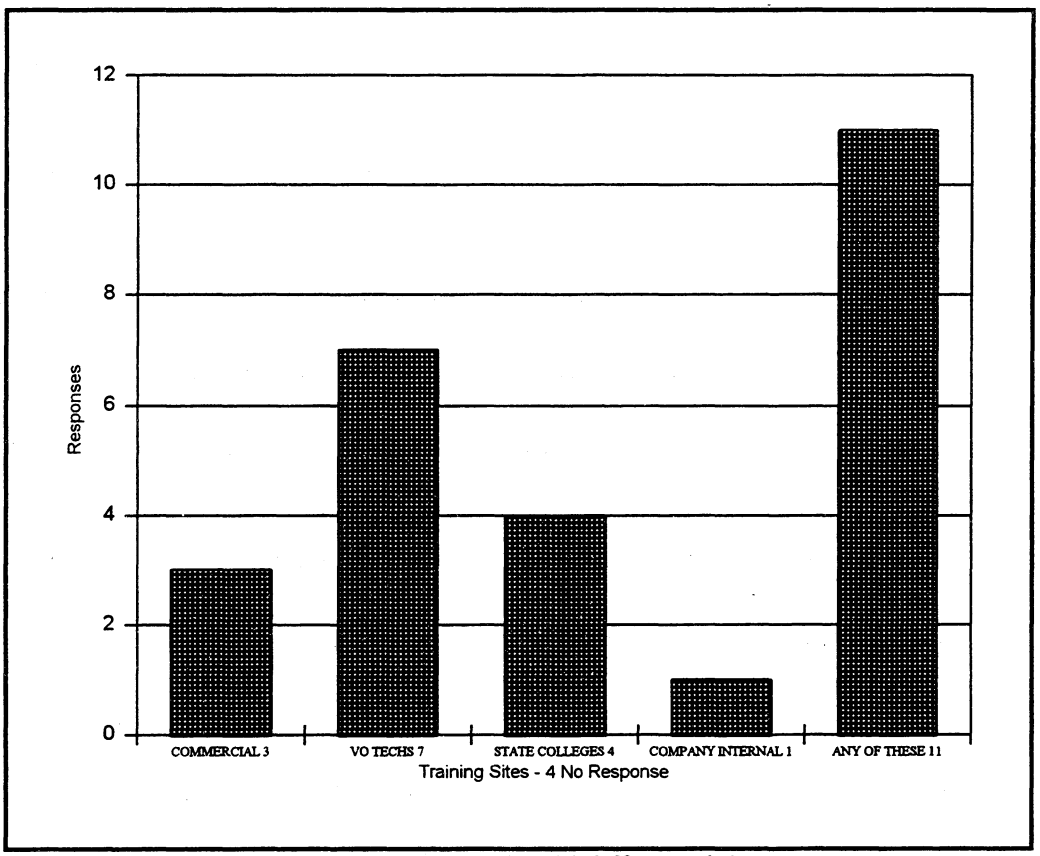


Figure 10. Who Should Offer Training?

The results fall into what is statistically called a bi-modal distribution (Spiegel, 1996, p. 40). This implies that there are two loci of interest involved in the responses. The larger category shows that it makes no difference as to who offers the training. A secondary locus is that Vo-Techs should offer ISO-9000 training.

The final question posed a tax incentive for companies that had achieved ISO-9000 certification. Again, a bimodal distribution of the results occurred. However, this bimodal distribution was more in line with the strength of wanting the tax incentive with nine respondents believing it should be offered and 12 respondents strongly believing a tax incentive should be offered. From another perspective, over 60% of those asked believe some tax incentive for ISO-9000 certification is needed.

Response to Research Question

Does the Oklahoma Aerospace Industry That Successfully Operated under MIL-Q-9858A and MIL-I-45208 Have the Training, Education, and Academic Infrastructure in Place to Effectively Operate under ISO-9000?

Certification, which was once the responsibility of the United States government, has now transitioned to the commercial sector without an attendant affordable, available, and reputable infrastructure in place to meet the needs for military and commercial aerospace parts vendors, especially among the rural aerospace-manufacturing firms within Oklahoma. In essence, by changing from MIL-Q to an ISO environment, the DOD has caused a reduction in Oklahoma Aerospace Industries' ability to provide products to the U.S. military. This research describes the state of quality certification existing in Oklahoma today.

Response – The description of Oklahoma Aerospace Industry indicates a decline in formal quality certification. Only two (6%) of the thirty companies surveyed were approaching certification. In the past, the Department of Defense (DOD) certified

industry as being MIL Q 9858A or MIL I 45208 capable. That is no longer being done. DOD still does source inspections at vendors' plants and questions are still asked by a vendor about the quality system in place. However, the shift to ISO-9000 has not had most of the industry respondents interviewed becoming certified. In fact, only one company of those interviewed had become certified, and their expenditures were in excess of $50,000 to become certified. One other company had spent $15,000 to start the certification process.

Certification training was found to be available throughout the state. Almost all respondents rated it as expensive. Further, 70% or 21 of 30 respondents believe some form of tax incentive should be offered to those companies that become ISO-9000 certified.

Summary

Thirty corporate leaders were interviewed for the research. Most of the companies are near Oklahoma City or Tulsa. Almost all of the companies attributed less than 10% of their sales to government business. Only two were spending more than $15,000 on ISO certification. Most thought ISO to be costly and few believe it is important to their industry. Certification versus compliance revealed a mixed response. Most indicated ISO training was available nearby. Most respondents had no preference as to who should provide ISO training. Of those who articulated a preference, most preferred the Vo-Techs do the ISO training. Most also prefer a tax incentive for ISO certification.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions from the Search of the Literature

The emphasis on ISO 9000 certification has gained significant momentum based upon the information derived from the interviews with senior leaders at Oklahoma City Air Logistics Center. Additionally, the larger companies that support OC-ALC seem inclined to follow the ALC's lead in matters of quality. According to the peer review of the survey question–one of the peers was a senior employee with Boeing–the larger companies will comply with ISO 9000 and become certified. Further, according to Deal and Kennedy (1982), once the cultural change is in place that expects ISO 9000 certification, it will be difficult for industry to provide services without being certified. In the interview with Mr. James Smith, he noted that the requirement to require ISO-9000 on all procurements was rejected as a Federal Acquisition Regulation (FAR) violation. However, if the requiring activity specified ISO certification, it would have to be included. A key facet of obtaining and maintaining ISO certification is that vendors and suppliers must have a rigorous quality system in place. With the entire ALC becoming ISO-9000 certified within two years, it will simply be a matter of time before ISO certification is required of vendors.

There has been very little study done on ISO-9000 implementation costs versus benefits. What articles were found were lacking in actual measurement, and none were found that approximate either a causal or cause and effect level of research. More research in this area is merited. To supplement the lack of journal articles and lack of recent books on ISO-9000 implementation, original research in the form of interviews was required to complete the picture of quality in Oklahoma required for this research. The CATT project proved to be a "gold mine" of information on the specifics of Oklahoma industry. That project has served both academia and the citizens of Oklahoma well in helping to understand what is going on with Oklahoma's Aerospace Industry.

Conclusions from the Findings

Responses of the individual questions was provided in Chapter IV. However, some additional conclusions were apparent from the research.

Word of Mouth Quality

Oklahoma businesses interviewed seem to believe that "word of mouth" quality is their market niche. Although not a survey question, several of the interviewees volunteered that their business was local and that their quality reputation was based upon "word of mouth" and not upon being certified. Also, there seemed to be a strong current of opinion that ISO certification was for the large company or for those involved in international business. Although outside the scope of this research, if the governor's initiative to win foreign markets is to be successful, then having the infrastructure in place

to ensure a quality product or service is provided seems to be appropriate. More research on ISO-9000 certification as a marketing tool may be needed.

One finding proved to be surprising–most of the companies attribute less than 10% of their sales to the government. The author's experience with the CATT project and 24 years in the defense industry leads to two possible reasons for this result: 1) perhaps most of the non-Oklahoma based industry focused almost exclusively on government business followed their customer (the government) to Oklahoma and/or 2) Oklahoma-based industry has not fully exploited their government market niche. With the downsizing at Tinker–which has caused significant outsourcing–Oklahoma-based companies not being involved in that market growth seems to be somewhat short-sighted. Certainly further research in this area is warranted.

Proximity to Tulsa or Oklahoma City and the size of the business did not seem to be a factor in any of the responses received during the interview process. With modern telecommunications, adequate lines of supply support–Oklahoma has an excellent network of roads connecting most of the towns within the state and mail delivery to any point in the state typically occurs within one day–the rural nature of a business setting seems to be less of a factor than in the past. However, the scarcity of industries in the more remote regions (the West and Southeast as noted in the CATT Project) indicates there is still ample opportunity for growth and development in those regions. Perhaps ISO-9000 certification could become a tool for helping to make this happen.

Confusion over ISO-9000 certification may lead to a loss of business. Only 10 (33%) of the 30 companies surveyed were taking action to become certified. If that trend holds true across the industry and the government begins requiring ISO certified vendors,

it would indicate a 66% reduction in Oklahoma-based capacity will result. Assuming uniform distribution for the revenue generated among Oklahoma-based industry, that would also equate to a significant loss in revenue as the Oklahoma ALC purchased $229 million of goods and services from within the state of Oklahoma (exclusive of salaries paid to civilian and military personnel assigned to the ALC) in 1998 (Alger, 1998).

Difference of perception between industry and government on ISO certification importance needs further research. More research may be merited to determine if the government will increase its emphasis on ISO-9000 certification. Based upon the legacy of several years of heightened quality focus within government, many management theorists would suggest that would be the case (Deal & Kennedy, 1982).

Certification versus compliance seemed to be an area of confusion. The research results indicate uniform distribution among those who favor one over the other. Among the responses the most (36%) had no opinion. Some respondents were not satisfied with ISO training. This area needs further study. From the survey it was not possible to determine if this response was because of the failure of a particular area enterprise to offer training or if the training offered was insufficient. More research in this area may be merited.

Recommendations

Lost Market Share – The small amount of government business that most of the individual firms have was discussed in Chapter IV. More research into why this is the case may be an area of interest for future CATT projects or for other academic endeavors. With $229 million flowing into the state from the ALC alone, it would seem prudent for

Oklahoma-based Aerospace Industry to attempt to capture more of that defined market share. Additionally, a much larger portion of the ALC's budget of $3.6 billion goes to companies based outside the state. Some insight into why this happens would be excellent information for Oklahomans involved in marketing to the government.

Government Future Direction with ISO – Although much of the inertia is in place to cause further ISO requirements, some fundamental research is needed into how the government intends to proceed as a consumer of goods and services. As this research pointed out, there is a strong imperative to continue the quality movement within the government. However, the restraints in the Federal Acquisition Regulation against precluding competition had acted as a safeguard thus far in keeping ISO from being required on all procurements. That safeguard may not in fact be a point of law. As more and more vendors become ISO certified, a pool of competent vendors which can compete will become a fact of life. When that occurs, the restraint on not requiring ISO-9000 on all procurements may not be defensible under FAR guidance. Further, the FAR can be modified by Congress and has been when the political will was present to make changes. For instance, the Competition in Contracting Act (CICA) legislation (1983) was a major change in the FAR that caused the government to encourage small businesses to compete rather than just allow them to compete. A list of other acquisition reforms is included in (Christensen, 1999) Appendix E.

ISO Training Adequacy – The research seemed to indicate there is ample ISO–9000 training available, but that what is available (in some cases) may not be adequate. More research into the specifics of ISO-9000 training may be needed to clarify

the reason for this response. This may be an area for the Vo-Techs to explore, as they seem to be the most favored training provider by the survey respondents who articulated a training preference.

Vo-Techs to Offer ISO-9000 Training – Of the respondents who articulated a preference, the respondents to this research seemed to prefer the Vo-Techs for ISO-9000 training. Perhaps a survey of the need by industry and by location should be accomplished to further refine industry preference. Because over 70% favored a tax incentive for ISO-9000 certified companies, it may be prudent to examine these two facets of the research together. Low cost ISO-9000 training that actually leads to certification may be an excellent market for Vo-Techs to pursue.

ISO-9000 Certification Cost Versus Benefit – Basic research into this facet of ISO–9000 has not been done. It appears to be a fertile area for more research, especially causal or cause and effect type of projects. What was found in this area was historical or descriptive in nature. As more companies become certified, the statistical data needed to accomplish such a project should be (or soon become) available.

ISO Certification as a Market Tool – Two areas merit further research on ISO–9000 as a market tool. One is the federal sector and some of the foundation work for that project has been done in this research. The other is in the international setting. As the world moves more toward a world economy, perhaps ISO-9000 certification will become more important in the local market place. Research into ISO-9000 as a marketing tool seems to be an area fertile for investigation.

ISO Certification and Japanese Management – This area was outside the scope of this research. However, some of the literature reviewed seemed to suggest that there was a correlation between Japanese economic success and their management style. The only work found that provided insight into Japanese management was by Pascale and Athos (1981). That preceded the development of ISO-9000. Although articles in *Business Week* and other business periodicals have described the insufficiency of the Japanese model, there is still ample opportunity for significant research on how the world's conversion to an international standard of quality will affect the Japanese or other economic powers in the next century.

Overall Analysis

The quality picture in Oklahoma does not indicate a serious effort to become ISO-9000 certified. Although it would be difficult to segregate the actual loss of potential revenue because of the lack of initiative in this area, the upward potential could correspond to a significant portion of the $229 million of goods and services purchased by the Oklahoma ALC from within the state of Oklahoma in 1998 (Alger, 1998). If only a third of that revenue was consumed by Oklahoma-based businesses, then the attendant loss could be over $50.38 million annually (229/3 x 0.66 = $50.38 million). The formula for establishing that level of loss follows:

$229 = total goods/services purchased within Oklahoma by OC-ALC.

$229/3 = assumes 1/3 of the Oklahoma-based firms participate equally in generating that revenue.

66% = the percent of Oklahoma-based industry not becoming ISO certified.

Additionally, ISO-9000 is designed to help companies involved in international sales. Although beyond the scope of this research, perhaps more research is needed to determine the potential for overseas market growth for those companies that become ISO-9000 certified.

Summary

Research

More research is needed for ISO-9000. Specific research into the cost versus benefits was lacking. The proximity to a major city, Oklahoma City or Tulsa, did not seem to affect the availability of ISO training. Research into the merits of Vo-Techs doing ISO training and the potential for a tax-incentive are strongly supported by the research.

Recommendations

Recommendations from the research fall into three general areas:

1. Loss of market share,
2. ISO benefits, and
3. The future direction of ISO.

BIBLIOGRAPHY

Air Force Logistics Command (AFLC). (1991). Application for Baldridge national quality award. Wright Patterson Air Force Base, OH: Author.

Air Force Material Command. (May 25, 1993). Air Force material command guide on integrated product development. Wright Patterson Air Force Base, OH: Author.

Alger, R. (1998, April 24), Contracting conference helps educate small business owners. Tinker Take Off, 56(15), 1.

Athos, A., & Pascale, R. (1981). The art of Japanese management applications for American executives. New York, NY: Warner Books Inc.

Boeing Defense and Space Group. (July 1990). Desktop guide for continuous quality improvement. Seattle, WA: BAC.

Cartlin, T. (1993). Principles and practices of TQM. Milwaukee, WI: ASQC Quality Press.

Christensen, D., Searle, Capt. D., & Vickery, D. (Summer, 1999). The impact of the Packard commission's recommendation on reducing cost overruns on defense acquisition contracts. Acquisition Review Quarterly, Vol. 6, No. 3, 251-259.

Creech, B. (1994). The five pillars of TQM: How to make total quality management work for you. New York, NY: Penguin Group.

Crosby, P. (1979). Quality is free. New York, NY: Mcgraw Hill, Inc.

Deal, T. E., & Kennedy, A. (1982). Corporate cultures. Reading, MA: Perseus Books.

Drucker, P. (1986). The frontiers of management. New York, NY: Harper & Row Publishers Inc.

Drucker, P. (May-June, 1990). The emerging theory of manufacturing. Harvard Business Review. Cambridge, MA: Harvard Business Press.

Feigenbaum, A. (1993). Total quality control, 3rd Ed. New York, NY: McGraw Hill, Inc.

Fletcher, C. (August 20, 1999), Workload recommended for ISO 9002 registration. Tinker Take Off, 57(33), 1.

Gay, L. (1996). Educational research, 5th Ed. Upper Saddle River, NJ: Prentice-Hall, Inc.

Goodell, Brigadier General F. (July 1988). USAF R & M 2000 Process, 1st Ed. Washington, D.C.: United States Air Force.

Goldratt, E. (1990). The haystack syndrome. Croton-on-Hudson, NY: North River Press, Inc.

Graham, A. (1993). Statistics. London, UK: Hodder Headline Ltd.

Gunn, T. (1992). 21st century manufacturing. New York, NY: Harper Collins Publishers, Inc.

Holcombe, Capt. S., (Ed.) (May 1999). Annual Check-up. Leading Edge, Public Affairs Office Headquarters Air Force.

Holmes, Msgt. S. Ed. (1993). The total quality approach: Your guide to quality in today's Air Force. Washington, D.C.: United States Air Force.

(1998). Japan's amazing ability to disappoint. The Economist, 348,(8087), 21-24.

Juran, J., & Gryna, F. (1970). Quality planning and analysis. New York, NY: McGraw-Hill Inc.

Juran, J. (1964). Managerial breakthrough. New York, NY: McGraw-Hill, Inc.

Keller, M. (1989). GM rude awakening. New York, NY: Harper Collins.

MacManus, S. (1992). Doing business with the government: Federal, state, local and foreign government purchasing practices for every business and public institution. New York, NY: Paragon House.

Malishenko, T. (May-June 1999). C-17 Program – From the brink of cancellation to Baldridge National Quality Award winner. Program Manager, Vol. XXVIII (3) DSCM 150, 34-38.

McDonald, General C. (Feb. 1991). Application for the president award for quality and productivity improvement. Wright-Patterson Air Force Base, OH: HQAFLC/XPP.

McGurk, M., Ed., (1999). Thomas regional directory: North Texas – Oklahoma. New York, NY: Thomas Regional Directory Company.

Meier, K, & Brundney, J. (1979). Measurement and analysis for public adminstrators. Norman, OK: University of Oklahoma Press.

Meyer, H. (March 1998). Small firms flock to quality system. Nation's Business, 86(3), 66-68.

Peppers, D., & Rogers, M. (1993). The one to one future building relationships one customer at a time. New York, NY: Doubleday Dell Publishers, Inc.

Peters, T. (1987). Thriving on chaos: Handbook for a management revolution. New York, NY: Alfred A. Knopf.

Peters, T., & Austin, N. (1986) A passion for excellence. New York, NY: Time Warner.

Pryor, M. (June 1990). Total quality management: Statistical process control level I courses. Greenville, TX: E Systems.

QUALTECH. (1988). Quality improvement program. Palm Beach Gardens, FL: Florida Power and Light Company.

Rahl, F. (1989). Promoting total quality in the logistics community, total quality management symposium proceedings. Baltimore, MD: Westinghouse Electric Corporation.

Sawyer, K. (May 8, 1986). NASA cut quality monitors since '70. Washington Post.

Sewell, C. (1990). Customers for life: How to turn the one-time buyer into a lifetime customer. New York, NY: Pocket Books Division of Simon and Shuster.

Shephard, L., Bakula, G., & Teufel, J. (1995). Mike Monroney Aeronautical Center [Brochure]: Federal Aviation Administration.

Smith, G. (1995). Statistical process control and quality improvement. Englewood Cliffs, NJ: Prentice Hall.

Strickland, J. (Undated). Total quality management: An executive overview. Washington, D.C.: Federal Quality Institute.

Szymanski, D., & Story, Lt. Colonel D. (1993). Metrics and TQM: Are they compatible? Software Engineering Technology, special edition, 124-125.

Taguchi, G., & Clausing, D. (Jan.- Feb. 1990). Robust quality. Harvard Business Review.

Thurow, L. (1992). Head to head: The coming economic battle among Japan, Europe and America. New York, NY: Warner Books.

United States Department of the Air Force (1989). QP4, Quality leadership for managers. Human Resources Training Notes. Oklahoma City Air Logistics Center, Tinker, AFB, OK.

United States Department of Defense, Defense Logistics Agency. (1995). Computer-aided technology transfer (CATT) final report, phase I (Subcontract # oko1-95-TMR-0004). Author.

United States Department of Defense. (June 29, 1994). Specifications & standards –a new way of doing business. Washington, D.C.: U.S. Department of Defense Memorandum.

United States Department of Navy. (1985). Best practices, DoD 4245-7 M or military standard 1528A. Washington, D.C.: Author.

United States Department of Navy. (rescinded). Soldier specification, MIL-S-45743E. Washington, D.C.: Author.

United States Government. (1965). Handbook 50, quality and reliability assurance, evaluation of a contractor's quality program. Washington, D.C.: Assistant Secretary of Defense – Installation and logistics.

United States Government. (1967). Handbook 51, quality and reliability assurance, evaluation of a contractor's inspection system. Washington, D.C.: Assistant Secretary of Defense – Installation and logistics.

United State Government. (1981). Military specificatión inspection system requirements. Washington, D.C.: Department of Defense, NPO (NAVEXOS-P-1034).

United States Government. (1985). Military specification MIL-Q-9858A quality program requirements. Washington, D.C.: Author.

Woodruff, D., & Phillips, S. (April 30, 1990). A smarter way to manufacture. Business Week, 110-117.

Wright, P. (1979). On a clear day you can see General Motors. Grosse Pointe, MI: Wright Enterprises.

Zettler, Major General M. (October 8, 1999), Back to Basics: New plan stresses quality, safety, within centers. Tinker Take Off, 57(40), 2.

Zuckerman, A. (Oct. 23, 1995). Move to revolutionize supplier/quality auditing. Electronic News, 41(2088), 38-42.

Zuckerman, A. (Oct. 14, 1995). Standards proliferation concerns U.S. firms. Electronic News, 42(2138), 46-50.

APPENDIXES

APPENDIX A

INTERVIEW QUESTIONNAIRE

QUESTIONNAIRE

The purpose in developing these questions is to determine the level of interest of Oklahoma-based industry in meeting new commercial standards for quality. The survey is divided into three parts and will be administered by telephone interview with a number of key corporate decision-makers, preferably an owner, CEO or corporate officer involved in corporate strategic planning.

Preamble:

I am a student at Oklahoma State University studying the recent Government mandate to use commercial quality standards in lieu of military standards. Could you spare about 10 minutes to help me with the study? If you can, I'd be glad to send you a copy of the results for your use. I assure you that your answers will be confidential and will not be reported in anyway to reveal either your name or your firm's name.

Part I
Demographics

1. What is your current title _____, and how long have you been associated with your current firm?

   a. Less than 2 years
   b. Less than 5 years
   c. More than 5 years
   d. More than 10 years

2. How many employees do you currently employ?

   a. Less than 10
   b. Less than 50
   c. More than 50 but less than 100
   d. More than 100

3. How far from either Tulsa or Oklahoma City is your company located?

   a. 25 miles or less
   b. 50 to 100 miles
   c. More than 100 miles

4. How much of your business sales (revenue) are either directly or indirectly related to US Government purchases or services?

   a. Less than 10%
   b. More than 10% but less than 50%
   c. More than 50% but not all Government
   d. 100% Government business.

5. Which best depicts changes in your business you have seen over the last three years:

   a. Our Government business has increased by 10%
   b. Our Government business has increased by more than 10% but less than 20%
   c. Our Government business has remained a stable with little or no increase or decrease
   d. Our Government business has decreased by 10%
   e. Our Government business has decreased by more than 20%

6. Which best describes where you think your company will be in five years:

   a. Our company sales will expand by 10% with Government business being the key driver
   b. Our company sales will expand by more than 10% with Government business being the key driver
   c. Our company sales will expand by 10% with non-Government business being the key driver.
   d. Our company sales will expand by greater than 10% with non-Government business being the key driver.
   e. Our company sales will not expand
   f. Our company sales will shrink by greater than 10%

Part II

Quality

7. Are you aware of the recent change in Government quality requirements to go to commercial standards in lieu of government (military) standards?

   a. Fully aware and we're taking action to become certified
   b. Fully aware but are not taking certification actions as of yet
   c. Not fully aware and are taking action to learn more about the new requirements
      Not aware of any Government change

8. Since 1997, how much would you estimate that your company has invested in becoming ISO 9000 certified?

   a. Less than $5,000
   b. More than $5000, but less than $15,000
   c. More than $15,000 but less than 50,000
   d. More than $50,000

9. What do you think about ISO 9000 costs versus benefits?

   a. Affordable by most businesses your size/but of little real value
   b. Affordable and valuable
   c. Not affordable but valuable by most businesses your size
   d. Neither affordable nor valuable

10. In your industry, do you think ISO 9000 certification is

    a. Not important
    b. Important, but not vital to my business base
    c. A costly but necessary expenditure vital to my business base
    d. Absolutely vital to my business base

11. From my company's perspective ISO 9000 compliance is a suitable means of meeting ISO 9000 standards in lieu of formal ISO certification?

    a. Strongly disagree
    b. Disagree
    c. Agree
    d. Strongly agree
    e. Have no opinion on compliance versus certification

12. Do you think the Government is serious about IS0 9000?

    a. Very serious
    b. Somewhat serious
    c. Just another "quality buzz word"
    d. Not serious at all

13. ISO 9000 Certification will affect your Government sales by

    a. Less than 10% increase
    b. 10%- 20% increase
    c. 20% – 30% increase
    d. No change in sales is foreseen

Part III

Training

14. Do you think ISO 9000 training is amply available to firms such as yours?

    a. Some training is available, but not much
    b. Training is only available in the larger cities and not close by
    c. Sufficient training is available nearby
    d. More training is available than is needed

15. Who should offer IS0 9000 training?

    a. Just commercial firms
    b. State supported Vo Techs
    c. State Universities and Colleges
    d. A firm should internally develop ISO 9000 training
    e. Any of the preceding

16. The Government should give a business a tax incentive for ISO 9000 Certification?

    a. Agree
    b. Strongly Agree
    c. Disagree
    d. Strongly Disagree

APPENDIX B

ADVANCE LETTER SENT (FAXED) TO INTERVIEWEES

October 29, 1999

Jerry McMahan
4600 SE 29th St. Suite 520
Del City, OK 73115

Dear Sir or Madam:

I am currently working on my doctoral dissertation at Oklahoma State University. My course work has been done in the College of Adult Education, Applied Studies Aviation and Space Education. My research is on the effect of the recent U.S. Government mandate to use commercial standards instead of the military standards used in the recent past. My interest in particular is in the field of aviation & aerospace quality assurance. To successfully complete this work, I need the input from senior leaders in the business community such as you. Rest assured that no record of who was interviewed or which firms were contacted will be maintained or become a part of the final published dissertation. The information will strictly be provided in aggregate format. As an example, "firms of less than 25 employees indicated the cost of quality training was . . . ." Enclosed are examples of the questions that will be asked during the telephone e interview. There will be no recording (except by hand written notes) of the responses to the questions. Once the information is aggregated, the actual questionnaire instrument will be destroyed to further guard your privacy. Naturally, you will be provided a copy of the final survey results—which I hope you will find helpful in planning your business endeavors.

I truly appreciate you agreeing to participate in this research. At the start of the interview you will be ask if you are or are not willing to participate. No record of that response will be kept but a positive response will serve as your permission for the interview to proceed. In the event you believe someone else in your firm is more qualified to respond to the questions that will be ask, please let them know and the interviewer know who that is when they call.

I will call your office in the morning on ____ October 1999. The interview should take approximately 10 minutes of your time.

Thanks you in advance for your corporation and help with my graduate studies. You may reach me at my work telephone (405) 677-8500 should you desire to arrange a special time for the interview or have any questions about the project.

Jerry McMahan

OSU Doctoral Candidate

Enclosure: Interview Questionnaire

APPENDIX C

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD

Date: October 28, 1999 IRB #: ED-00-171

Proposal Title: "AEROSPACE QUALITY PROCESS TRAINING IN OKLAHOMA"

Principal Investigator(s): H.C. Mc.Clure
Jerry McMahan

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Signature:

Carol Olson, Director of University Research Compliance

October 28, 1999
Date

Approvals are valid for one calendar year, after which time a request for continuation must be submitted. Any modification to the research project approved by the IRB must be submitted for approval with the advisor's signature. The IRB office MUST be notified in writing when a project is complete. Approved projects are subject to monitoring by the IRB. Expedited and exempt projects may be reviewed by the full Institutional Review Board.

APPENDIX D

INTERVIEW QUESTIONNAIRE RESULTS

TABLE II

INTERVIEW QUESTIONNAIRE RESULTS

# Interview Questions (See Appendix A)	Question Response A	Question Response B	Question Response C	Question Response D	Question Response E	Question Response F	Did Not Respond	Total Question Responses
1. Years with Firm	2	6	4	17			1**	30
2. Number of Employees	10	12	4	3			1**	30
3. Distance from Tulsa/OKC	26	3					1**	30
4. Sales % from Government	25	3	1				1**	30
5. Business Change			24	1	1		4	30
6. Business Change in 5 Yrs			7	18	3	1	1	30
7. Aware of Government Mandate	10	7	10				3	30
8. ISO Investment	23	2		2			3	30
9. ISO Cost Versus Benefit	5	6	3	9			7	30
10. ISO Certification Importance	11	5	6	4			4	30
11. Certification Versus Compliance	2	2	7	5	11		3	30
12. Government Serious on ISO?	10	5	6	2			7	30
13. ISO Affect on Government Sales	3		1	23			3	30
14. ISO Training Available	4	1	14	4			7	30
15. Who Should Offer ISO Training*	3	7	4	1	11		5	31
16. ISO Government Tax Incentive	9	12	4	1			4	30

Note: * = One respondent provided two answers; ** = one respondent declined to provide demographic data on that firm;
Note 2: = 3 owners, 6 presidents, 5 vice-presidents, 4 senior executives, and 12 senior managers responded to the interview.

APPENDIX E

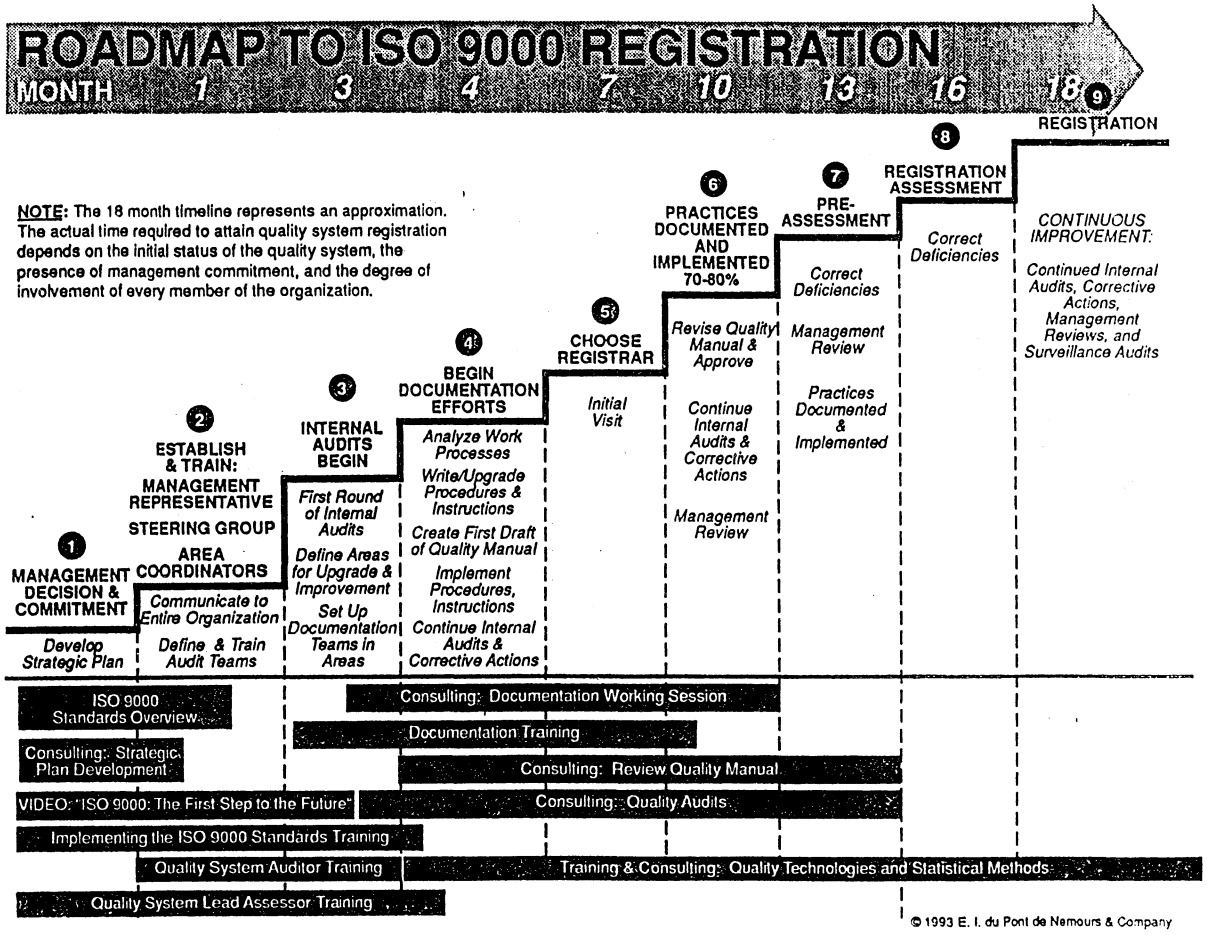
RECENT ACQUISITION REFORMS

Table 1. Acquisition Regulations and Initiatives[1]

Year	Regulation or Initiative Published
1969	Packard Initiatives
1971	Blue Ribbon Defense Panel (Fitzhugh Commission)
1972	DoDD 5000.1 (Major System Acquisitions); Commission on Government Procurement
1973	DoDD 5000.4 (CAIG); DoDD 5000.3 (T&E)
1975	DoDI 5000.2 (Major System Acquisitions); DoDD 5000.28 (DTC)
1976	OMB Circular A-109
1978	Defense Science Board Acquisition Cycle Task Force
1979	Defense Resource Management Study
1981	Carlucci Initiatives; Defense Acquisition Improvement Program
1982	Nunn-McCurdy (thresholds)
1983	Grace Commission
1985	DoD 5000.43 (streamlining)
1986	Packard Commission
1987	DoDD 5134.1 (USD(A); DoDD 5000.49 (DAB)
1989	Defense Management Review
1991	Revised DoDI 5000.2 (Major System Acquisitions)
1994	Federal Acquisition Streamlining Act (FASA)
1995	Federal Acquisition Improvement Act (FASA II)

APPENDIX F

DUPONT'S ROADMAP TO ISO 9000 REGISTRATION


ROADMAP TO ISO 9000 REGISTRATION
MONTH 1 3 4 7 10 13 16 18
NOTE: The 18 month timeline represents an approximation. The actual time required to attain quality system registration depends on the initial status of the quality system, the presence of management commitment, and the degree of involvement of every member of the organization.
1 MANAGEMENT DECISION & COMMITMENT
Develop Strategic Plan
2 ESTABLISH & TRAIN: MANAGEMENT REPRESENTATIVE
STEERING GROUP
AREA COORDINATORS
Communicate to Entire Organization
Define & Train Audit Teams
3 INTERNAL AUDITS BEGIN
First Round of Internal Audits
Define Areas for Upgrade & Improvement
Set Up Documentation Teams in Areas
4 BEGIN DOCUMENTATION EFFORTS
Analyze Work Processes
Write/Upgrade Procedures & Instructions
Create First Draft of Quality Manual
Implement Procedures, Instructions
Continue Internal Audits & Corrective Actions
5 CHOOSE REGISTRAR
Initial Visit
6 PRACTICES DOCUMENTED AND IMPLEMENTED 70-80%
Revise Quality Manual & Approve
Continue Internal Audits & Corrective Actions
Management Review
7 PRE-ASSESSMENT
Correct Deficiencies
Management Review
Practices Documented & Implemented
8 REGISTRATION ASSESSMENT
Correct Deficiencies
9 REGISTRATION
CONTINUOUS IMPROVEMENT:
Continued Internal Audits, Corrective Actions, Management Reviews, and Surveillance Audits
ISO 9000 Standards Overview
Consulting: Strategic Plan Development
VIDEO: "ISO 9000: The First Step to the Future"
Implementing the ISO 9000 Standards Training
Quality System Auditor Training
Quality System Lead Assessor Training
Consulting: Documentation Working Session
Documentation Training
Consulting: Review Quality Manual
Consulting: Quality Audits
Training & Consulting: Quality Technologies and Statistical Methods
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VITA

Jerry McMahan

Candidate for the Degree of

Doctor of Education

Thesis: AEROSPACE QUALITY PROCESS TRAINING IN OKLAHOMA

Major Field: Applied Educational Studies

Biographical:

Personal Data: Born in Andrews, North Carolina, October 4, 1947, the son of Howard and Lenora McMahan. Married to Louise Prater McMahan in 1972. Father of four children: Rhonda, a graduate of Virginia Tech; Joy, a senior at Oklahoma Baptist University; Julie, a sophomore at the University of Oklahoma, and Jerry, a sophomore at Choctaw; High School. Serves as Chairman of the City of Choctaw's Planning Commission. Former President of Choctaw Youth Football Association, 1994-1996.

Education: Graduated from Andrews High School, Andrews, North Carolina in 1965; received Bachelor of Arts degree from Georgia State University in June 1970; received Masters in Public Administration degree from the University of Oklahoma in May 1982; received Masters of Business Administration degree (with high honors) from Oklahoma City University in December 1992. Completed the requirements for the Doctor of Education degree at Oklahoma State University in December, 1999.

Professional Experience: Program Director for Engineering Management Concepts, 1996 to present; Program Manager for Frontier Engineering, 1994-1996. Retired Lieutenant Colonel United States Air Force 1994. System Program Manager for the KC-10, C-9 and KDC-10 Aircraft, Oklahoma City Air Logistics Center, 1991-1994. Chief Acquistion Logistics Inspector Headquarters Air Force 1989-1991. Program Director for Air to Air Missiles, Naval Air System Command, 1987-1989. Chief Program Integration Division, HQ Air Force Systems Command, 1986-1987. War Planner, HQ 8th US Army 1985, Seoul, Korea. Deputy

Program Manager Logistics, Air-to-Air Missiles, 1983-1985. Chief, Quality Assurance Operations, HQ Logistics Command, 1979-1983. Commander Detachment 68, Site Activation Task Force, Ogden Air Logistics Center, 1977-1979. Maintenance Officer 341st and 308th Strategic Missile Wings 1971-1976. Commissioned Officer, United States Air Force, March 16, 1971. Public School Teacher, Paulding County and Grennard-Watson Public Schools 1970.

Certifications and Recognition: Certified Acquisition Logistics Professional (highest level) February 1992, by the Department of the Air Force. Certified Program Manager (highest level) April, 1991, by the Department of the Air Force. Appointed to the Air Force Acquisition Corp, 1991. Certified Public Teacher Georgia, 1970. Twelve Department of Defense Awards for merit and outstanding accomplishment. Tinker Management Association Senior Manager of the Quarter in 1992. Chairman Society of Logistics Engineers Pentagon Chapter, 1988. Dayton, OH Jaycees and Air Force Logistics Command Headquarters Outstanding Young Man for 1982.