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Lessons learned from the implementation of Total Quality Management at the Naval Aviation Depot, North Island, CA.

Warmington, Jeffery Allen

Monterey, California. Naval Postgraduate School

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THESIS

Lessons Learned from the Implementation of Total Quality Management at the Naval Aviation Depot, North Island, CA

by

Jeffery Allen Warmington

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by

Jeffery Allen Warmington
Lieutenant Commander, Supply Corps, United States Navy
B.S., United States Naval Academy, 1977

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Total Quality Management (TQM) has been presented as a way to improve productivity at Department of Defense installations. There are many obstacles to the successful implementation of TQM in a military organization. This thesis defines TQM. It documents the implementation of TQM at the Naval Aviation Depot, North Island, San Diego, California. It presents the lessons learned during the implementation, recommendations for further implementation, and demonstrates that any organization can benefit from TQM philosophies.

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I. INTRODUCTION

A. BACKGROUND

This thesis will investigate the area of quality control. Total Quality Management (TQM) has been adopted as the new quality control method at a number of Government and commercial establishments. It will familiarize the reader with the aspects of, the potential uses of, and the lessons learned at selected establishments during the implementation of TQM.

The reader should gain an insight into the potential of TQM at any establishment and recognize the possible benefits and pitfalls that could be expected during its implementation.

B. OBJECTIVE

The objective of this thesis is to familiarize the reader with Total Quality Management and how it might be implemented. Lessons learned during its implementation at various installations can be applied to those activities intending to use the concept.

C. RESEARCH QUESTIONS

Primary research question: Can Total Quality Management (TQM) theories be successfully implemented within DoD and the major defense contractors?

Subsidiary questions:

1. What is TQM?
2. In what areas has TQM been implemented within DoD?
3. To what extent has its implementation been successful?
4. How can the experience gained by DoD activities using TQM be applied to other DoD activities and to the major defense contractors?

D. SCOPE, LIMITATIONS AND ASSUMPTIONS

There is a general consensus that the quality of material procured for use by the DoD could be improved. Numerous legislative attempts have been made to require improvements in the quality of products received from vendors. This paper will be restricted to an area relatively untouched by recent legislative attempts; that of Total Quality Management, or what is commonly referred to as the "Japanese style of Quality Control."

TQM will be described, from its inception and history, to its use and successes in both Japanese and American establishments. Elements within the Naval Air Systems Command have attempted to implement TQM. Their experiences will be identified and the extent of their successes will be evaluated.

A case-study style approach will be used. The area of concentration will be the Naval Aviation Depot, North Island, California.

The reader should be able to adapt the strategies used and the lessons learned to meet their own implementation needs. While it is not intended that this paper be used as a "cookbook" approach to the implementation of a philosophy as encompassing and important as TQM, it is expected that the reader can implement TQM much more smoothly by adhering to the recommendations and procedures discussed in this thesis.

E. LITERATURE REVIEW AND METHODOLOGY

A basic literature search was conducted by the author including the local library and personal literature and publications held by the author. Additional literature was obtained from various TQM training courses and other personal libraries. The literature search was conducted to familiarize the author with the basic philosophy underlying the TQM principles and to gain insight into the implementation problems. Personal interviews were conducted to gain precise information regarding the problems associated with TQM implementation at the various levels. Key operational personnel were interviewed as well as middle and upper management, where available.

F. ORGANIZATION OF THE STUDY

This research effort is organized into five chapters. Chapter I is a broad introduction presenting the overall objectives and methodology of the study. Chapter II provides a background and familiarization to the TQM philosophy and principles. Chapter III contains a review of the implementation of TQM from an operational level. The Naval Aviation Depot at North Island, California has been chosen for this purpose. Chapter IV contains conclusions.

II. WHAT IS TOTAL QUALITY MANAGEMENT?

A. BACKGROUND

Total Quality Management (TQM) is an alternative to the present quality control philosophy. TQM is a combination of statistical process control and management principles. Statistical process control was introduced by Dr. Walter Shewhart while working in New York City at the Bell Telephone Laboratories. Dr W. Edwards Deming developed the philosophy further and applied it in the industrial reconstruction of post-war Japan. Dr. Deming is so revered and respected in Japan for his contributions, the Japanese Scientist and Engineers (J.U.S.E.) present the Deming Medal each year to the Japanese company with the most outstanding achievement in quality control. Dr. Kaoru Ishikawa recognized the potential of statistical process control during one of Dr. Deming's many instructional visits to Japan. He wrote the Guide to Quality Control which has been utilized for both self-study and classroom training. In the Guide to Quality Control, Dr. Ishikawa describes statistical process control and the purpose for collecting data.

> The manufacturing procedure will be most effective if a proper evaluation is made, and on-the-job data are essential for making a proper evaluation.(Ishikawa, p. 14)

The gathering of data and its subsequent analysis are the foundation of statistical process control. For example, a machine that extrudes copper wire with a nominal size of 32 thousandths of an inch. Random measurements of the extruded wire will provide valuable information as to the actual size the machine produces at given settings. A properly maintained machine will normally produce wire of a thickness that is symmetrically distributed around the nominal thickness. See Table 1:

TABLE 1: WIRE THICKNESS

Class Boundaries	Mid-Value	Frequency
25-27	26	3
27-29	28	9
29-31	30	22
31-33	32	38
33-35	34	20
35-37	36	6
37-39	38	2

Source: Developed by researcher

The statistical description of the data reveals the actual mean of the machine as 30.88 thousandths of an inch with a standard deviation of 5.54 thousandths. If the sampled data are assumed to be normally distributed, measurements will be between 19.8 and 41.96 thousandths 95.44% of the time.

This information is valuable in describing the characteristics of the extruding machine. The information is useless however, if it is not compared with some standard. If, for example, a buyer had the need for copper wire with nominal thickness of 32 thousandths of an inch, the owner of the above machine would surely believe his machine could supply the required wire. If the buyer had failed to communicate that the requiring process could not tolerate wire of less than 27 thousandths or more than 37 thousandths, he could expect wire purchased to be within those tolerances only 60 % of the time. The extruding machine in the above example is not capable of producing wire that meets the requirement in its present condition. However, it may meet the need of a process requiring less accuracy. A buyer armed with the statistical information, such as that given in the above example, could certainly make a better purchase decision than one merely based on raw output from machinery.

The owner of the machinery could also benefit from the statistical control process. Machine variances increase with age and time between maintenance. Information gained from data collection can be used as an indication of an out of control machine. If information collected from random sampling produces distributions that are not normal, external factors influencing those variances could be identified. External factors may be:

1. A change in the machine setting.
2. A change in the input raw material
3. A change in temperature surrounding the machine
4. A machine in need of maintenance

B. CONTROL CHARTS

The collection of data, however, is not enough. It must also be studied and analyzed against historical data.

> This means that we not only have to see what changes in data occur over time; we must also study the impact of the various factors in the process that change over time. Thus, if the materials, workers, or working methods or equipment were to change during this time, we would have to note the effect of such change on production.(Ishikawa, p. 38)

Dr. Ishikawa proposes the use of control charts for visually displaying data and tracking performance. There are various types of control charts depending on the nature of the process and the type of data collected. Where the process and data collection techniques permit measurement of output such as volume, product weight, power consumed, or product length or thickness as in the above example, the X-R chart is commonly used.

> An X-R control chart is one that shows both the mean value, X and the range, R. The X portion of the chart mainly shows any changes in the mean value of the process, while the R portion shows any changes in the dispersion of the process. This chart is particularly useful because it shows changes in mean value and dispersion of the process at the same time making it a very effective method for checking abnormalities on the process.(Ishikawa, p. 124)

When the process is better measured by counting the number of defective items, a pn and p chart should be used. "A p chart is one that shows the fraction defective, whereas a pn chart shows the number of defectives".(Ishikawa, p. 156)

Regardless of the process, collection techniques, or types of control charts used, the unique characteristics of a production run may be known. The benefits to both the plant manager and the buyer of the product are obvious. Control charting enables the plant manager to identify areas of concern regarding the production process. Changes in the production process can be identified on the control chart, allowing the manager to "see" the results of such changes. Machines or operators can be identified as being "out of control" and adjusted as in the earlier example, or trained as in the case of the operator. Defective or substandard raw material can quickly be identified and replaced or repaired during the production run instead of sometime after the run is complete, as would happen if normal post-production inspection techniques were used.

The production control charts are a unique signature of the production run lot. They can be used by consumers or buyers of the product as well as the managers. Different lots produced by the same process or machine can have entirely different characteristics. For example, suppose the copper wire extruding machine produced another lot of copper wire resulting in an X or mean thickness of 32.3 thousandths with a standard deviation of 2.65 thousandths of an inch. The buyer who requires wire between 27 thousandths and 37 thousandths of an inch could now expect to receive "good" wire from that lot 95 % of the time. The difference between the 60 % received before adjustment and 95 % after adjustment could be crucial to the buyer. An important aspect to process control is that the output of one process becomes the input of another process. The lot that contained wire within tolerances only 60 % of the time may cause an otherwise "in control" process to seem "out of control". Managers, even if using statistical process control could incorrectly blame variations in output on machines or operators. Attempts to remedy the problem through machine adjustments could only compound the variances since the machine was not in need of adjustment. The operator, too, could feel frustration if every attempt to correct the problem by machine adjustment simply lead to greater variances in output. Management needs the tools to allow identification and correction of the actual cause of variations.

The importance the buyer plays in this scenario cannot be overlooked. While the machine operator could not successfully control the output of his machine, the buyer could have improved the entire process by knowing more about the wire he was buying. If the buyer received the production control charts from the supplier when he received the material, the characteristics of the material would be known and further inspection would not be necessary. Many companies, and DoD, use receipt inspectors to ensure the quality of incoming material. With the use of control charts, however, the need for quality inspection for incoming material is often reduced. Futhermore, if control charts were included in the material deliveries, machines could be adjusted to accommodate different raw material lots before the material was introduced into the process.

The overall savings from the elimination of unneeded inspectors, reduction in scrap materials and defective items reworked, coupled with the ability to produce items with less variance significantly increase the overall competitiveness of the vendor.

> The fundamental precept taught to the Japanese in the 1950s by Dr. Deming is that building quality into a product brings lower cost and hence improvements in productivity and competitive position. This is an idea that the greater part of American management has not been able to understand, mainly because their concept of quality control has been one of sorting out the bad from the good.(Mann, p. 32)

C. MANAGEMENT PRINCIPLES

In his book Quality, Productivity and Competitive Position, Dr. Deming presented his fourteen principles for management. The principles cover a wide range of management theory. Principle number one is:

> Create consistency of purpose. Problems of today encompass maintenance of quality of product put out today, regulation of output not to exceed too far immediate sales, budget, employment, profits, sales, service, public relations , forecasting, etc....Problems of the future command first and foremost consistency of purpose and dedication to improvement of competitive position to keep the company alive.

Principle number two is:

> Adopt the new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of mistakes, defects, material not suited for the job, people on the job that do not know what their job is and are afraid to ask, handling damage, failure of management to understand their job, antiquated methods of training

on the job, inadequate and ineffective supervision.

Principle number three is:

> Cease dependence on mass inspection. Routine 100% inspection is the same thing as planning for defects, acknowledgement that the process can not make the product correctly or the specifications made no sense in the first place.

The example of the copper wire machine demonstrated that with the benefit of control charts, inspection is not needed for most items. Inspectors that would normally be checking incoming material could better serve the company by preforming sampling and process control tasks within the process itself. A receipt control clerk would only need to verify the lot number of the material and the lot number on the enclosed control charts to know if the material met the specifications of the contract. With proper elementary training, buyers and receipt clerks could include statistical control information on procurements and rely on the control charts for the acceptance of material. It would become easy for the personnel to recognize the mean and variation of the required material. In the above example, a clerk should have recognized that the first lot of wire would not be able to meet the requirements while the second lot would.

The underlying precept of process control is visual, easy-to-see, control points during the production process. To the Japanese, quality is the responsibility of the production worker, the production supervisor, and even the production department head, not something assigned to a quality control department. The achievement of a quality goal is often used as the basis for production bonuses. The Japanese understand that productive output, as measured in quality, can be affected by many factors not controllable by the production department or even the individual production worker. If the production process is designed correctly, however, the worker can directly influence the quality of the output. The Japanese visually display process control charts, not to intimidate the workers, but as an incentive and source of pride.

> Display boards are everywhere in Japanese plants. They tell the workers, the bosses, the customers, and the outside visitors what quality factors are measured, what the recent performance is, what the current quality improvements projects are, who has won awards for quality, and so forth. Some displays are lighted electronic devices, resembling basketball scoreboards- which call for help when there are quality problems.(Shonberger, p. 48)

Quality, in Japan, is a very visual concept. Everyone can see the results of poor quality and its associated costs, so can they see the benefits of producing high quality. Recently, that concept has been translated into programs where the Japanese measure defects, not in per cents (defects per 100), but in the number of defects per million items produced! The Japanese take pride in producing high quality material and the visibility of their quality control programs are one of the reasons. The significant gains by the Japanese in traditionally American markets should serve as an indication that their quality programs are successful.

American companies continue to create slogans saying that "Quality is Job One" or "The Quality Goes in Before the Name Goes On", but persist on keeping secret the actual measures of quality and their actual results. The reliance on inspections and the tendency to keep the results secret are primary reasons why there is no confidence in American quality.

> Accept the inadequacy of inspections for critical parts. Inspection will never do the job--it never has. It´s the afterthought that is necessary when the vendor doesn´t have the manufacturing process under control and cannot provide consistent quality. Purchase quality control. Statistical charts, along with records of action taken, must accompany your purchased materials and goods. There is no other way of purchasing to know what it or the vendor is doing.(Gottlieb)

By insisting on control charts with every material contract, DoD can assume the lead role in increasing the quality in the American industrial base. As contractors see the benefits of using process control and control charts, they will begin using them for their commercial items as well as those they produce for the DoD. Since DoD is the largest source of procurement and has the right to dictate many policies that would not be tolerated in a commercially competitive environment, it is in the position to demand higher quality--and get it. The area to improve cost savings is in the production of high quality material. As quality goes up, so does productivity. As productivity goes up, prices go down. One of the great misconceptions surrounding quality is that increased quality requires increased costs. Nothing could be further from the truth.

> Why is it that productivity increases as quality improves? Less rework. There is no better answer. Improvement of the process increases uniformity of output, reduces rework and mistakes, reduces waste of manpower, machine-time, and materials, and thus increases output with less effort. Other benefits of improved quality are lower costs, better competitive position, and happier people on the job, and more jobs, through better competitive position of the company.(Deming, p. 12)

The current procurement regulations require, for the most part, that DoD procurements go to the lowest bidder. Any attempt by a company to improve quality and productivity in the long run would result in lost revenues and could even threaten the company`s existence in the short run. This economic fact leads to Dr. Deming´s fourth principle for management.

Dr. Deming´s fourth management principle is:

> End the practice of awarding business on price tag alone. We can no longer leave quality, service, and price to the forces of competition for price - not in todays requirements for uniformity and reliability. Price has no meaning without a measure of the quality being purchased. Without adequate measures of quality, business drifts to the lowest bidder,low quality and high cost being the inevitable results. American industry and the U.S. Government, civil and military, are being rooked by rules that award business to the lowest bidder.

The fifth management principle deals with a continual improvement of the system:

> Constantly and forever improve the system of production and service. This means continual reduction of waste and continual improvement in quality of every activity: procurement, transportation, engineering, methods, maintenance, location of activities, instruments and measures, sales, methods of distribution, accounting,

payroll, service to customers. Continual improvement of quality brings continual rise in productivity.

Dr. Deming's sixth principle deals with training of the workers:

Institute modern methods of training on the job. Training must be totally reconstructed. Poor training of hourly workers, or none at all, and dependance on unintelligible printed instructions, seem to be a way of life. Sweeping changes are necessary. Statistical methods must be used to learn when training is finished.

The seventh principle involves methods of supervision:

Institute modern methods of supervision. Supervision belongs to the system and is the responsibility of management.

The eighth principle deals with fear in the workplace:

Drive out fear. Most people on a job, especially people in management positions, do not understand what the job is, nor what is right or wrong. Moreover, it is not clear to them how to find out. Many of them are afraid to ask a question or to take a position. The economic loss from fear is appalling. It is necessary, for better quality and productivity, that people feel secure.

The ninth principle of management deals with the barriers that build up between staff areas and the production areas:

Break down barriers between staff areas. People in research, design, purchase of materials, sales, receipt of incoming materials, must learn about the problems encountered with various materials in production and assembly. Otherwise, there will be losses in production from the necessity for rework caused by attempts to use materials unsuited for the purpose.

The tenth management principle covers the use of numerical production goals and the use of slogans:

> Eliminate numerical goals for the work force. Eliminate targets, slogans, pictures, posters, for the work force, urging them to increase productivity, sign their work as a self-portrait, etc. What is needed is not exhortations but a road map to improvement, management´s obligation.

Dr Deming´s eleventh principle states:

> Eliminate work standards and numerical quotas. These quotas take account only of numbers, not quality. A work standard is a fortress against improvement of quality and productivity.

The twelfth principle deals with the barriers that the hourly worker faces every day:

> Remove barriers that hinder the hourly worker. The hourly worker in America is under handicaps that are taking a terrific toll in quality, productivity, and competitive position. Barriers and handicaps rob the hourly worker of his birthright, the right to be proud of his work, the right to do a good job....Only management can remove these barriers.

The thirteenth principle of the Deming philosophy is:

> Institute a vigorous program of education and training. Management has a new job; so has everybody else....Education and training will fit people into new jobs and new responsibilities. So-called quality control departments must adjust themselves to new responsibilities.

The fourteenth principle includes the challenge to upper management to create an atmosphere that will foster the other 13 points:

> Create a structure in top management that will push every day on the above 13 points. Top management will require guidance from an experienced consultant, but the consultant can not take on obligations that only

management can carry out. Part of his duties would be to teach statistical methods and to develop teachers.

D. APPLICATION OF DEMING´S PRINCIPLES

Japan embraced the management principles presented by Dr. Deming. The Japanese concepts of Just-in-time, Total Quality Management, and Statistical Process Control were actually developed from Deming´s principles. All of the Japanese concepts stress the importance of developing a small number of suppliers. By having a small number of suppliers for a given commodity, it is possible to work with the vendors and even contribute to the design of the desired product. Under the Total Quality Management/Statistical Process Control methods, the item to be produced, the quality control system, and the production process are all designed simultaneously. This recognizes the belief that quality can only be built into a product, it can never be inspected in after the production process is complete.

Managers in Japan realize that control of the process involves control of suppliers. They know that for process control to work in their plants, their suppliers must use process control as well.

> At Kawasaki´s Nebraska plant, quality control inspectors do perform receiving inspections, but only for parts and material purchased from U.S. suppliers. Sixty-five percent of Kawasaki´s street bike parts are shipped from Kawasaki, Japan, mostly in lots of 200, but those lots are not inspected. Since Kawasaki, Japan employs rigid process control, the parts it makes for export to Nebraska can be counted on to be of exceptional quality, so that they need not be inspected.(Shonberger, p. 210)

They can do this for two reasons. The first is that the supplier uses process control techniques. The second is because they have developed reliable single sources for their supplies. If they had been awarding their business based on the lowest bid, they would not have been receiving consistent material and would have had to inspect every part before it went into production. The Japanese do not disdain competition, as may be implied by the above discussion. They rely on competition to chose the best supplier. The difference is that the Japanese develop suppliers from early competitive proposals. Suppliers know that the competition is for the entire length of the requirement and so they are very anxious to be the winner. As opposed to American competitions which are for one delivery or one years supply only, the Japanese competitions are for the life of the product. At the time a winner is selected in a Japanese competition, the subject of price may not have even entered the discussion. Profit margins are expected to be normal for the item being produced. If, however, the supplier proves that they cannot control costs or cannot meet the quality requirements of the buying company, the supplier will lose that business permanently.

All of the Deming principles discussed go hand-in-hand. It is not enough to institute one or two of the principles and believe the job is complete. Developing single sources of supplies is only one of Deming's principles. It should be apparent that price is not the sole determining factor for source selection. While price is always a consideration, it is rarely used as the only deciding factor in normal purchases. Average consumers rarely use price alone to determine their purchases. If that were not true, only the cheapest car, the cheapest toaster, or the cheapest clothing would ever be bought. Consumers use a combination of price, quality, and suitability for the intended purpose as major decision factors. They realize that what might have the lowest price tag can cost more in the future in higher repair bills or higher operating costs. The item purchased by price tag alone may not even be able to perform the task for which it was purchased adequately and, therefore, was a complete waste of money.

For buyers that translates to:

* Don´t trade nickels for quality goods
* Don´t rely on mass inspections
* Insist on evidence of quality through control charts from every vendor
* Work with fewer vendors. First find one good supplier, then you can look for more.(Gottlieb)

Government buyers need to adopt practices employed by successful commercial activities. While it is understood that Congress uses DoD procurement practices to achieve numerous socio-economic goals, the primary goal of a viable defense at a reasonable price must not be overlooked. If DoD can make better use of its funds through productivity and quality gains, the socio-economic goals can be met more indirectly. DoD can establish long-term relationships with disadvantaged companies or companies in distressed areas and assist them in establishing process control methods. Once the company has improved its competitive position through the use of process control, it can take its place in the economy as a quality leader. Under this philosophy, the Government could achieve its socio-economic goal and develop a source for high quality material at the same time. As DoD encourages more and more companies to adopt process control methods, the companies can be placed on a Qualified Suppliers List. Companies on the Qualified Suppliers List could be given contracts automatically when requirements arise. The use of the lists would reduce procurement time and eliminate the need for routine inspection.

> Typically, an industrial company will keep a list of qualified suppliers that have maintained historically high standards of product quality and reliability. As long as these standards are maintained, industrial buyers do not require exhaustive inspection, and thereby save expense on both sides. Suppliers are highly motivated to get - and stay - on lists of qualified suppliers by consistently exceeding quality control standards.(Packard, p. 36)

Although the preceding discussion has been focused on the production or manufacturing applications, the TQM philosophy is also applicable to administration and clerical quality problems. The main determining factor in assessing whether or not the philosophy can provide benefit to a process is to determine if the process includes sources and customers. The sources and suppliers may be different organizations, different sections within a single organization, or even different work stations within a single section. The product may be a machined part, the application of paint to a manufactured item or even a travel voucher, as will be demonstrated in later chapters.

Since TQM has a variety of applications, the installation selected for this research was specifically selected for its diversity in purpose and internal requirements. As various processes are presented and various lessons learned are identified, visualize each one as the wire extruding machine presented earlier. The control procedures and statistical process charts will apply equally well to all of them.

III. IMPLEMENTATION OF TQM AT NAVAL AVIATION DEPOT, NORTH ISLAND, CALIFORNIA

A. BACKGROUND

The Naval Aviation Depot at North Island, San Diego California, hereafter referred to as the Depot, the NADEP, or the command, is a large industrial facility that repairs and overhauls aircraft, engines, and avionics for the Navy and other Services.

> The largest of six similar facilities located in the United States, it employs 4750 civilians and 27 military personnel. With an annual operating budget of 360 million dollars, the Depot produces approximately 100 aircraft, 600 engines, and 40,000 various aircraft components in any given year.(Loisell and Silverman, p. 16)

The Depot began the TQM implementation process in 1980, when, in an effort to improve its production performance reputation, several high level managers attended a seminar given by Dr. Deming. These managers began the process by convincing some of their peers of the merits of TQM. Although some of the managers were impressed by the prospects of TQM and its promised productivity improvements, the organization was not convinced that TQM was really needed.

A familiar phrase often heard at a repair depot is "if it ain´t broke, don´t fix it". It is felt that the period of stagnation between the initial exposure of TQM in 1980 and its adoption in 1984 was due to the reluctance of management to believe the present system actually needed "fixing".

In June of 1984, the group of people who supported Deming´s philosophy

> ...approached the Commanding Officer (CO) and the Executive Policy Board (EPB) of the Depot with a proposal to develop an implementation plan. This proposal was approved and the entire EPB (19 members) took responsibility for developing this implementation plan for TQM at North Island.(Loisell and Silverman, p. 18)

Thus began Phase I of the implementation of TQM at the Depot at North Island. Phase I can be characterized as one of general training and exposure to the TQM philosophy. The training, however, was generally limited to upper and middle management. Exposure to TQM at the first-line supervisor and worker level was limited to what was passed down by the upper management and by the observance of a single prototype process improvement project that had been established.

> The EPB chose a troublesome manufacturing process and a group of divisional managers and shop employees were assembled to thoroughly examine the process and make recommendations to the EPB for corrective action. Navy Personnel Research and Development Center (NPRDC) personnel developed a training curriculum and administered required training for the group. (Bolt, p. 19)

The area chosen to participate in a prototype implementation included plating and grinding functions. Included in the study was the physical movement of parts from one area to another and the specifications to which they were being worked.

> Basically the reason for the enormous defect rate(70%) was the fact that the grinding shop was using

> three or four different specifications (all of which were legitimate) in their pre-plating procedure, while the plating shop was using only one specification for plating, regardless of the size of the pin when it was received.(APC 53, p. 4)

The initial implementation phase lasted until August of 1985, when an outside consultant was brought in to measure the progress achieved and provide recommendations for further improvement.

Even though the initial implementation was conducted on a very small section within the Depot, there were problems with the internal communications and decision processes.

> The EPB learned that the full board was too large and indecisive to implement the TQM program. The board realized that the feedback from the prototype group was inadequate and needed improvement in the full implementation. The EPB also realized that a group of in-house consultants would be needed to train and assess improvement.(Albrigo, p. 12)

It is at this point in the process where the management of the Depot falls ill to what Deming calls the number one crippling disease; lack of constancy of purpose. The EPB had assumed responsibility for the implementation of TQM in June of 1984. Yet 14 months later they had lost the collective will to expand the implementation beyond the prototype stage. By removing themselves as the controlling body of the process, the board was able to "return to the problems at hand" thereby delegating the responsibility of TQM implementation to a staff organization.

The Depot, being a military organization, is faced with a constantly rotating upper management. The Commanding Officer and Executive Officer normally remain four years. The remainder of the upper level military officers remain only three years which translates to a 30 percent turnover per year. The EPB consists of the military officers plus civilian Department Heads who provide corporate consistency in the face of high military turnover. It is believed that the consistency sought from the civilian Department Heads during normal operations actual provided an impediment to change in the case of TQM implementation. It is felt that the EPB acted correctly and responsibly in 1984 when it assumed the leadership role in TQM implementation. It is further felt that the EPB reached a correct conclusion when they deemed themselves too large and indecisive to implement the TQn the command view the EPB as the controlling and influencing force. Transferring the responsibility of TQM implementation from that body to a newly created staff organization sent the signal to the command that the EPB "has more important issues" to deal with. Personal interviews with first-line supervisors revealed the belief that they were "...under two separate chains of command. The normal chain of command and the TQM chain of command."(Supervisors interview)

In addition to the above problems during Phase I of implementation, the command identified two others. First, "...while the prototype effort was going on, the remainder of the plant ignored the TQM program..., and "Finally, a group of in-house facilitators would be needed to train and assist new process groups as the process grew."(Loisell and Silverman, p. 19)

The Depot entered Phase II of implementation when they created a "TQM Organization".

> The ESC's (Executive Steering Committee) initial plan (in September 1985) focused on process improvement. It called for the formation of a facilitator group, Process Action Teams (PATs) consisting of artisans and first-line supervisors, and Quality Management Boards (QMBs) to serve as boundary spanning organizations between the PATs and the ESC.(Loisell and Silverman, p. 19)

The initial success of the newly formed PATs encouraged the ESC to nearly double the effort merely five months after the beginning of Phase II. This period of time saw a dramatic increase in the number of PATs and facilitators.

> In October, 1985 the ESC selected eight in-house consultants and eight processed. The in-house consultants were trained and the PATs were formed in November. In February, an additional seven processes were selected by the ESC for PAT action because of the excellent progress made by the original eight.(Bolt, p. 21)

Phase II ended in July, 1986 when the EPB reviewed the progress achieved by the individual PATs and the extent of implementation of TQM Depot wide. The July, 1986 progress review identified several problems encountered throughout Phase II. The first and most serious was a "lack of commitment from all concerned, especially at the middle management level."(Bolt, p. 22) Very few QMBs had actually been formed which left the PATs with no link to the ESC. Attempts by the ESC to bridge the gap resulted in the ESC

"...being spread too thin and any efforts were actually too late to be truly effective."(Bolt, p. 22)

Another commonly held belief was that "...expansion of the program through the addition of the new PATs was premature."(Bolt, p. 22) It is felt that the command, in an anxious attempt to provide results, added additional PATs before individuals were properly trained and supported by upper management. It is further believed that the "TQM chain of command" was allowed to continue to grow and solidify its position apart from the legitimate chain of command during Phase II.

In July, 1986 the Depot invited an outside consultant, Mr. Ron Moen, to conduct an audit of the first two phases and provide recommendations for improvement. Mr. Moen is a long-time TQM and Deming advocate. He has over 20 years experience as a teacher, manager, and consultant to business, industry, and the Government. Mr. Moen is the former Director of Quality at the Pontiac Motor Division where he supervised the implementation of the TQM principles.

Mr. Moen´s audit consisted of personal observations of processes, attendance of PAT, QMB and ESC meetings, and the use of a survey to all levels of the depot. His final recommendations included:

1. Continue TQM training and team activities. You need a larger "critical mass." Greater focus on improving processes. Rotating membership for ESC and facilitators will help in the long run. Show involvement doesn´t require formal structure.

2. Continue other training and education courses. Continually seek to improve them. Identify candidates for advanced statistical training (grow your own statisticians).

3. Offer a course for supervisors. Include TQM managing teams, counselling people skills, leadership skills and other needs.

4. Managers - get down in there. Strong leadership not nodding. Break down barriers between departments. Identify your downstream customers. Balance the workload better.

5. Develop working groups to better understand and develop a course of action for the following:

   - work standards, management by objective, numerical goals, management by numbers

   - role of inspection

   - defining quality

   - break down barriers between departments, divisions and branches

   - relationship with suppliers. (Moen, p. 6)

Mr Moen's recommendations became the basis for the third phase of implementation. Phase III focused on a permanent TQM organization with the goal of finally "institutionalizing" the philosophy at all levels of the command.

> Two major assumptions became paramount as the plan for expansion was developed. First, management must accept TQM as a complete management system. No less than full commitment is essential. Second, managers are to be held accountable for their participation in the process. Their participation in the process is essential and is maintained by conducting periodic audits.(Bolt, p. 23)

Phase III represented an attempt to dissolve the "TQM chain of command" and return the total management of the organization along with the implementation of TQM to the "legitimate" chain of command. It is unfortunate, however, that the EPB delegated management responsibility to lower levels and not at their own. One positive step taken by the EPB was to provide members to the ESC on a rotating basis. This provided continued exposure of the implementation process at the senior management level and also provided an appearance of total involvement to the lower levels.

B. ANALYSIS

Senior management at the Depot is under tremendous pressure to implement a management system that focuses on long term productivity gains and cost reductions. They also must continue to deal with parties only interested in short term problems such as budget constraints, personnel cuts, and the promise of savings from the implementation of TQM that can make the short term goals possible. An unfortunate reality of Government service is that productivity improvements are often met with resistance by the people at the implementing levels because there is the fear of being displaced or forced to accept early retirement. The survey conducted by Moen revealed that this fear is still present at the depot. "...87 per cent said the amount of fear is the same or worse than two years ago." (Moen, p. 4)

Removing fear from the organization is an integral step in the implementation of any program. Deming says, in his eighth point of application, that fear must be eliminated from the workplace if TQM is to be successful. Only through the elimination of fear can change take place. But Deming offers no recommendations as to how to go about making the required changes. Lewin offers some insight into the process of managing change. He likens change to a three step process. The first step he calls the unfreezing phase. The status quo must be unfrozen in the minds of the people. The goal of unfreezing is to make people dissatisfied with the status quo. Lewin feels that only when people are not satisfied with the status quo will they accept change. The second phase is the installment of the change itself. The third and final phase is the refreezing of the organization following the change. Refreezing reinforces the new method as the norm of the organization.(Stoner, p. 402)

It is felt that much of the fear that Deming and Moen discussed could have been eliminated through the use of the above process. Some of the fear mentioned by Deming and Moen is the fear that existed in the organization before any attempt was made to institute change. It is believed, however, that a majority of the fear Moen discovered in his survey was the result of the implementation of a system completely foreign to most. They viewed TQM as a threat to the way they had been doing business for years. They were afraid of losing their positions of power and since they did not understand TQM, they would not be included in the new TQM organization.

In spite of the fear and problems cited above, the Depot continues to show that TQM is working and should continue to work once implementation is continued. The Depot has shown productivity gains in almost every area where implementation has occurred. Gains in productivity have been identified in the internal processing of Beneficial Suggestions, an employee feedback and idea processing plan. Savings in excess of $24,000 have been identified as being directly related to the PAT that was formed to improve the process.(NADEP, p. 17)

In addition to gains in productivity in the administrative area, tremendous gains have been made in the management of the overhaul of F-14 fighter aircraft. The implementation of TQM in the F-14 overhaul process has been credited with a reduction in labor expenditures that averaged 3050 hours per aircraft and an additional savings in material expenditures that averaged $100,000 per aircraft. Total fiscal year 1988 savings in the F-14 overhaul process was estimated to be $673,000.(NADEP, p. 18)

An example of productivity gains involving entities external to the command include the handling of bulk and junk mail within the command. A PAT was formed in an attempt to reduce the manhours spent in sorting and delivering the voluminous amount of bulk and junk mail and the unsolicited magazines and sales brochures received at the command daily. Process improvements included requiring repeat companies to limit the number of copies sent to the command and addressing them only to the Commanding Officer. The process was improved to a point where total manhours spent on the handling of bulk and junk mail was reduced by 50%. That reduction represented a total savings to the command of $35,000 per year.(NADEP, p. 19)

The Depot should be applauded for its dollar savings and productivity gains. They must be cautious, however, not to fall into the trap of "instant pudding" expectations. Deming defines "instant pudding" as the hope for quick results after implementing a new program and calls it one of the obstacles that stand in the way of a successful transformation. Deming differentiates between his deadly diseases and his so called obstacles by their ease of cure. He says obstacles "...are easier to cure than the deadly diseases." (Deming, p. 129)

The Depot is facing pressure from its immediate superior to produce the same short term results Deming and TQM seek to avoid. Pressure for short term success is also being felt at the first-line supervisor level. Personal interviews with first-line supervisors reveal pressures from middle and upper management for dollar savings. One individual stated they were told to organize a PAT after certain process improvements were completed so the results could be credited to TQM. Another individual said statistics are being collected only for use by upper management and not being utilized for daily management as suggested by statistical process control.(Supervisors)

The overwhelming feeling observed of the TQM facilitators was one of frustration. As facilitators, they were highly trained and highly motivated toward TQM implementation. They expressed frustration, however, that implementation was being hampered by conflicting messages from upper management. "They tell us we must implement TQM but our BPAPS (employee evaluations) are written just like they always were".(Facilitators)

Deming calls the reliance on performance appraisals as a deadly disease.

> Basically, what is wrong is that the performance appraisal or merit rating focuses on the end product, at the end of the stream, not on the leadership of people. This is a way to avoid the problems of people. A manager becomes, in effect, a manager of defects.(Deming, p. 102)

It is no wonder that the supervisors are confused. How can management tell them to do one thing but evaluate their performance on something else? How can anyone measure productivity gains in the short term? In an apparent attempt to increase the pace of TQM implementation..."Each department was tasked to pick five additional processes that they wanted to attack with this new (management) structure".(Loisell and Silverman, p. 22)

It became apparent that the frustration felt by the first-line supervisors was also being felt within the EPB. It is believed that requiring "five additional processes" is very similar to the numerical goals opposed by Deming. In addition to "eliminating work standards and numerical quotas" (Deming, p. 40) as one of his 14 points for TQM implementation, Deming cautions against the "Degeneration of counting" (Deming, p. 105) as one of the deadly diseases.

> Unfortunately, people that are measured by counting are deprived of pride of workmanship. Number of designs that an engineer turns out in a period of time would be an example of an index that provides no chance of workmanship. He dare not take the time to study and amend the design just completed. To do so would decrease his output. (Deming, p. 105)

Requiring Department Heads to submit five additional processes for process control techniques is, in a way, setting quotas for them. Managers could be tempted, or even forced, to select processes at random with absolutely no regard for those that actually need improvement the most. The Department Heads would, in effect, be providing a product of their own--that of selecting the best candidate for process control. Whether the department contains only three or as many as twenty processes cannot be determined arbitrarily. Upper management is showing its frustration and a return to the "old ways" by making such a requirement of the Department Heads.

C. LESSONS LEARNED DURING IMPLEMENTATION

It is logical to take Dr. Deming´s advice on the warnings and deadly diseases of implementation of TQM, however, it is more difficult to actually implement it. The researcher experienced implementation of TQM at the Depot from 1984 to 1987. During that time the Depot saw a complete military turnover which included the Commanding Officer, the Executive Officer, and all senior management positions. In addition to the military turnovers, retirements and reorganizations caused tremendous turnover in the senior civilian positions.

In a personal interview with the researcher, the present CO, Captain Tom O'Connor, said the greatest lesson he learned in his three years of command at the Depot is that upper management has the ultimate responsibility for everything that happens in the plant; and that includes the implementation of TQM. He inherited a command deeply involved in the implementation of TQM. He said it was hard to keep the focus on TQM implementation when the overhaul of F-14 fighter aircraft, the mainstay of the Depot, was in the process of being competed with private industry. The oversight of the competition to retain the F-14 overhauls within the Depot required Capt. O'Connor to be away from the command more than a third of the days during 1987.(O'Connor)

Capt. O'Connor saw a major weakness in the implementation of TQM at the Depot as having focused on the transition to Statistical Process Control (SPC) and not providing enough emphasis on the cultural changes required. TQM is a complete change in management principles. SPC is only one aspect of the overall change that is required. Deming's management principles must be stressed continuously to provide understanding and meaning to SPC.(O´Connor)

While the EPB quickly adopted TQM as their own responsibility, they proved too large to effectively implement it. Whether the root problem was the sheer size of the board (19 members) or the possibility that not all members shared the same level of commitment to TQM will probably never be known. A group of between five and seven members, chaired by the CO is believed to be the most effective. This group is known as the Executive Steering Committee (ESC) at the Depot. Membership of the ESC, in addition to the CO, consists of the Production Officer, the Engineering and Quality Officer, the Quality Assurance Department Head, and the TQM Manager. The three remaining positions are rotational and are presently filled by the Administrative Services Department Head, the Management Controls Department Head, and the Business Office Department Head. EPB members who are not permanent members of the ESC will serve on a rotating basis.

The ESC charter is to:
- provide strategic guidance to the organization
- identify major goals
- provide training resources
- monitor implementation efforts and provide status to the EPB (NADEP, p. 12)

Some of the members of the ESC have been involved with the implementation of TQM at the Depot almost since its inception in 1984. They summarized lessons learned as follows:

1. There is a need for continuous training ar all levels of the organization.

TQM is a very pervasive set of philosophies. Continuous exposure to the philosophies and a greater understanding of the power of statistics in management is essential to the success of TQM. Old habits die hard and people are always tempted to revert to the old methods of doing business. Continuous training reminds people of a greater goal than their day-to-day problems.

2. Upper and middle management must take the lead.

TQM is a top-down procedure. Since it is a management philosophy, it must first be adopted and supported by upper management. Middle management and supervisors can only adopt the new philosophy once upper management allows it to happen.

3. Improvement of processes must be quantified.

In spite of lessons to the contrary, management both internal and external to the organization still relies on quantified results. We still live in an environment dominated by numbers. Rather than attempting to go "cold turkey" on management reports and quantifiable results, processes must be measured or baselined prior to implementation. Only through baselining can progress be measured and the entire program be allowed to continue.

4. There is a definite need for trained statisticians and facilitators throughout the organization.

Very few people in the organization knew anything about statistics when the implementation process began. With all the process control training going on, the teaching of statistics or the development of statisticians was ignored. The key to SPC is the measurement of the process and management through statistical control. People must understand the use and power of statistics before they can use them to manage with.

In this command, facilitators hold the TQM organization together at the working level. They direct the PATs and provide guidance and interpretation of management principles. Facilitators are highly motivated toward the success of TQM and the command as a whole; and need to be constantly trained and made aware of new developments.

Commander George Silverman is the present Production Officer at the Depot. CDR Silverman is not only a member of the EPB and the ESC but is a student of TQM as well. He recommends a slice or pilot approach to implementation of TQM. He says that timing is a crucial factor in implementation. Once the upper and middle management has adopted the TQM principles and is committed to its implementation, the present environment at military establishments requires one process be taken at a time. Once an individual process is selected and used as a pilot, it can be fenced or protected from the rest of the organization. Since TQM requires total commitment, pilot processes would not show their full potential for improvement unless segregated in some way from the old style of business. There would be too many opportunities for "managerial sabotage" of a system that threatened a change from the old philosophies.(Silverman)

CDR Silverman further stated the need for a better definition of the problem. The use of TQM involves the use of statistics to identify, localize, and pinpoint the cause of problems within the process. It is very easy to try to solve the problem before the actual cause is finally pinpointed. This leads to frustration when the process has been "improved" yet no real productivity improvements can be shown. It takes a great deal of patience to follow through on all the steps to finally reach the point where the actual cause of the problem is identified. It is important to develop the patience to define the problem properly to avoid the frustration and wasted efforts involved in "fixing" the wrong problem.

CDR Silverman says a "critical mass" of highly motivated, trained people are needed before the process can be internalized and proceed by itself. The Depot has decided that the critical mass of people will have the facilitators and the ESC at its core. The number of people converted to the TQM philosophy should increase as more people are trained in external facilities. Once internal training programs and a Process Improvement Training Model have been developed, the number of people will continue to grow until the critical mass is achieved. The Depot continues to receive external assistance from consultants and NPRDC in the area of training and the development of a training model.(Silverman)

In the area of training, Capt O´Connor said that the key to implementation of TQM is continuous training. He said you must keep TQM in the people´s minds, even if they are not involved in the prototype effort. Training is an investment. It requires the discipline and long range vision to sacrifice short term gains for the betterment of the command in the long run. Taking people away from their jobs and sending them to training classes can be very frustrating to managers who are still faced with internal deadlines. You need to remember that the whole command will be more productive once TQM has been fully implemented and the investment in training will really start paying off.(O´Connor)

D. SUMMARY OF LESSONS LEARNED AT NAVAL AVIATION DEPOT, NORTH ISLAND

1. Begin with broad-based TQM training at all levels of the organization.
2. All levels of management must be committed to the TQM management philosophies if the program is to succeed.
3. Review the internal organization structure to ensure responsibility for implementation is given to an organization with the dedication, authority, and ability to complete the task.

4. Revise employee review systems early in the implementation process so people will be reviewed for what you actually want them to do.
5. Select prototype or pilot processes for initial implementation and continue with a "slice" approach until all areas have been completed.
6. Once pilot processes have been selected, baseline the process so improvements can be measured and results can be more meaningful.
7. Even though the bulk of facilitators should be "home grown", the use of external consultants for evaluation and initial training is essential.
8. Upper management must be trained and their thinking must be converted to the new methods as soon as they arrive. The need for constance of purpose in upper management is paramount. Rotation of upper managers must not be permitted to interrupt the process.
9. Ensure enough facilitators and internal support exists before expanding the implementation process. It is important to create the "critical mass" as early in the process as possible.
10. Keep focused on the long term benefits of TQM. Do not get discouraged by the length of time it takes to change management philosophies. Do not allow upper management to fall into the trap of hoping for "instant pudding".

11. TQM involves Statistical Process Control (SPC) and a cultural change in the way people and processes are managed. Ensure both aspects receive equal attention. You will not achieve the desired results without a full implementation of both SPC and the management principles.

IV. RECOMMENDATIONS AND CONCLUSIONS

A. RECOMMENDATIONS

1. The rightful owner of TQM implementation is the EPB. Either reduce the size of the EPB so they can be effective or make the ESC a direct "line" organization with control over the EPB.

   TQM implementation must be one of DoD's highest priorities. The only rightful place for it is with the most senior and powerful organization in the command. The EPB should be reporting the progress of TQM implementation to the ESC; not the other way around.
2. Demonstrate a full understanding of the management principles in the implementation process. Think of the implementation of TQM as being the first process to be improved. Organize a PAT to assist in the implementation. Do not use numerical quotas, fear, or employee evaluations for the tools of implementation.
3. It is upper management's responsibility to remove the reliance on short-term goals from the organization. Short term pressures still exist at all levels of the organization, even in the TQM implementation process.
4. Do not allow a "TQM chain of command" to develop within the organization. The only way a dual chain of command could form is if implementation of TQM is allowed to be other than the command's number one priority. Its

emergence is an indicator that the TQM message is not making its way down to the worker level of the organization. Detection of a dual chain of command can only signify a loss of constancy of purpose in the upper levels of management.

5. Utilize Lewin's theory of management of change in areas that still require implementation. People <u>must</u> be dissatisfied with the status quo before they will be receptive to any change. The unfreezing process Lewin refers to can only be accomplished through constant training and management attention.

6. It is management's responsibility to shield the organization from the external pressures for short-term results. This will probably prove to be the most difficult of all tasks. Upper management will feel the pressures for short-term results from the outside but must not allow those pressures to influence their commitment to their long term goals. Remember, that frustration is now being felt at the first-line supervisor level. It rightly belongs to upper management.

7. The Depot has made tremendous gains in productivity and cost reductions since the initial phases of implementation. Do not allow yourselves to be frustrated by the changes in pace in process improvement. A total commitment to change is required.

TQM involves a permanent change in management philosophy. It is not something that can be "done and forgotten". Keep improving the process. Continue the training.

An overwhelming feeling of TQM commitment was felt at all levels of the organization. The depot is extremely close to reaching the "critical mass" mentioned by Moen and Silverman. A change in the way people approach problems was seen since the author left the command in 1987. People are using process control in their everyday problem solving; without even knowing it!

B. CONCLUSIONS

Total Quality Management is not a radical departure from generally accepted management principles. The philosophies and procedures suggested by Deming does not represent a total abandonment of "American" style management. Instead, the basis of his philosophy is a "back to basics" approach. He recommends a long term approach to planning, material acquisition, production control, and personnel management.

TQM is one method being supported as a way for the United States to recapture the share of the world markets lost to the Japanese and other Asian and European countries. An underlying fact of Deming´s philosophy is that the emphasis on short term profits creates a downward spiral in quality and productivity, which leads to a decrease in overall competitiveness. A reduction in competitiveness leads to a decrease in long term profits and jeopardizes the future of the company.

TQM emphasizes long term profits through increased competitiveness and productivity. Increased competitiveness and productivity are possible only with an emphasis on quality and a reduction in scrap and rework.

The initial attempt to implement TQM at the Depot at North Island was met with suspicion and resistance. While TQM can be described as basic management, it was a dramatic change from what managers were actually doing at the time. Evaluation systems provided motivation to managers for short term planning. The inevitable downward spiral would hopefully be confronted by "someone else", typically after a reorganization or transfer had occurred.

But the Depot was able to reduce their dependance on short term results because they had the commitment of upper management over the long term. Even though the implementation process is not complete and the results have been less than optimal, the use of TQM at the Depot has produced favorable results and must be considered successful. There is no doubt that additional increases in productivity could be achieved by expanding the use of TQM at the Depot. Additional processes need to be reviewed for inclusion in the process. Additional effort must be made to comply with more of Deming's 14 points. Even though resistance to the philosophies is still present, both within the organization and in the form of external orders and regulations, the success can be brought to other areas.

Other establishments can also benefit from the implementation of TQM. The Depot has shown that administrative organizations can benefit from TQM just as effectively as organizations primarily involved in production. The Depot provided an excellent example of the versatility and adaptability of the TQM philosophies. Productivity gains attributed to TQM were identified in material requirements planning and mail receipt and delivery as well as the more traditional area of production.

There was nothing peculiar to the Depot that would enable TQM to succeed there where it would not succeed at some other installation. Any organization can benefit from increased productivity, regardless of their function or purpose. The only essential characteristic for successful TQM implementation is an intense and unwavering commitment by upper management to improve the present system.

The results will not become apparent overnight. The Depot has only recently reached the point where improvements are being made without extreme pressure from upper management. TQM implementation is a long term process that can easily extend five to eight years, or even more. The

Depot is in its fifth year under a commitment to TQM but it has been almost nine years since its initial exposure.

The Depot can serve as a model for other activities during their implementation of TQM. The lessons they learned are included in this Thesis. Managers should review the lessons learned within this Thesis and familiarize themselves with Deming´s "deadly diseases."

TQM can be implemented in any organization and any organization can benefit from its implementation and use. Only through the increased productivity made possible by TQM can the United States compete with the rest of the industrial nations for its rightful share of the world markets.

Implementation of Deming´s principles at a military organization can certainly pose additional problems not normally faced in a non-military environment. Probably the greatest problem in military organizations is turnover. Normal military organizations experience a complete turnover every three years. The constancy of purpose required to successfully implement TQM is very difficult to achieve under such circumstances. There is a constant need to "convert" the thinking and management style of the newly reported senior managers throughout the process. The need for continuous training becomes critical as new people report for duty.

The lessons learned from the Depot were presented with the hope that, armed with the knowledge of the possible pitfalls, some of the lessons may not need to be repeated by every organization attempting TQM implementation.

Management owns the responsibility of TQM implementation. It is management's job to give the workers the tools needed to perform the required task. TQM is a necessary tool, just as a lathe is to a machinist, a typewriter is to an administrative worker, or a drafting table is to a designer. The tools of yesterday are not enough to produce the quality required for the United States to compete in the world market tomorrow. TQM is the additional tool needed by the workers.

C. ANSWERS TO RESEARCH QUESTIONS

1. Total Quality Management (TQM) is a combination of Statistical Process Control (SPC) and the management philosophies attributed to Dr. W. Edwards Deming. TQM is described in depth in Chapter II.
2. TQM has been implemented in all six of the Naval Aviation Depots. Other commands have completed partial implementation or have expressed interest in future implementation. Recent directives issued by the Secretary of Defense indicate a possible future requirement for all DoD activities to implement TQM.
3. The implementation of TQM has been successful at the Depot at North Island. Improvements in productivity and processes are included in Chapter III.

4. The lessons learned by the Depot at North Island have value to any command attempting to implement the TQM procedures. The Depot is not unlike many of the other commands within the DoD. They share the same restrictions and organizational problems. Lessons learned by the Depot at North Island are included in Chapter III.

D. AREAS FOR FURTHER RESEARCH

It is recommended that the other 5 Naval Aviation Depots be compared to the Depot at North Island for consistency in findings and experiences. A survey type questionnaire could be developed from the information included in this thesis.

Other possible research areas regarding TQM could include a survey of some of the commercial companies that have completed implementation to verify the results gained from the above recommendation and the results from the Depot at North Island. The experience gained from the above recommendations could be used to generate a generic type of implementation guide.

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