QUALITY MANAGEMENT:
GUIDELINES, METHODS, IMPACTS

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Quality Management:
Guidelines, Methods, Impacts
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ABSTRACT

Competition across all sectors of industry is increasing. The need for quality in technology-based industries has heightened in recent years. According to this study, the primary focus and motivation of quality programs is competitive advantage, increased profits, and customer satisfaction. In addition to achieving these goals, quality programs also have extensive impacts in other areas of the organizations. A key requirement to a successful quality program is participation throughout the organization; support from upper management is key. Furthermore, management must commit to a quality program on a long term basis. The process is never ending. Results take time to measure. Two suggestions are offered for improving current quality methods at the end of the paper along with improvements for future studies.

INTRODUCTION

Competition across all sectors of industry is increasing. This is forcing organizations to take a serious look at how they are operating and the product or service they are delivering. In order to remain competitive or increase competitiveness organizations are down-sizing, restructuring, and producing better product or services. Thus, the need for quality in technology-based industries has heightened in recent years. Quality programs have become an important concern for business and industry. Much research has been done [2],[4],[5],[17]. Many methods and guidelines of quality have been proposed and put into use [1],[3],[22],[23].

In this move toward quality there are questions as to what are the best methods and guidelines to follow [3],[6],[10]. There are concerns as to the best way to implement new programs, how soon outcomes can be measured, what the impacts are, and what the problems are [11],[18],[21].

The finding are indicating that more to quality besides increased customer satisfaction and increased profits [3],[6],[18]. There is more to quality than being the current buzz word.

PROBLEM DEFINITION

The purpose of this project is to evaluate existing quality programs in the field of engineering and technology development. We are looking for what is actually being done in the industry to promote quality and what is the status of these programs at this time.

Our goal is to determine:

- What quality programs are currently being used
- What impacts these programs have had on their companies, divisions, and teams
- What factors/measures are being used to determine success
- What programs and methods are successful and why
- What organizational/policy changes have resulted due to the programs
- What has been learned from the experience
- What are some of the problems
- What is planned for the future

LITERATURE SURVEY

Recently the number of articles, workshops and seminars on quality guidelines has increased, especially ISO 9000, Six-Sigma and Malcolm Baldrige has been broad discussed. The following is a brief summary of the most popular quality programs.

ISO 9000

The publication of the ISO 9000 (International Standard Organization) series in 1987, together with the accompanying terminology standards, ISO 8402, has brought harmonization on an international scale and has supported the growing impact of quality as a factor in international trade. ISO 9000 represents the national standards bodies of 90 countries.

Whether organizations sell products or services, customer expectations are usually incorporated into a set of specifications. However, these specifications are not guarantees for the consistency of a product's quality. This need for consistent quality has resulted in a series of standards, ISO 9000. The standards are basically a set of Quality Management System (QMS) practices and guidelines. The ISO 9000 system is not a unique "system" in itself. Implementing ISO 9000 forces a company to record its management systems such that certain specifications and procedures are not overlooked. However, the series is not intended to standardize quality systems implemented by these companies[15].

The ISO 9000 series must be looked at as a series of minimum quality system requirements. It can be thought of as the lowest common denominator of quality system requirements meant for all industry and service groups. These standards focus on establishing and maintaining controls to assure that customer requirements are continually met. The five standards are described in Table 1.

ISO 9000 STANDARDS

ISO NAME	ANSI NAME	STANDARD TITLE	DESCRIPTION AND APPLICATION EXAMPLE
ISO 9000	Q90-1987	Quality Management and Quality Assurance Standards - Guidelines for Selection and Use	Guide for appropriate selection of standards 9001-9003. Applies to all companies.
ISO 9001	Q91-1987	Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.	Applies to companies that design and supply product, such as, engineering, and construction companies.
ISO 9002	Q92-1987	Quality Systems - Model for Quality Assurance in Production and Installation.	Applies to companies that use processes to deliver a product, such as, manufacturer and primary constructors.
ISO 9003	Q93-1987	Quality Systems -Model for Quality Assurance in Final Inspection and Test.	Applies to companies that assure product conformance through inspection and test, such as, distributors or value-added contractors.
ISO 9004	Q94-1987	Quality Management and Quality Systems Elements - Guidelines.	Guide for application of the elements used in developing and implementing Quality Management Systems. Applies to all companies.

TABLE 1

The ISO 9000 standard system series, originally British Standards (BS) 5750, were accepted and raised to the level of Euro-standards. ISO 9000 deals with quality management and use. Based on this standard, there are three levels of quality systems (base, medium, high) which a factory or firm can choose to introduce[8]. Those wishing to comply must first check in ISO 9000 for guidelines on the selection and use of ISO 9001 through 9003.

The three models are successive subsets of each other, with ISO 9001, the most comprehensive, covering design, manufacturing, installation, and servicing system. This is the arena where companies involved in customization will need to prove themselves. ISO 9002 deals with production and installation. ISO 9003 covers only final product inspection and tests. ISO 9004 is used as a guide to producers developing their own internal quality system. The ISO 9000 Series covers the gamut of business practices from the moment an order is placed, through the entire manufacturing process, to the actual delivery of the product to the customer[7].

Total Quality Management

Total Quality Management (TQM) is a quality system combining quality culture, statistical tools, and quality principles. It is a macro view comprehensive approach to customer satisfaction. Many quality system components used in the past five years fit under the TQM umbrella.

The primary failure of TQM is not TQM itself but how it is understood and implemented. Many companies fail to grasp the need to create a strong foundation upon which to begin the TQM process. They treat TQM as a quick fix which is indicative of lack of commitment not a failure of the method.

TQM requires customizing by the owner company and is seldom a benefit in a generic format[9].

Malcolm Baldrige

In order to conform to the Malcolm Baldrige National Award criteria the owner organization must implement a program of quality management based on seven categories. These categories delineate specific areas of focus for quality.

The seven categories are
1. Leadership
2. Information and Analysis
3. Strategic Quality Planning
4. Human Resource Utilization
5. Quality Assurance of Products and Services
6. Quality Results
7. Customer Satisfaction[20].

Within each of these seven categories, are sub-categories which aid in specifying and providing direction for the quality program developed by the owner company.

For example, to comply with the category of strategic quality planning companies should avoid these common mistakes: 1) TQM process implementation is the only goal; 2) the quality strategy is not tied to the business strategy; 3) goals, priorities, and targets are unclear; 4) goal setting is unaggressive; 5) goals are not quantified or substantiated; 6) the process lacks customer focus; 7) customers are viewed generically; 8) company lacks perspective on competitors; 9) employees or suppliers are left out of the planning process; 10) data insufficiently support the planning process[12].

Six-Sigma Quality Programs

In 1988, Motorola developed and vigorously pursued a quality management program called six-sigma. Six-sigma is a customer-driven approach that provides an

overall framework for quality management. The components of a six-sigma quality process are improvement process, quality initiatives, quality measurement, and improvement tools.

The goals of the six-sigma program is to improve customer satisfaction through reducing and eliminating defects. The six-sigma program is defined at two levels, operational and managerial. At the operational level, six-sigma uses several statistical measures to characterize defect levels and process capabilities. At the managerial level, six-sigma relies on an improvement process that is used by all employees to improve the quality of products, services, and processes.

Six-sigma relies on normal distribution theory to predict defect rates. Suppose a controlled process is producing a stable distribution of results in a key measured variable. Assume the measurement follows a normal distribution and that the mean(μ) and the standard deviation(σ) are known or have been estimated from sample statistics. Every process must be defined in sigma-level 1 to 7. For example, the area within +/- 3σ of the mean includes 99.73% of all measurement. This is a three sigma process and represents 99.73% of conformance[13].

METHODOLOGY

The purpose for our research was to acquire data on which methods companies currently use for quality management and how those methods are being used. We wanted this data to come from the practitioners of these methods so as to support the literature. The group was aware that in all likelihood there would be a certain lack of congruence between the literature and our data; however, we expected to find some direction of the quality management methods used in industry today.

Our procedure to gather data was through interviews with managers and quality control managers in various technological firms. The choice of the interview method was based on several points. First, there was a limited amount of time to perform any data gathering. Secondly, mail-and-return questionnaires are noted for having poor return rates; rates of less than thirty percent are common. We also wanted to capture direct personal insights and not put words in the participants mouths. This yields a high level of detail that are not always available with many data gathering techniques. Lastly, the purpose of the survey was not to obtain statistical data but rather to accumulate anecdotal information and experience.

This being our purpose, we developed our interview tool in several intensive brainstorming sessions. In these sessions we focused on the data and the form it should take to be useful to the research. This allowed us to develop the questions which would generate this data. There was an underlying philosophy that the survey form was meant to serve only as a guideline for the interview and should not limit the dialogue. If the participant wished to elaborate on any aspect of quality management, we would encourage it.

After some preliminary work we also decided to quantify as many of the results as possible. This provided measurements and helped to establish the direction that quality

management is taking. In order to establish the quantifying questions, we used Teeter [19]. From this we were able to adapt several of their questions or modify questions we had developed. A copy of the fully developed interview guide is provided in Appendix A; included with it are some examples of the replies we received.

To obtain as broad a swath across as many companies as possible, we established a goal of between twenty and thirty interviews with an absolute minimum of twenty. The biggest difficulty we encountered in the process was in finding mutually conducive times to conduct the interviews. The final total of interviews was twenty-two. Instead of the original focus of only managers, the table in Appendix B shows a great diversity of positions and job descriptions.

RESULTS

From the twenty-two interviews that were conducted, we tabulated the quantitative data and bulleted key comments. The tabulations were taken from the cues and the discrete metrics of the interview form. These were placed into a spreadsheet and analyzed. The analysis was a straight forward summing and averaging of the metrics. From this we developed the graphs which are in the following sections.

The key comments were selected for one of two distinct reasons: 1) they were representative of the majority of the comments from a particular portion of the interview; 2) or they were remarkable on their own. Some of the comments provided great insights into the problems and challenges facing management in implementing quality programs and maintaining them. They provided further elucidations on the topic.

CRITICAL ISSUES

Our findings from the data fell into seven critical issues. These form the driving forces behind quality management today.

Motivation

The need for quality programs in organizations is driven by nine major goals. These are summarized in the graph "Motivation" on the following page. Competitive advantage is the main driver by a large measure, almost a full point. This is supported by the comments noting that one organization, Boeing, must now compete with a strong European competitor, Airbus. Airbus continues to manufacture aircraft despite the fact that there are no orders. These "white tails" are finding markets because of the long lead-time Boeing currently is experiencing in manufacturing.

The next significant motivational factors are increased profits and customer requirements. These, along with the factors of management policy and selling in the U.S., scored above a level fifty percent. Organizations need to consider this in formulating quality programs.

The respondents in the interviews noted that selling in Europe is a major motivation for using ISO 9000. Even when selling in Europe is not a factor, ISO 9000 is frequently the guideline of choice.

Program Drive

When implementing quality programs the most prevalent method is top down. This means that upper management is the driving force. As stated by one of the respondents "most programs will fail due to lack strong management support and lack of knowledge."

Even though initial direction is from the top, internal controls will usually provide the necessary bottom up feedback for continued quality process improvement. This demonstrates that the program needs multi-level support. Companies which have had several quality programs fail tend to lose this important ingredient, global buy-in. Middle managers who have been with the company a great number of years typically see the current program as another doomed to fail. They provide lip service to the program but do not truly stand behind it. This, in turn, results in yet another failed quality program.

External factors rank as the second most important driving component. Customers provide critical input for many industries. A respondent states, "managers must know and understand customer needs and have a method to improve quality." This can be seen in the bar chart "Program Drive" on the following page.

Guidelines

According to the data the ISO 9000 guideline is currently the most popular quality guideline. As noted earlier, this popularity is driven by organizational desire to sell in Europe. However, companies currently not in the European markets are joining the ISO 9000 endeavor because "I may not want to sell to Europe today, but tomorrow, who knows." The prevalence of this method is emphasized in the following chart "Guidelines".

By industry sector, there is some uniformity of methods used that does not show in the chart. For example, manufacturing uses primarily ISO 9000; aerospace uses some quality method but without consensus; the software sector varied with little to no consensus. But it must be kept in mind that these generalities are based on a very small sample size.

QULAITY PROGRAM MOTIVATING FACTORS


Average Response of 0 to 5 Scale
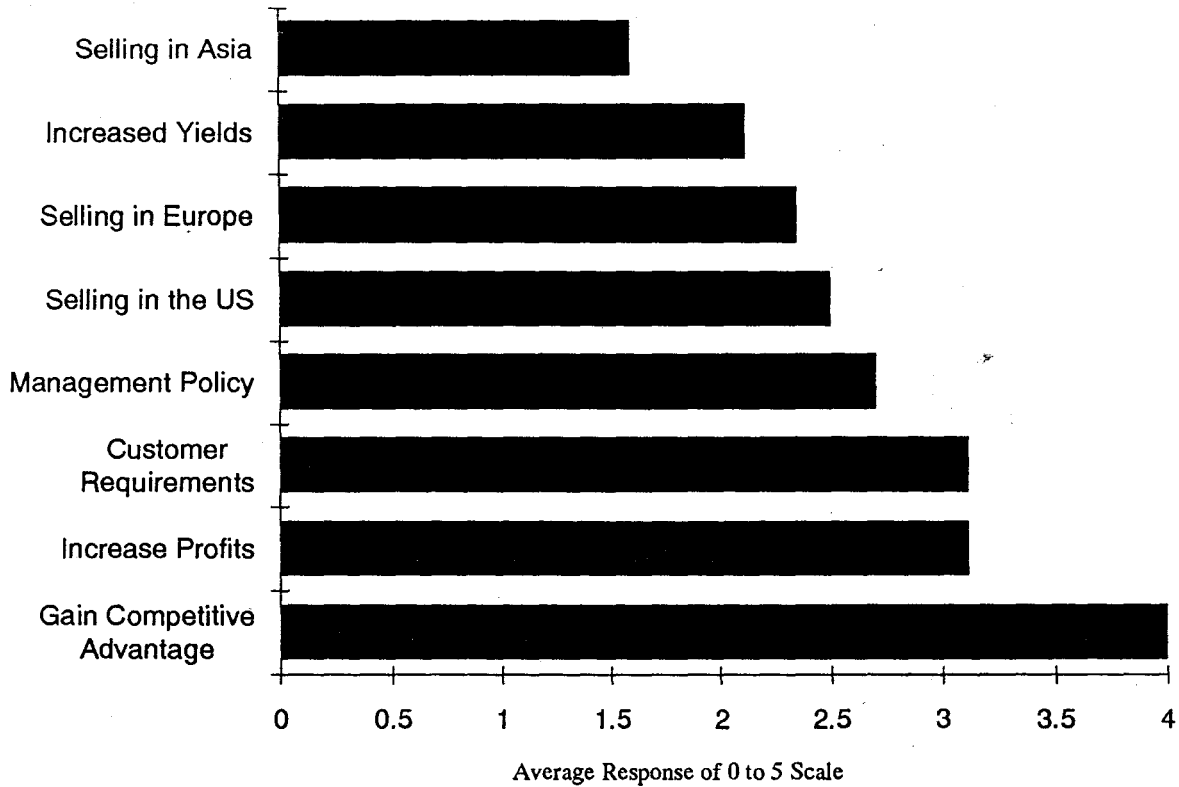
GAINING COMPETITIVE ADVANTAGE WAS REPORTED AS THE MOST IMPORTANT REASON FOR IMPLEMENTING QUALITY PROGRAMS. THIS WAS INTERPRETED, THROUGH ACCOMPANYING COMMENTS, TO MEAN "ATTAINING CUSTOMER SATISFACTION".

THOUGH CUSTOMER REQUIREMENTS RATED HIGH THERE WERE MOST RESPONDENTS STATED THERE WERE FEW SPECIFIC QUALITY PROGRAM REQUIREMENTS COMING FROM CUSTOMERS.

ONE REPORTED "THREE YEARS AGO IBM INFLUENCED QUALITY PROGRAMS; TODAY, THEY DON'T ASK ANY QUESTIONS".
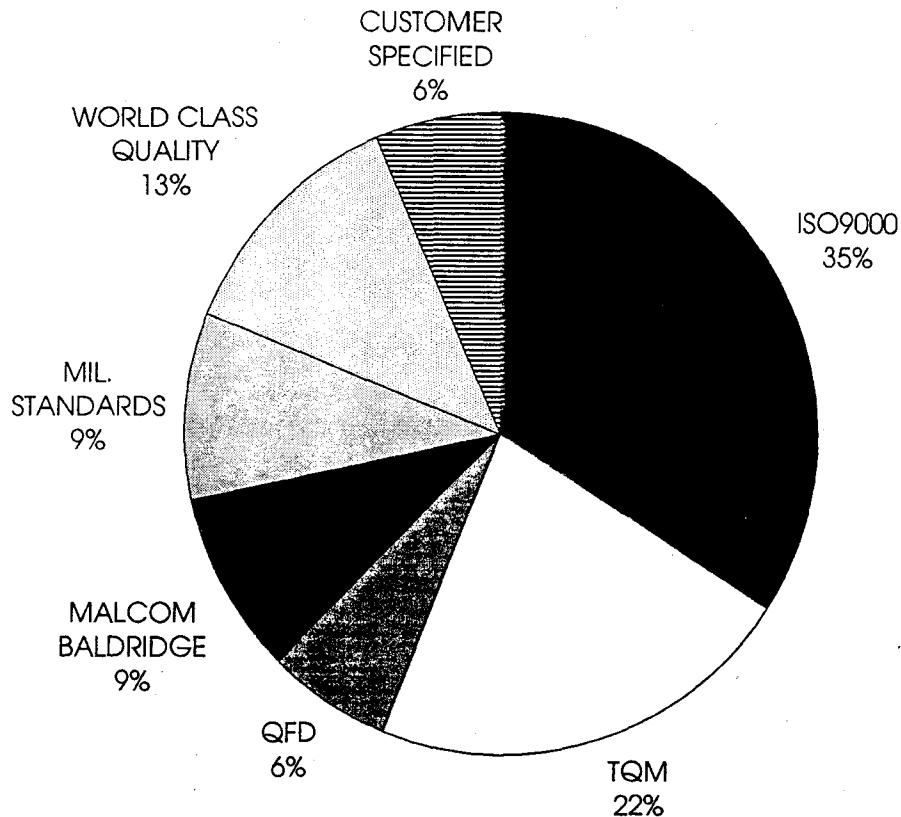
HOW PROGRAMS ARE DRIVEN

Average Response of 0 to 5 Scale
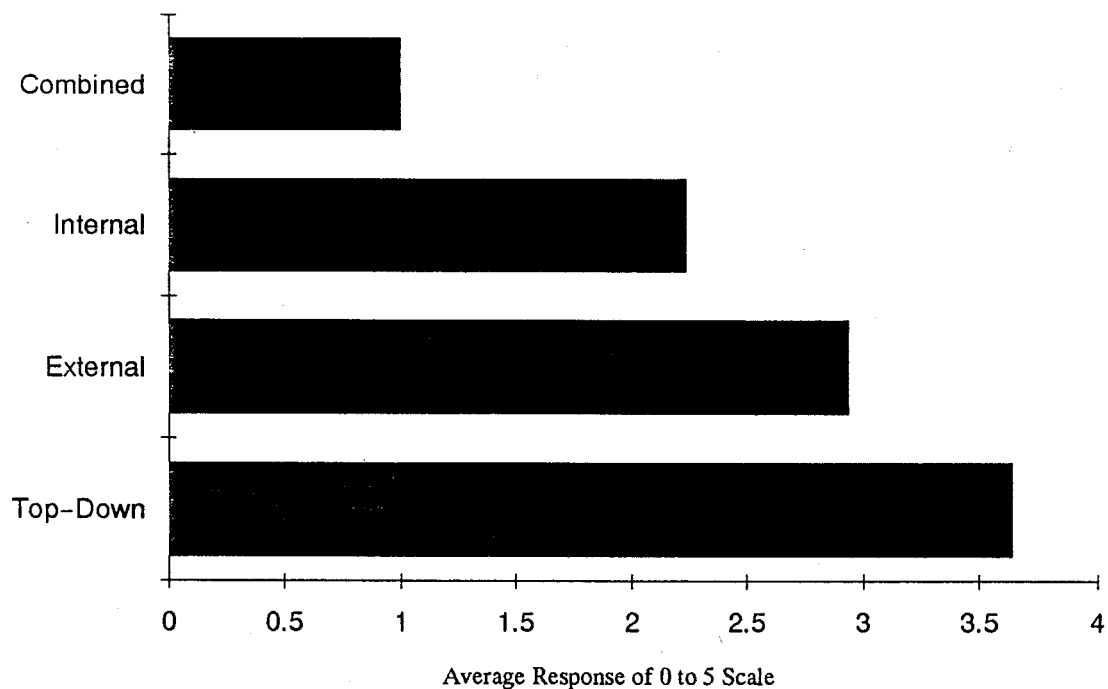
TOP DOWN DRIVE MORE PREVALENT.

TOP DOWN OFTEN FOLLOWED BY BOTTOM UP.

MANAGEMENT DRIVE EMPOWERS OTHERS TO ACT.

ONE COMMENT:"MANAGEMENT DRIVES BUT DOESN'T PARTICIPATE."

QUALITY GUIDELINES

CUSTOMER
SPECIFIED
6%

WORLD CLASS
QUALITY
13%

ISO9000
35%

MIL.
STANDARDS
9%

MALCOM
BALDRIDGE
9%

QFD
6%

TQM
22%

REPORTED AS PERCENT RESPONDENTS.

ISO 9000 REPORTED AS THE LEADING GUIDELINE IN USE OR
EXPECTED TO BE IN USE IN THE NEAR FUTURE.

MOST RESPONDENTS REPORTING ISO 9000 PROGRAMS ARE
PURSUING CERTIFICATION - FEW ARE CERTIFIED.

COMPANIES REPORT QUALITY PROGRAMS HAVE BEEN IN
EFFECT FOR 1 TO 2 YEARS. FEW HAVE BEEN IN EFFECT
LONGER.

BALDRIDGE CRITERIA WELL KNOWN, AND IN SOME USE, BUT
MOST RESPONDENTS USE AS GUIDELINES ONLY - NOT
PURSUING AWARD.

Measures

Success and progress tracking varied almost uniformly although financial measures seem in greater use at twenty-six percent. One of the replies is that "yield is the best measure for manufacturing organizations." From the comments it is clear that customer feedback is also used extensively to measure the success of programs. This was not prompted for in the survey but had it been it may well have taken the lead measure. The data is summarized in the chart "Measures".

Training

Almost every respondent replied that training played a heavy role in their quality program. "[Training] reinforces ongoing daily experiences", and "[it helps you to] think about the job and how it effects competitiveness."

The Oregon chapter of the American Electronics Association has initiated a pilot program for training competitiveness to smaller companies [15]. Currently there are five companies involved in the program according to partnership director/manager. They are Planer Systems, OrCad, Micropump, Etec Systems, and Althin Medical. There are hopes for future expansion of the partnership.

Overall most respondents did not have much if any formal training in quality management. Almost all mentioned that their organizations had provided training for their quality program during company time and at company expense.

Impacts

Human resource practices is the surprise finding of the study (see chart "Impacts"). The question about changes regarding hiring practices generally received a negative response. The negativity results from the change in hiring practices due to layoffs and

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down-sizing. The comments state that the employees who do not support the quality programs are now the first to be layed-off. This reinforces the need for global buy-in for a program to be successful. Also mentioned was the fact that job descriptions are being changed to meet the challenges of the new environment. There may not be any relationship between hiring practices and quality management but one can no longer separate them.

There is a consensus among the respondents that organizational structures are changing. The change is not so much in the visible organizational charts but is more subtle. Project teams are becoming more cross-functional. This means that the structure of the teams is changing. As the artist/assembler/integrator notes, "[I'm] working with the people I build the art for." With this change comes the "placing of the emphasis on the individual" but paradoxically these changes also "become process oriented instead of people oriented." What the managers and practitioners of quality are saying is the employee is being held more accountable while the organization is now looking at the product as a process rather than a group of people performing a task. Another change being noted in the structure of the organization is that customers and suppliers are frequently part of the project teams. This results in increased interaction and improved interfacing. As one respondent said, "why build it if it's not necessary [if the customer does not want it]."

Respondents frequently stated that meetings are more efficient. "We are talking the same language," notes a participant. This better communication is making for more effective team problem solving.

IMPACTS

Average Response of 0 to 5 Scale
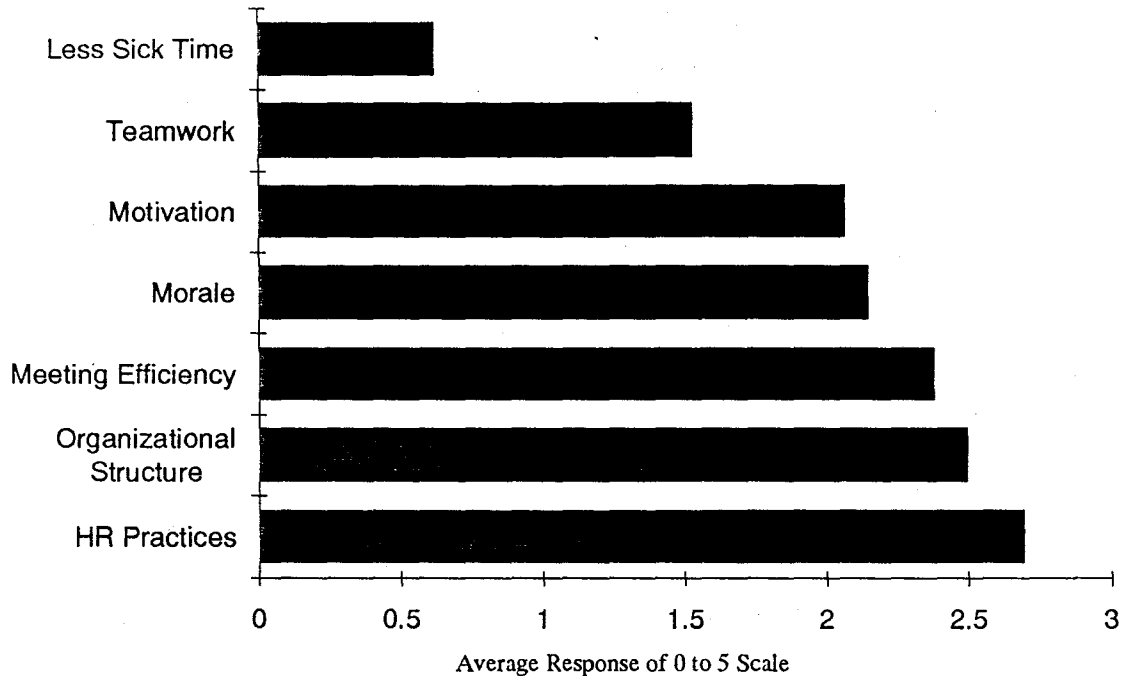
HR PRACTICES INCLUDES CHANGES IN JOB DESCRIPTIONS, POSITION STATEMENTS, AND EXPECTATIONS.

"PEOPLE WHO DON'T BUY-IN GO OUT".

LITTLE CHANGE IN HIRING PRACTICES (DIVERSITY, MINORITY RECRUITMENT, ETC.) NOTED.

ORGANIZATIONAL STRUCTURAL CHANGES NOTED:
    CROSS FUNCTIONAL TEAMS
    SIGNIFICANT CHANGES IN PROJECT TEAMS.
    SUPPLIERS AND CUSTOMERS ON TEAM – MORE
    DIRECT INTERFACE
    LITTLE CHANGE IN ADMINISTRATIVE STRUCTURE.

MEETING EFFICIENCY
    USE SAME LANGUAGE.
    EFFECTIVE TEAM PROBLEM SOLVING.

Future Plans

Most organizations have a stated goal for the quality management program, but the upper management is not communicating that goal well: "Permanency of change is dependent on management influences." Other comments of note are, "move quicker, drive harder, spend less time building consensus", "get rid of middle management", "current program *is* sustainable." More comments are noted on following page. Some respondents wondered how long the program would last after the idea champion had departed. However, another interviewee countered this by noting that "I will be able to better manage programs since I've learned about quality management."

WHAT OUR RESPONDENTS TOLD
US THEY WOULD DO
DIFFERENTLY IN THE FUTURE

UNDERSTAND PROGRAM COMPLEXITIES; STRUCTURE
PROJECTS ACCORDINGLY (DON'T UNDERESTIMATE EFFORT

UNDERSTAND THAT NOT EVERYONE IS GOING TO LIKE TQM
AND THE CULTURAL CHANGE - "THOSE THAT DON'T WILL
HAVE TO LEAVE

MOVE QUICKER, DRIVE HARDER, SPEND LESS TIME BUILDING
CONSENSUS

NEEDED MORE TRAINING; TRAINING PROVIDED WAS
UNORGANIZED AT FIRST

LET EMPLOYEES KNOW THAT PERFORMANCE UNDER
QUALITY PROGRAM IS RELATED TO LAYOFFS

BE MORE AGGRESSIVE WITH PERFORMANCE MEASURES,
ESPECIALLY MANAGEMENT - "IF MANAGEMENT DOESN'T
WALK THE WALK, THEN IT'S DIFFICULT TO FOLLOW."

GET HELP EARLIER IN THE PROCESS

INSTIGATE TEAM WORK EARLIER

STATE WHY TRAINING IS IMPORTANT

RESPECT OPINIONS OF OTHERS

CLARIFICATION OF EMPOWERMENT

DISCUSSION

The consensus of the responses indicate the following three issues must be addressed by organizations implementing quality management programs: 1) methods must be implemented corporate-wide; 2) the process must be seen as an ongoing process; 3) results take time to acquire.

Almost all respondents said that the implementation of the quality program is organization-wide. In the cases where there was uncertainty as to the extent of implementation, there was also less satisfaction with the program or more resistance to it. Many multi-divisional organizations are not uniform in the subgroup implementations but each division's quality program is driven by the parent company's program. Clearly, the vision or direction of the program must come from the highest levels of management.

The quality process must be ongoing. This becomes evident from the replies to the two questions regarding projected implementation end-time. Few respondents indicated that there was an end-date for the program. Most of the quality guidelines require a proposed end-date for implementation to be completed or certified. But even within these is an implicit idea that the process is a continuing, self-monitoring, and self-correcting process.

The results will take time to acquire. In specific projects and teams quality programs will engender immediate changes, as in project implementation. However, in the global organization, measurable results will take time to show. As one quality person said, "It's like a huge ocean vessel; it takes a long time to turn it around."

An additional focus in the quality programs according to the interviews is the outcomes of competitiveness and customer satisfaction. This last ingredient brings us to the classic project theory components of time, cost and performance. Cost is implicit; without customer satisfaction and competitive products or services, there is no revenue

generated. Time is inherently reflected in the process of quality as an ongoing activity. Performance is represented in the focus of quality methods and processes. Thus, quality programs are well-defined as management entities.

CONCLUSIONS

According to this study, the primary focus and motivation of quality programs is competitive advantage, increased profits, and customer satisfaction. In addition to achieving these goals, quality programs also have extensive impacts in other areas of the organizations. A key requirement to a successful quality program is participation throughout the organization; support from upper management is key. Furthermore, management must commit to a quality program on a long term basis. The process is never ending. Results take time to measure.

The following two suggestions may assist in the formation of a whole quality management program:

1. Establish quality consortiums provide small companies an economic solution for building and maintaining their quality programs. Small companies often do not have the necessary resources to develop successful quality programs on their own. An example of such a consortium is the pilot program which is being sponsored by the AEA.

2. Develop a profile typical of an organization within its specific sector of industry for organizations of that sector to emulate. This follows the idea of the consortium in supporting strong commonalties. The idea behind the suggestion is that this ongoing process will be the self-monitoring and self correcting quality program for an industry as it is within organizations.

This study provides a current detailed sampling of quality methods, but by no means is the sample comprehensive or large enough to draw strong conclusions. The interview guidelines developed by the team were general. Future work should refine the focus of the questions. Also, a larger sampling should be structured around various segments. This would provide a more accurate view of quality programs. Possible segmentation schemes include: industry, company size, and revenues. Another area of particular interest

that may be pursued is the relationship between human resources and quality management in today's corporate climate of restructuring.

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APPENDIX A

INTERVIEW GUIDELINES