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Author(s):   J. Dorrance, V. Scalesse, S. Cimen, D. Lee, T. Dugan and K. Thayib

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Abstract: In our study, we have shown how Total Quality Management (TQM) has evolved as a competitive strategy involving continuous improvement of products, processes, and services to enhance quality, reduce costs, improve productivity, and increase total customer satisfaction.

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by

Selahattin Cimen   Doug Lee
John Dorrance   Vincent Scalesse
Tim Dugan   Kostaman Thayib

Portland State University

EMGT 520

Dr. Kocaoglu

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EXECUTIVE SUMMARY

Over the past decade, quality has become increasingly important to customers. As a result, many suppliers of goods and services have found it necessary to focus on quality, not to gain a competitive advantage, but to be able to compete and stay in business.

Total Quality Management (TQM) is now a commonplace term in most organizations. Even though many organizations are embracing the philosophies and practices of TQM, a standard definition of TQM cannot be agreed upon. The reason for this is that TQM is all-encompassing. Since it deals with all aspects of the organization, TQM means different things to different companies. Many definitions of TQM can be found in the literature, but none is complete. Therefore, it may be more appropriate to discuss the "scope" of TQM rather than its definition. The following elements, as a minimum, should be addressed by any TQM Program:

- Customer Focus
- Management Commitment
- Employee Participation
- Education and Training
- Effective Communication
- Continuous Improvement
- Long Term Perspective
- Supplier Relations.

Two cases are studied in this paper to illustrate ways in which TQM is being implemented. These studies compare and contrast the move toward TQM in two organizations. The first case is of a company that has been employing the TQM philosophy for over 20 years. The other is of a company that has just started to develop a formal quality program in the last two years. As one might expect, the progress made by these two organizations differs greatly. However, it is interesting to note that TQM has not been fully achieved by either company.

TQM is an ongoing process – a process of continuous improvement. A TQM program may start out with a narrow focus, but as the organization adapts to the changes, the program must be continually expanded in order to succeed. All aspects of a business need to be affecting changes in support of the TQM philosophy, because TQM is not just a program to be administered by the Quality Department. But rather, it is a totally new way of doing business. As the customers' demand for quality continues to increase, TQM is becoming more of a necessity than a distinction. Even though Total Quality is an ideal state which will never be fully realized, today's companies are investing in future success as they take strides toward TQM.

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INTRODUCTION

In the 1960s and 1970s, the way for a company to succeed in the market place was to make products and deliver services quicker and cheaper than its competitors. Business processes, promotions, training and education programs were all oriented toward this goal.[1] During that period, Japan gained a competitive advantage in world markets by undercutting prices.[2]

In the 1980s, businesses recognized that while making products and delivering services more quickly and cheaply remained a competitive necessity, producing quality products was the best way to make and sell them cheaper and quicker. An unprecedented growth of emphasis upon quality was seen in that period, and competition shifted from the basis of price alone to price and quality. Data on customer preferences for the year 1986 indicate that eight out of ten buyers throughout international industrial and consumer markets now make quality equal to or more important than price in their purchase value decisions.[1] In the last few years, American companies have seen their market shares slide as foreign competitors have provided customers with higher quality products at lower or equivalent prices.[3]

In today's global market, companies face strong competition from competitors not only in their own country, but also from all over the world. In this increasingly competitive world, quality is an essential business strategy.[1,40] The ability of a company to provide higher quality goods and services is a competitive advantage and key for success. Without quality an organization cannot survive.[41]

Total Quality Management (TQM) has evolved as a competitive strategy involving continuous improvement of products, processes, and services to enhance quality, reduce costs, improve productivity, and increase total customer satisfaction.

TQM involves the use of quantitative and qualitative methodologies, management techniques, statistics, economics, and system engineering tools and methods to control the production and service processes of an enterprise in order to satisfy customer needs and requirements. It is based on the principle that continuous quality improvement results in increased productivity, lower costs, a stronger competitive position, and increased market share and profitability.[27]

DEFINITION OF QUALITY

The term quality can be defined in different ways depending on the perspective of the user. The traditional definitions of quality can be summarized as follows:[4,29]

- Conformance to applicable specifications and standards.
- Fitness for use.
- Reliability.
- Durability.

These traditional definitions of quality center around the quality of goods. Today, customers' expectations go beyond these definitions.[37] Customers expect the same high quality from sales, service, and support as they do from products. Therefore the definition of quality in the context of TQM includes all these customer expectations: quality of goods, services, time, place, equipment and tools, processes, people, environment and safety, information, and measurement.[5] From a TQM point of view, quality can be defined shortly as "whatever the customer says it is".[6] Quality is meeting and exceeding the customer's requirements, needs, and expectations the first time and every time. In other words, customers define quality and customer satisfaction is paramount.[7,28,30]

DEFINITION OF TQM

TQM is a broad term and is defined in a number of ways. Each definition describes an organization's efforts towards quality improvements. There are various terms used to refer to TQM philosophy. They include:[8]

- Total Quality Control
- Total Quality Involvement
- Total Quality Leadership
- Total Quality Commitment
- Total Quality Improvement
- Total Quality Programs.

There are as many definitions of TQM as there are terms for the philosophy. Each of these definitions emphasizes different aspects of TQM philosophy. Popular definitions of TQM are:

- "TQM is an approach for continuously improving the quality of goods and services delivered through the participation of all levels and functions of the organization."[2]

- "TQM is an approach for building quality in from the beginning and making quality everyone's concern and responsibility."[2]

- "TQM is defined as the totally integrated effort for gaining competitive advantage by continuously improving every facet of organizational culture."[6]

- "TQM is a commitment to excellence in an organization achieved by team work and a process of continuous improvement."[9]

- "TQM is a synthesized, pervasive, and unwavering commitment to quality through continuous process improvement by all members in the organization."[10]

- "TQM is a management philosophy that emphasizes the need to meet customer requirements precisely and the importance of doing things right the first time."[11]

- "TQM is a structural system for creating organization-wide participation in planning and implementing a continuous improvement process that exceeds the expectations of the customers."[12]

- "TQM is a management process directed at establishing organized and

continuous process improvement activities, involving everyone in the organization in a totally integrated effort toward improving performance at every level."[3]

Total Quality Management is a management philosophy. It is a way of operating that[13]

- Requires a total commitment to quality
- Focuses directly on customer needs and expectations
- Views all activities as processes which can be continually improved through the use of scientific methods
- Requires universal participation and a teamwork approach to problem solving
- Seeks perfection as the goal.

ELEMENTS OF TQM

TQM consists of the following areas of emphasis:

1. Customer Focus
2. Management Commitment
3. Employee Participation
4. Education and Training
5. Effective Communication
6. Continuous Improvement
7. Long Term Perspective
8. Supplier Relations.

1. Customer Focus.

The Total Quality Management organization is dedicated to satisfying the customer. To become customer oriented means shifting the day-to-day focus to customer needs and requirements.[14,39]

In TQM, the word "customer" has a new meaning. The customer is the beneficiary of the work. Beneficiaries may be people or organizations. They may be people outside the organization, or people at the next line or in the next office. Beneficiaries outside the organization are called "external customers", and those within the organization are called "internal customers".[15,16,30]

Present and future market conditions require a far more rigorous

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examination of customer needs. The goal is no longer customer satisfaction. Rather, it is customer delight and excitement. Therefore, TQM emphasizes identifying, satisfying, and exceeding customer expectations.[6,17]

To satisfy the external customer, internal relationships of an organization must work in harmony. The concept of "the next process is the customer" requires every person and every unit in the organization to regard itself as both a supplier and a customer, and to insist on receiving products and services of better quality at each stage of the process until they reach the end user.[18]

The way the people in an organization feel is the way their external customers are going to feel. Therefore, internal customers should be treated with reverence, honesty, competence, respect, and dignity. Treating people in this way also helps create a good working environment and culture which is suitable for work improvement.[15,19]

2. Management Commitment.

Leadership, as Eisenhower said, is the art of getting someone to do something you want done because he wants to do it. It starts with a vision. A leader with a clear vision and strong commitment to that vision will find a way to spark in others a desire to bring that vision into reality.[15]

A senior leader must be the "TQM evangelist" of the organization. He or she must be the focal point that provides broad perspective and vision to the improvement activities. The leader must be determined enough to establish the TQM initiative and be committed to sustain its activities prior to the time quality has markedly improved.[2,26,36]

In order to maximize productivity and efficiency, people should be motivated by leaders who can bring out the best in them. There must be a constant leadership effort in an organization geared toward improving quality. This kind of effort can

be provided by leaders who are knowledgeable about TQM.[19]

A company's senior leaders must create clear quality values, specific goals, and well-defined systems and methods for achieving these goals. The systems and methods need to guide all activities of the company and encourage participation by all employees. Through their regular personal involvement in visible activities such as goal setting, planning, review of company quality performance, and recognizing employees for quality achievement, the senior leaders reinforce the values and encourage leadership in all levels of management.[20]

3. Employee Participation.

To be successful, TQM requires universal participation. Everyone must participate in the improvement effort at all levels. In any organization, the person who best understands the job and how it can be improved is the one performing it. The organization should attempt to maximize the use of the knowledge, skill, and experience of its employees to improve the work process.[43]

Elements of employee involvement include mainly:[8]

- Senior management commitment
- Focus on strategic operational issues
- Empowerment
- People
- Reward system
- Suggestion handling
- Training
- Communication
- Time commitment
- Human resources management practices.

TQM also stresses the importance of a teamwork approach to problem solving. When organized and managed properly, teams are the best means to solve work problems and improve work processes. Moreover they cause people to take ownership of their work, take pride in their achievements, and take joy in their

work. In other words, teamwork is the best way to empower people. Teams working on cross-functional processes, those that cut across the organization and involve several work units, reap the greatest benefits.[15] These multi-functional teams break down organizational barriers that exist in an organization. They promote cooperation among employees and discourage individualism or departmentalization.[3]

Several techniques that can be used to encourage participation include:[2]

- Recognize team and individual accomplishments contributing to the improvement process. Share success stories and disseminate good ideas applicable to other parts of the organization
- Encourage risk taking by removing the fear of failure
- Encourage the formation of quality circles, problem "hit squads" and other quality improvement teams
- Implement a suggestion system that acts rapidly, provides feedback and rewards implemented suggestions.

4. Education and Training.

Education and training are principle ingredients in motivating an organization towards a TQM philosophy. Education on the concept of TQM is needed by everyone. Training is necessary for those in an organization to utilize the various techniques available to support the TQM process.[3]

TQM requires employees to receive training in basic quality skills related to performing their work and to understanding and solving quality related problems.[31,33] Because TQM focuses on process, "Process Analysis" is very important to deal with such quality problems. Process Analysis is an analysis that clarifies the relationship between cause factors in the process and effects such as quality, cost, productivity, etc. Ninety-five percent of the process analysis can be accomplished through the use of the seven tools of statistical process control. These seven tools are:[18]

1. Pareto chart
2. Cause and effect diagram
3. Stratification
4. Check sheet
5. Histogram
6. Scatter diagram
7. Graph and control chart

5. Effective Communication.

Good communication is vital to the success of TQM. With proper execution, the right messages will contribute immeasurably to the success of the TQM program. Well received communication will gain widespread commitment, rally the organization, and encourage action. Conversely, poorly managed communications might produce adverse effects.[21,35]

Communication strategy is the least and most poorly understood aspect of many TQM implementations. Leaders of the total quality implementations often lack formal training or hands-on-experience in communication management. Similarly, professional communicators frequently lack the in-depth understanding of TQM required to shape and execute an effective total quality communication plan.[21]

Organizations implementing TQM require improved communications to support the improvement process. In a TQM environment people need to communicate across organizational levels, functions, product lines and locations to solve current problems, avoid new ones and implement change.[2]

Every functional group or individual that can influence quality throughout the hierarchies of the organization should be informed and aware of the quality objectives. Specific details of communication should include:[22]

- The quality objective

- The scope of the quality objective

- The plan for achieving the objective
- The desired personnel interfaces
- The direct and indirect benefits of higher quality
- The expected cost of low quality
- The desired personnel contribution to the quality objective.

The following guidelines will help managers communicate total quality inside their organizations:[21]

- Making involvement the goal
- Providing a plan of action
- Developing a document with guidelines
- Providing an example of TQM in action
- Using existing internal communication channels
- Arming management to deliver the total quality message
- Reporting process achievements as well as results
- Celebrating.

Internal communication systems generally have four important goals:[23]

1. To inform the staff of ongoing objectives, policies, and plans
2. To control the work of employees to ensure that individual effort is congruent with organizational goals
3. To assist in problem solving at all levels of the organization
4. To develop team building by sharing information with employees and providing opportunities for them to give input.

In addition to formal communication, informal communication is used and trusted by employees at all levels of the organization. The flow of information through the informal network is very rapid compared to the flow through formal channels. In some situations (i.e. crises etc.) the information needed to solve problems might come almost completely through informal communication links.

Informal communication is often richer in content than formal communication because it usually allows the parties to receive immediate feedback and clarification.[23]

6. Continuous Improvement.

An organization employing TQM should actively pursue and encourage improvement at all levels, and views change as a natural, continuous part of its activities.[2] It is critical to understand that improvement is not a one-time effort. An organization should be constantly improving the system of production and service. Management is obligated to continually look for ways to improve quality and reduce waste.[24,25]

Achieving the highest levels of quality and competitiveness requires a well-defined and well-executed approach to continuous improvement of all operations and all work unit activities of a company. It cannot be limited merely to manufacturing or the service delivery systems. Purchasing, transportation, engineering, maintenance, sales, personnel, training, and accounting all have a role to play.

Improvement may be of several types:[20]

1. Enhancing value to the customer through improved product and service attributes
2. Reducing errors and defects
3. Improving responsiveness and cycle time performance
4. Improving efficiency and effectiveness in use of all resources.

Thus, improvement is driven not only by the objective to provide superior quality. It is driven also by the need to be responsive and efficient – both conferring additional marketplace advantages. To meet all of these requirements, the process of continuous improvement must contain regular cycles of planning, execution, and evaluation. It must be accompanied by a basis, preferably quantitative, and for

deriving information for future cycles of improvement.[20]

7. Long Term Perspective.

In organizations, major improvements do not usually happen rapidly. Planning and organizing the improvement activities takes time and requires major commitments on the part of all participants.[38] Also, change may be resisted, explicitly or implicitly, because it will be threatening to certain organizational, social, political and physical structures and relationships. It will take time to allay the fears and suspicions of those elements most affected.[2]

Unfortunately, while time is necessary to the success of TQM, it can also work against it in two ways. First, the longer an organization takes to implement TQM, the further behind its competitors it will fall. Second, unless steps are taken to ensure TQM remains a priority, the organization risks losing the commitment of individuals and departments key to its success.[2]

8. Supplier Relations.

One of the fundamental principles of TQM is that quality downstream is best assured by maintaining quality upstream.[42] This concept extends to the relation between the organization and its supplier.[24,25,34]

An organization usually operates on orders to seek the lowest price vendor. Frequently, this leads to supplies of low quality. The practice of awarding business on price tag alone should be ended. This practice has three major drawbacks:[24,25]

1. It leads to a proliferation of suppliers. Multiple suppliers for the same item will multiply the variations. Variation causes problems in production and impairs quality.

2. It causes buyers to jump from vendor to vendor.

3. It produces a reliance on specifications, which become barriers to continuous improvement.

Instead, an organization should seek the best quality, and work to achieve it with a single supplier for any one item in a long-term relationship. This will lessen the variation for each item and improve overall quality and costs. The supplier has large long-term customers and can commit resources to satisfying them. As production runs are longer, costs are lower. By investing in facilities, costs can be further lowered. Suppliers can devote time to working with the buyer, understand the buyer's needs, and find out how the product is being used, which allows supplier to continually improve quality and lower the costs.[24,25]

Supplier integration involves not only selecting those suppliers that can deliver a quality product on schedule, but also imposes some elements of the TQM concept on them if it does not already exist.[3] An organization should assist suppliers to initiate TQM programs, helping them introduce various improvement programs such as suggestion programs and small group activities, and maintaining better communications on product quality, quantity, and delivery schedule.[24,25]

IMPLEMENTATION OF TQM

TQM has been implemented broadly in organizations, public or private, profit or non-profit, as a new management philosophy and strategy. Not only the manufacturing sector, but also the service sector is discovering the benefits of TQM. Increasingly hospitals, hotels, banks, utilities, and government agencies are turning to TQM to improve the delivery of services to their clients.[14,32]

There is no right way to implement TQM. Each organization must adapt TQM to its own corporate culture,[14] and tailor its approach to exploit its unique strengths and concentrate on its particular weaknesses.[2]

In TQM, how a process is implemented is as important as what the process includes. Several activities which appear necessary for implementing TQM, regardless of organization are as follows:[2]

1. A realization that in a global marketplace customer satisfaction is the key to survival and success

2. Understanding that quality improvement is key to increased customer satisfaction, increased productivity and reduced costs

3. The commitment of a leader to the philosophy of TQM

4. A change in the organization's culture to accept the tenets of TQM

5. Training within the company, from top to bottom, and with its customers and suppliers

6. The immediate beginning of improvement activities.

A non-profit TQM research company, GOAL/QPC, found that the following six implementation models of TQM are currently being used:[12]

1. The TQM Element Approach

   This approach, used in the early 1980s, employs elements of quality improvement programs such as Quality Circles, Statistical Process Control, Quality Function Deployment, etc. rather than full implementation of TQM.

2. The Guru Approach

   This approach uses writings of a guru such as Deming, Juran, or Crosby, as a benchmark to determine what the organization lacks, then uses the guru's systems to make changes. Use of Deming's 14-point model is an example.

3. The Japanese Model Approach

   Organizations using this method focused on the study of the Japanese "Deming Prize Winners" as a way to develop an implementation master plan.

4. The Industrial Company Model Approach

   In this approach, people visit a U.S. industrial company using TQM, identify its success, and integrate this information with their own ideas to create a customized approach. This method was used in the late 1980s by many of the Baldrige National Quality Award winners.

5. The Hoshin Planning Approach

   This approach, developed by a Japanese firm, Bridgestone, was used

successfully by Hewlett-Packard. It focuses on successful planning, deployment, execution, and monthly diagnosis.

6. The Baldrige Award Criteria Approach

In this model, an organization uses criteria for the Malcolm Baldrige National Quality Award to identify areas of improvement. The criteria cover seven key components of TQM. As the 1990s begin, this approach is being used by many industrial companies.

CASE STUDIES

Two case situations were studied to develop a better understanding of TQM implementation issues. First, a company with a mature comprehensive quality program was considered. This case study provides an example of an existing quality program which has been developing over several years. Second, a company with an emerging formal quality program was studied. This study provides information on TQM implementation issues in an organization that previously had no formal quality program.

Case 1: "Firm A"

Case Background

In this case the subject is a locally-based international telecommunication company which we will call Firm A. Branching out with facilities in this country about 25 years ago, this company develops and manufactures products for the North American marketplace. Within the diverse product line that is produced in Firm A are facsimile machines, mobile telephones, pagers, microwave equipment, and central office high capacity data transmission equipment. The company relies heavily on the success of the transmission equipment product line to remain profitable (and successful). Thus, many of the quality activities performed in the organization are due to the highly regulated telephone transmission equipment industry. What is important to understand is the fact that much of the

manufacturing processes implemented to obtain high quality applied to transmission equipment specifically are also carried over to the production of the other products mentioned above. In shaping the company quality program in Firm A, we will investigate "the customer influence and involvement" aspect of TQM as it is presently implemented. Our aim is to determine if such a situation exists and if so, to what extent both the supplier (Firm A) and the customer interface.

Within any quality program, implemented or developing, the fact of establishing standards and procedures must be complemented by the participation of the employees. This is a key issue that is addressed in forming the TQM concept. Significant focus in this case study is placed on Firm A's commitment in creating a successful quality program through the efforts of the participants. Information such as what activities are encouraged for employee participation, what is the method and level of training given to employees in promoting quality awareness, and what motivation and incentives are used.

Methodology

The method that was used in obtaining the following information included interviews with personnel within the "Quality Assurance" (QA) department in Firm A as well as access to internal confidential documents and published material. The initial scope of information gathering focused mainly, as described above, on the customer relationship and employee participation influencing aspects found in the quality movement in Firm A, but an attempt was made to branch out further in gaining a better understanding of the company's philosophies (and approaches) pertaining to quality. The intent was to concentrate on generalities from a company philosophical perspective while detailing specifics on company actions and policies.

Company Background

Firm A is a well-established international organization with roots in Japan. Since the middle 1960s the company has built its foundation of quality on what is known as the Zero Defects (ZD) Program. The advantages of producing high quality products are obvious today, but this was the vision as viewed by the organization's president some 25 years ago. To quote the president in 1964 he said, "I want to use your (management level people) energy to make Firm A into a worldwide first-class company with worldwide first-class products." Thus, the concepts and policies of the organization's quality issues revolves around the program coined as "ZD". The ZD concept was born in 1962 in a plant of Martin Marietta Corporation of Orlando, Florida for the production of American military missiles and missile launchers. In such an environment involving military supplies, extreme precision was required and improvements in product quality and reliability were of major concern.

The ZD Program was, therefore, seen by Firm A as the vehicle to achieve their business goals of obtaining international success through quality. The objective of the ZD movement is the effective approach to work in terms of quality, cost, and delivery time through the care and innovation of each individual employee to remove causes of error in his own work and to perform his work correctly the first time. With the ZD approach, an environment once operating on goal achievement at the managerial level now, in conjunction, concentrates on the goal management at all levels of the work force and most specifically those "front-line" employees.

Employee Participation

Just as it is important for Firm A to involve its upper level management in implementing practices in realizing the quality program of ZD, it has emphasized that other employee participation be established and maintained to make the

program successful. The basic organizational chart of the ZD program is given below in Figure 1. Thus, in general, the most important aspect of ZD is people. People involvement in ZD activities by being motivated, constantly challenged, well trained and highly skilled.

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                    ┌─────────────────────────┐
                    │  Steering Committee     │
                    │ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ │      ┌──────────────────┐
                    │  Advisory Committee     │      │  ZD Coordinator  │
                    └─────────────────────────┘      └──────────────────┘
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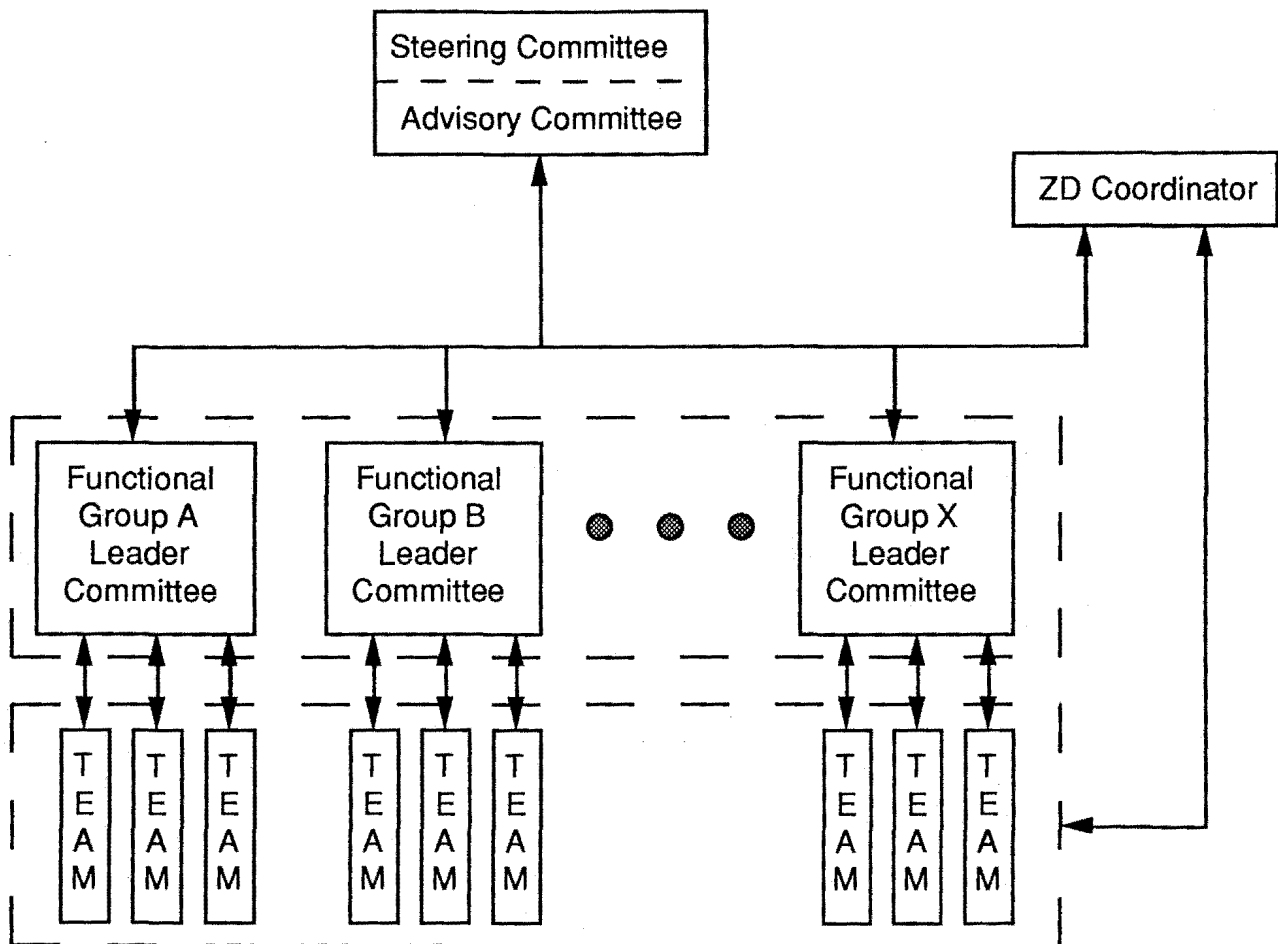
Figure 1. ZD Organizational Chart

The ZD program existing in Firm A applies a goal-oriented approach. The basic concept is to instill into each person the idea of doing the job right the first time. Though this premise may sound elementary, the effects of this concept are widespread. Such elements as improved quality, reduced cost, meeting deadlines,

improving skills and knowledge levels of the workers, and employee happiness are some characteristics that are developed in the company through the ZD movement.

What is most evident in Firm A is the commitment made by the employees in continuously implementing new ideas and approaches to the manufacturing process via group involvement. A strong sense of satisfaction and accomplishment is obtained by the employees knowing that they have an active role in the company's success. These groups are formed primarily within functional areas (but may go beyond functional areas if skills and expertise are shown in other areas) with sizes ranging from 5 to 10 people. The group members are those mainly on the front-line of the manufacturing process headed by a group leader. Some specific guidelines of the team structure are established which include items such as all employees in the manufacturing environment *should* be members of a group, team members must meet at least once a month, and time used for ZD activities must average two hours a month.

In forming groups, teams must develop a goal; a goal that drives a ZD project. Firm A published an internal document which is the Zero Defects Regulation for the program. Described in this document is that emphasis of ZD project focus must be quality and/or productivity related. Some recommended project topics include quality, cost, schedule, and performance. An example of a project on quality could be implementing a procedure to increase a component yield by 15% or from a scheduling improvement case, finding ways to reduce work order completion by 30%. Each project must be worked on for at least three months. Each team can tackle more than one project but no more than two at a time. This is an interactive program with each project in development monitored by the ZD coordinator as well as periodic (quarterly) presentations made to the advisory committee.

Obviously, not every employee possesses the same degree of self-motivation to initiate the amount of effort necessary for positive results; one of the

characteristics of human nature. Thus, in some cases it is necessary to inject external elements into the system to encourage and persuade people to make positive contributions. To deal with this situation, Firm A has implemented, as part of the ZD program, an incentive policy applying to project teams and individuals for achieving certain levels of accomplishment.

The method of motivation by project achievement is implemented through a recognition and awards approach based on a company developed point system. Points are awarded for both improvement suggestions and team projects. The points are accumulated via five categories: project approval, monthly status reports, project presentations, goal achievement, and project maintenance. More specifically, evaluation of projects are judged by logical problem solving, problem definition, teamwork, benefits, and documentation. Recognized achievement include that of team of the month, Firm A ZD Conference presentation awards, and yearly achievement awards. Various gifts and/or certificates are presented to team members such as acknowledgement in the corporate newsletter, representation of Firm A at the national ZD conference, gift certificates, etc. An added motivational factor is the possibility of representatives from award winning teams to present their concepts at Firm A's parent company's international ZD conference in Japan.

Employee Training

With participation of the employee in the ZD program of great significance and with the demand of the employee to generate new ideas, each must be skilled and knowledgeable about the working environment and the products that are being manufactured. For the continuing improvement philosophy that the ZD movement and Firm A expect, the participants must also be continuously increasing their knowledge and skills. This is where the training aspect is required. The training mission as quoted from Firm A's internal Training Regulation

document is "to create an effective learning environment in which employees can improve their full potential and apply their abilities to the benefit of Firm A." The bottom-line objective is "to improve customer satisfaction through manufacturing excellence."

Training is conducted through a formally established internal Training Department. "Course work" is available in-house to all employees. Some training course participation is required depending upon job responsibility. Many other courses can be attended upon request of the employee and approval from supervisors. In Appendix A the list of training courses offered by Firm A is given. The list of in-house courses offered by Firm A is included in this discussion to demonstrate the existence of the formal training program that is established and implemented in the company. Serious efforts are made in following through with improved employee knowledge and skill in understanding the impact they have on the manufacturing process at Firm A.

Customer Influence

The telecommunication industry is a highly regulated one. It is not enough for products to be leaving supplier premises with internal quality standards fulfilled and maintained. On the contrary, the customer has and will play a more important and significant role in shaping the product and process evaluations within the industry. However, there is one additional factor that is thrown into the equation when discussing quality standards and regulation. This factor is the "regulating body". Due to the divestiture of the Bell System, seven Regional Bell Operating Companies (RBOCs) were formed to provide telephone service. These RBOCs are the so-called customers of Firm A. The quality assurance systems are provided by this regulating body known as Bell Communications Research (Bellcore). Bellcore is the industry's recognized standards governing body that forms and dictates

equipment specifications, product criteria, and overall equipment performance. The customer relies on the "stamp of approval" that Bellcore provides as recognizing a supplier as qualified. Suppliers must adhere to these standards forged by Bellcore or else risk a high possibly of rejection from customers. In some respects, Bellcore is the representative of the customer in approving suppliers. Hence, the customer influential aspect within the telecommunication industry is a major player in developing supplier internal quality programs.

Bellcore imposes a specific approach to be followed by suppliers in obtaining "certification". This is known as Supplier Quality Management. Bellcore intervention or involvement varies with the maturity of the supplier. It could be as detailed as resident (housed on supplier premises) Bellcore representatives performing 100% inspection of equipment to the "hands-off" approach of supplier furnished data. Of course, as the supplier becomes more and more qualified, 100% inspections are unnecessary and confidence of Bellcore could grow enough to eventually only requiring test results data. Other levels of intervention from Bellcore include lot-by-lot inspection (taking a representative sample from each lot), product audits, and process audits. Each indicating different levels of conformance and maturity. Figure 2 shows the hierarchy of this progression.
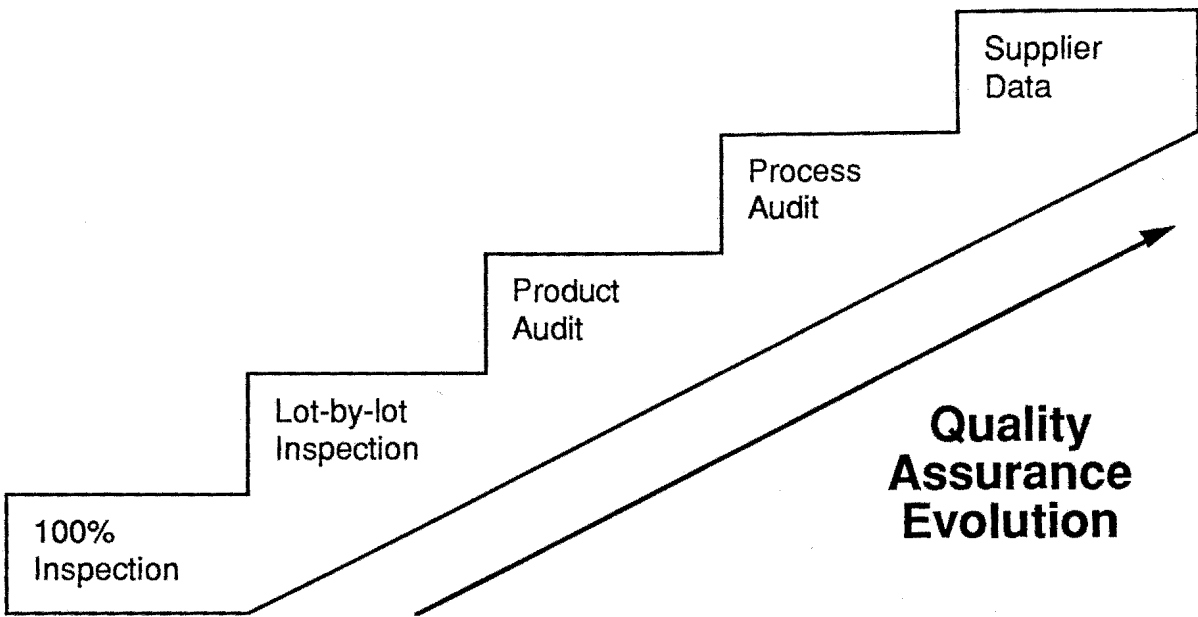
Figure 2.

Firm A is considered a mature and significant player within the telecommunication industry. In the eyes of Bellcore, Firm A has developed into a qualified vendor requiring only process audits. This is the step up from the product audits that include formulating data and performing statistical sampling of equipment performance. Product audits apply a purely defect-detection approach. Passing the product audit assures high quality product delivered to the customer (the bottom-line goal). Within the process audit phase, an in-house Bellcore representative periodically examines and evaluates specific areas of the operational aspects of the organization. For instance, process capability studies are conducted on general warehouse procedures, incoming inspection operations, document revision control aspects, and the manufacturing process. Ideally, this would include the studies involving the design department, purchasing department methods, and the like. However, currently, Firm A is not being examined in the design and purchasing

... (as well as others) due to Bellcore work loads. By evaluating the processing and procedures involved in each area, the goal of the studies is to determine how the current processes can handle change in the system. A disruption in the process could ultimately have an affect on the reliability of the equipment being produced. Events such as halting production on a unit for only six months or introducing a new product into the system could cause enough variation in a process to affect quality of product. So, the main focus is to determine how well an operation can adjust to change within the system. Where product audits are concerned with defect detection, process audits are introduced to ensure product quality by emphasizing prevention. So Firm A assists in a cooperative effort to allow Bellcore to investigate internal operations in conformance to maintaining quality standards. It is this cooperative effort at this mature phase of the quality process program that pays dividends for Firm A in obtaining approval and acceptance by the customer.

Along with participating in the Supplier Quality Management process as described above, Firm A was selected as one of four key suppliers to assist in implementing a new approach defined by Bellcore. This new approach introduced the concept of the customer-supplier relationship, Customer/Supplier Quality Process (CSQP). The belief is that, concurrent with the continuous need for the supplier to take full responsibility for their products' quality, there must develop an environment of greater cooperation between the customer and the supplier in obtaining high quality products. In the mature phase of the quality assurance evolution, as is Firm A, there is a mutual exchange of information between the buyer and supplier. In doing so, each party is establishing a long term relationship with quality as the goal.

Generic guidelines are drafted by Bellcore as either technical advisories (TAs) or technical requirements (TRs). A specific CSQP Requirements TA is introduced to suppliers as a basis from which to channel and concentrate their efforts. An

important aspect of these TAs is the fact that the generic requirements may be superseded by more specific guidelines as defined by the RBOCs. As a result, it is Firm A's responsibility to contact the customer directly to gain a complete understanding of their specific requirements, specifications, and needs.

In participating in CSQP, Firm A representatives gathered with members from two RBOCs along with Bellcore to form a Management Team. Gathering of these significant players is a major feature of CSQP, thus, requiring active participation from both the customer and suppler. From Firm A's perspective, they are required to perform a self-assessment audit on how well they conform to the CSQP criteria as defined by the TAs. After which the remaining members of the Management Team will follow-up with on-site conformance verification maintaining a continuous cooperative effort in presentations made by and discussions with Firm A. This is an important feature that the forming of the Management Team concept generates. An open two-way dialogue is established that not only allows Firm A to understand requirements and expectations of their customers, but also informs customers of the concerns Firm A is facing in fulfilling these standards. So, working as a team, Firm A and the represented customers will mutually agree upon requirements, verify proper application of products, and aim to find solutions to problems.

From this discussion, it is seen that there is vested interest from all dimensions of the telecommunications business to continuously improve the quality of products. This is accomplished greatly through the narrowing of the gaps between expectations and desired results from the customer's and Firm A's viewpoints. Both sides can come out winners in establishing a strong and long-term alliance that increases the potential of success through maintaining high quality product and process standards for equipment. What is perceived to persist as such an unorthodox approach of customer intervention as found in many consumer industries is very much commonplace within the telecommunication industry. Firm A's immediate

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and long range success hinges on its ability to adhere to and meet the quality standards developed by Bellcore and the RBOCs.

Recommendations

TQM as described from the literature research defines teamwork through cross-functional areas. This helps break down the barriers within the organization. In Firm A, the approach was specifically described that teamwork and group involvement remain within functional areas with few cases of cross-functional members within the same group project. When discussing ZD activities with some employees that are involved, there was a general concern about obtaining the necessary knowledge to contribute. Transferring of knowledge between functional groups is difficult. Thus, to improve this there must be more attention paid to this aspect of training as well as communications. Currently, it does not seem that Firm A is taking advantage of the expertise available within each functional group in collecting the knowledge base concisely to train the employees.

Another observation that we made was that Firm A did not involve the design department in ZD activities. With the TQM concept impressing total involvement of all employees at all levels and departments of the organization, Firm A may find it necessary to open channels for design engineering to assist in quality improvement. The current situation is understandable since this department was only established 4 1/2 years ago. But efforts must be made to create stronger human interrelationships throughout Firm A.

Conclusions

From the discussions and information we have obtained about Firm A's quality program, we can conclude that the philosophical approach and actual implementation of ZD activities and management's commitment to quality parallels

that of most aspects of Total Quality Management. As the concepts of TQM are presented, it is noted that theoretical approaches and techniques are not specified. Firm A has developed a quality program through its beliefs to continue quality improvement, satisfy customers, encourage overall employee participation via the ZD movement, and maintaining a well qualified and knowledgeable workforce through training. It is difficult to qualify the success of a quality management approach, but if company longevity and customer satisfaction are key measurements of success, then Firm A's concepts and practices establish a good model. Even though Firm A bases its primary quality effort by implementing ZD activities, the program can, effectively, be considered TQM. The elements of the ZD movement resemble greatly those found in describing TQM concepts.

Case 2: "Firm B"

Company Background

The company studied is incorporated in the State of Oregon and has been in business for over 40 years. Sales run between 20 and 25 million dollars annually. They are an industrial distributor and assembler of pumps, blowers and compressors. They have five branch locations throughout the Northwest, with the assembly facilities located in Portland, Oregon and Centralia, Washington.

They add a high degree of value to their products, as compared to their competitors. They buy bare components from the manufacturers they represent, and other suppliers, and design and fabricate their own semi-standard and custom assemblies in Portland, Oregon. This allows a great deal of flexibility in servicing their customers, assures high quality assemblies and deliveries consistent with requirements at the job site, and enables them to sell at competitive prices. In addition, special requirements by the customer are easily handled.

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Growth in Product Lines

With a larger technical sales and engineering staff and diminishing markets

of some products, the company has diversified into more product lines, some which they actually assemble and support through their life cycle, and others that they re-sell in engineered systems, which they support at a lower level. Since the company is committed to customer service, they have increased inventories to support these products in the field. This has also made it more complex to properly process an equipment order, especially since lower skilled individuals are actually entering orders now, and the content of those orders is increasingly complex.

In order to maintain process quality (and thus product quality), a more formal "Total Quality" program was initiated.

Initial Total Quality Program

In 1989, it became evident that internal communication problems in the processing of equipment orders were starting to effect the quality of the final product delivered to the customer. At this time, this was largely blamed on the inadequacy of the computerized information system. It also was quite evident that the company had physically out-grown the capacity of the existing computer. A cross-functional computer selection team was put together, and a major effort to write a comprehensive specification for a new system was initiated. This process became a catalyst for looking at the entire communication process and some management systems issues as well.

It should be noted that management was adamantly opposed to allowing a computer system dictate "how we run our business". It was seen as a tool to adapt to the existing system and make it more efficient. The company formal organizational system and management controls had remained essentially the same since the late 1970's, and management believed that there was no need to change them. Management also insisted that the system be so easy to operate and maintain that a full-time data processing staff would not be necessary. Also, the company did not

want completely custom software, due to the experience of incurring high costs for software updates. The fact that these requirements were in direct conflict with each other was not completely evident to management at the time.

Much work was done to "flow chart" the way information travels through the company for different types of equipment orders. It was found that most people had a different concept of how it actually occurs at the detail level. After this, the selection team discussed how the information system "should" function. The result was a "wish list" of somewhat disparate requirements, with the requirement that it all be completely "integrated". This integration was seen as the major tool to achieve the process quality improvements necessary to improve the product quality, and provide a foundation for growth.

The Need for a More Focused Total Quality Program

As an outside observer could have predicted, the above process did not initially result in an increase in quality. Also, the expectations of not changing organizational culture were not met. The survey results which are analyzed and discussed later in this paper, and the following discussion, show the result.

The computer system which was purchased required a much higher quantity and quality of information to be entered to initiate an equipment order than expected. This initial entry is called the "sales order".

According to Firm B's vice president, the sales order is the "constitution" of our business, the most critical component of the Total Quality effort to meet the mission, which is "to have no unsatisfied customer". In response to the questionnaire, other managers referred to it as the "precise contract" between the company and the customer, the "spring-board" for all future work for a customer's order, the "single most important link" between the customer and the company, and the "seminal document" that precisely defines our responsibility to the

customer. Thus, management sees the sales order as providing the dual functions of defining the relationship between the company and the customer, and initializing all transactions within the company.

This perception is accurate. In the "new system", complete and accurate entry of the sales order is sufficient to automatically produce almost all company-specific inventory, purchasing, accounting, manufacturing, and delivery instructions to meet a customer's defined needs. Of course, quality is also contingent on the proper execution of these instructions, as well as the maintenance of an accurate database. It was quickly recognized that in the integrated environment which now exists (and which was initially desired), complete and accurate sales order entry was the most critical process in the corporation. Thus, the Total Quality program focused on this process.

One might dispute the term "Total Quality Management" to refer to this type of focused program. In essence, this is true. However, in the evolution of the company's implementation of TQM, this is the most integrated, company-wide attempt to meet the company mission of satisfying every customer. One might also dispute the effectiveness of a "TQM" program which was initiated largely in a reactive mode, attempting to solve problems caused by a variety of factors. This section of the paper will attempt to discuss the effectiveness of this type of TQM approach.

Description of Focused TQM Program

The complexity and variety of the types of equipment manufactured and distributed at the company demands multiple procedures for sales order entry. These procedures were largely developed by trial-and-error by the implementation team during the first six months that the computer system was on line. Close contact was maintained between the implementation team and management

during this process, and the weekly department head meetings were largely devoted to tracking and guiding the process.

Day-to-day business was actually being conducted while the procedures were evolving. This caused a great deal of unpredicted errors and organizational stress. When the experiment was conducted, the first draft of a procedural manual, the first of its complexity, was being finalized.

Note that the original expectation of management was to have no additional permanent staff required by the new computer system. They did not foresee the extent of the link between the computerized information system and the management system, particularly staffing requirements.

In order to manage the more complex database required by the new integrated computer system, a full-time data processing manager position was created. Presently, there is a requirement of at least one half man-year needed for maintaining communications with the software vendor, answering questions, training, and hardware maintenance and troubleshooting. With this staffing level, the training needs are not being met. However, over time, management expects the communications with the software vendor to decrease.

To keep a tight reign on the quality of the sales order entry process, a full time position was created at the corporate level, and responsible individuals at each of the remote branches were identified to devote a portion of their time to sales order entry quality assurance. They were not linked by a new formal department, but might evolve into one eventually.

Two positions were added to the engineering department, one line manager and one engineering professional. The demands on engineering are due partially to the requirement for all "bills of materials", or lists of parts for manufactured assemblies, to be entered much sooner in the process than had been done before manually. Also, the level of detail required by the computer system is much higher

than the company previously required.

Purpose of Experiment

The purpose of the experiment was to determine the effectiveness of a focused TQM program in the midst of great organizational stress. The purpose for focusing on the sales order is evident from the above discussion of its role in TQM. Five years ago was chosen because the previous computer system was mature at the time, and the organization had not yet entered the last spurt of organizational growth, which includes not only the positions above, but also the addition of many degreed, young engineering and sales professionals.

Methodology of Experiment

A survey was designed to determine how company management perceived sales order quality today, as compared to five years ago. Specific questions were asked about both the accuracy and completeness of five categories of data in the sales order. The respondents were asked to give an integer factor from 1 to 5 to each category to indicate how significant of a problem it is (or was). The factors are as follows:

1. Technical – assembled equipment performance specifications
2. Inventory – individual component specifications and identifications
3. Commercial – pricing and terms of payment
4. Delivery – shipping requirements
5. Manufacturing – assembly configuration and labor requirements

The survey form is included in Appendix B.

Additionally, perceptions of overall timeliness of entry were polled. Finally, the respondents were asked to give significance factors to each of eleven contributing causes for the above problems. They were also asked to attempt to link

individual causes to the individual effects.

The authors of the survey have extensive personal experience in the sales order process, so they feel confident that the problem categories and causes are representative of the overall system quality.

Survey Results

The surveys were completed by 80 percent of those polled. The raw data is confidential. The quantitative answers for all ten categories were averaged, five for accuracy and five for completeness. Note that categories 1 through 5 relate to accuracy, while 6 through 10 relate to completeness. Data is presented in Appendix C to compare the perceived quality for the ten categories that existed five years ago to today's quality.

The authors of this survey feel that the results are negatively biased because of the timing of the survey. It was given in the midst of great organizational stress, and much criticism abounded. Also, the entire corporation was not completely finished with the computer implementation process at the time of the survey. However, the company headquarters, where all those surveyed were located, was supposed to be finished with implementation.
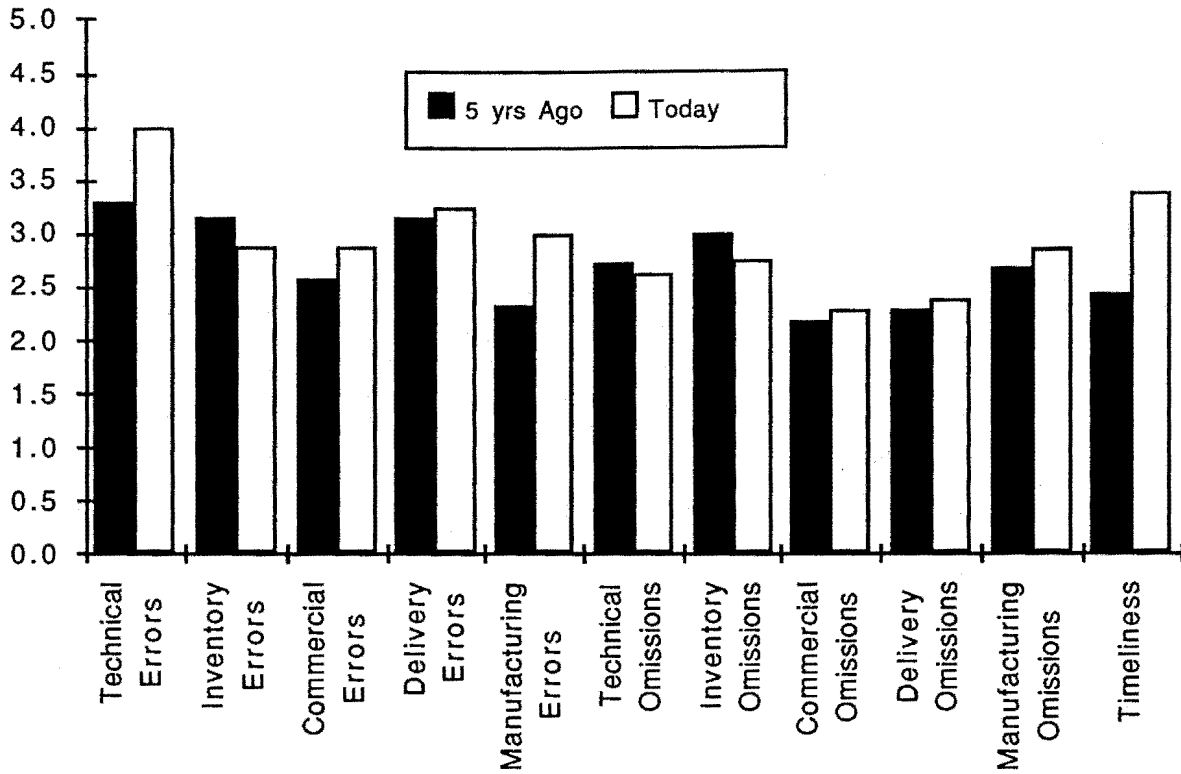
Problems Chart

Table 1. Perceived Sales Order Quality Problems

The results show that manufacturing information accuracy, technical accuracy, and timeliness problems increased the most. It also showed that inventory information accuracy and completeness problems decreased the most.
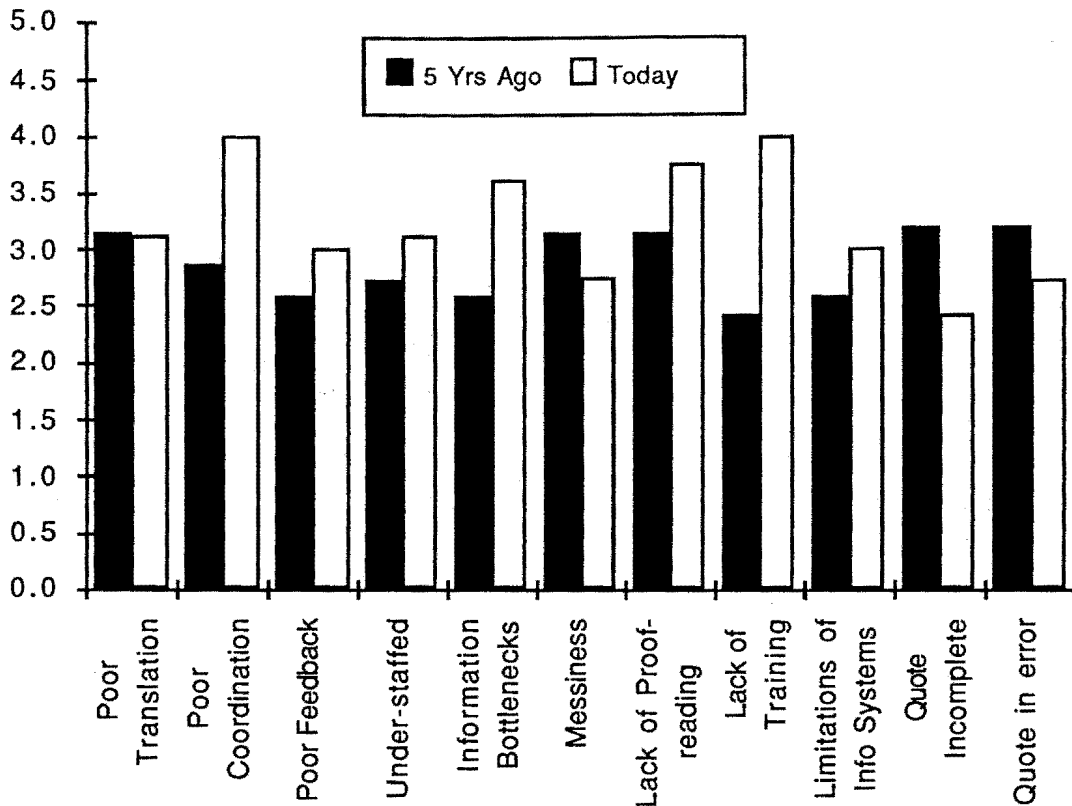
Causes Chart

Table 2. Perceived Causes of Sales Order Quality Problems

As shown above in Table 2, the causes portion of the survey showed that poor internal coordination and lack of adequate training were the causes that increased the most over the past five years. It also shows that general messiness and incomplete quotations (the document up-stream of the sales order) are less of a contributing cause to sales order quality problems now than five years ago.

Discussion

The problems and causes were grouped into broad categories. The problems are broken up into the following groups:

1. Accuracy – categories 1 - 5

2.   Completeness – categories 6 - 10

3.   Timeliness – category 11

The causes were grouped as follows:

1.   Systems Related – categories 2,3,4,5,7,8,9

2.   People Related – categories 1,5,6,7,10,11

Systems include information systems, organizational, and management systems. Note that training is considered a systems issue. People related causes are those that relate primarily to an individual's ability to produce quality work, irrespective of the systems available. Tables 3 and 4 show how these summary factors changed over the past five years.
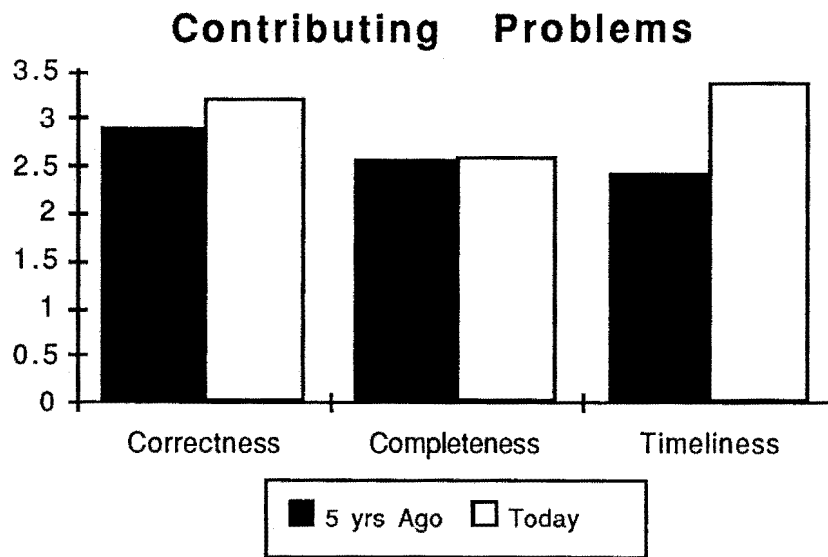
Contributing   Problems

Table 3. Sales Order Quality Issues Summary
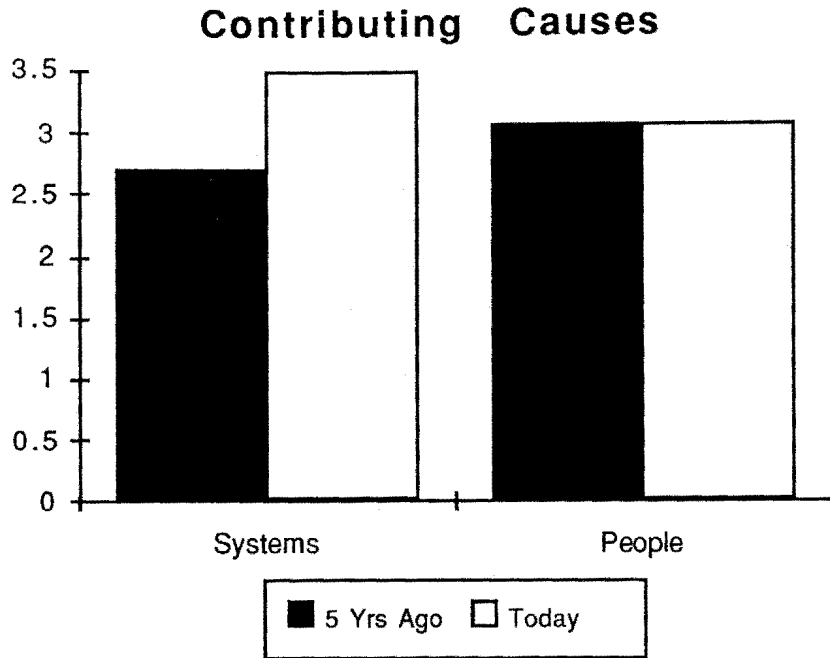
Contributing Causes

Table 4. Contributing Cause Summary

It is very clear that management perceives accuracy problems to be increasing, and that systems related causes have become much more evident over the same period of time. One could postulate that systems related issues are the primary causes of the accuracy problems encountered during this period of time. Even though the surveys do not correlate individual causes with individual problems, this generalization is accurate.

The negative bias of the survey lends the authors to believe that sales order completeness problems had probably decreased, rather than remained flat. Accuracy and timeliness problems probably still increased, but not as much as the survey indicates. The same observation holds for the increase in systems oriented problems.

The business reality was that no off-the-shelf, integrated software package was available for the job-shop/distributor/service and repair business. There are very few companies with this combination of business focuses.

emphasis and continued training in company management. No top managers really have a firm grasp on how all of the information and management systems interact, and how they relate to product quality.

The company does not have a program for continuous training, especially in the area of computer system procedures. This lack of training, as well as limited technical product training for sales order entry personnel, could be a major reason for the increase in technical inaccuracy problems.

The problems which occurred are partially a result of going into the computer implementation without a TQM program really in place. These are only partially being dealt with by the "focused" TQM program.

It should be noted that the company succeeded in many aspects of the true TQM process. Top leadership was extremely supportive throughout the "focused TQM" program, and that support continues. Employee participation is high due to the many group meetings which are held to discuss sales order quality. Communication is also very good, due to the corporate culture and example of top management.

G) Recommendations

Conduct research in similar companies that are ahead of this company in the implementation of TQM. The results from our survey revealed that all aspects of management are dynamic during the implementation. Maybe with further research we could have conducted staff forecasting in terms of training, and personnel hiring, and predict the new company's organizational structure prior to the implementation process.

Develop a program for continuous quality systems and procedures training for all information handling personnel.

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