

Total Quality Management: A Continuous Improvement Process

Introduction

In order to comprehend the need for improvement in the construction industry and to better manage our projects and construction companies, we need to look for a method to do so. Construction managers need to improve their performance. Construction costs are becoming far too high. Construction project management is more difficult than it should be. When turnaround at the end of a project becomes a gut-wrenching experience with unnecessary disputes (which must be settled) that arise due to insufficient quality or indifference to quality, settlement by negotiation, arbitration, or even litigation imposes a serious drain on the financial resources of a company and limits profit potential.

To be competitive in today's market, it is essential for construction companies to provide more consistent quality and value to their owners/customers. Now is the time to place behind us the old *adversarial* approach to managing construction work. It is time to develop better and more direct relationships with our owners/customers, to initiate more teamwork at the jobsite, and to produce better quality work.

Such goals demand that a continuous improvement (CI) process be established within the company in order to provide quality management. Ancient Greeks referred to the concept of continuous improvement as well as the Chinese. Recently CI has been referred to as Total Quality Management (TQM). Whichever name is preferred, the concept must be understood and applied to a firm's operations.

Meeting owner/customer requirements (providing customer satisfaction) is a primary objective of quality management, and contractors who are the suppliers of construction services must address owner/customer requirements if they are to succeed. The construction industry exists to provide a service to its owners/customers who are becoming more demanding and are seeking higher quality, better value, and lower costs. These owner/customer requirements mirror the economic pressures they face in their own businesses. Implementing total quality management / continuous improvement in managing everyday construction activities is relevant to all those who participate in and contribute to the construction process.

What you will learn from this article:

1. A management style that focuses on customer satisfaction, the elimination of waste, and continuous improvement
2. A method for upper management leadership to demonstrate its commitment to the new style of management with the involvement of all employees
3. An understanding of how the new style of management applies to owners, designers, prime contractors, specialty contractors, and suppliers

What is Total Quality Management?

TQM is a management philosophy, a paradigm, a continuous improvement approach to doing business through a new management model. The TQM philosophy evolved from the continuous improvement philosophy with a focus on *quality* as the main dimension of business. Under TQM, emphasizing the quality of the product or service predominates. TQM expands beyond statistical process control to embrace a wider scope of management activities of how we manage people and organizations by focusing on the entire process, not just simple measurements.

TQM is a comprehensive management system which:

- ◆ Focuses on meeting owners'/customers' needs by providing quality services at a cost that provides value to the owners/customers
- ◆ Is driven by the quest for continuous improvement in all operations
- ◆ Recognizes that everyone in the organization has owners/customers who are either internal or external
- ◆ Views an organization as an internal system with a common aim rather than as individual departments acting to maximize their own performances
- ◆ Focuses on the *way* tasks are accomplished rather than simply *what* tasks are accomplished
- ◆ Emphasizes teamwork and a high level of participation by all employees

TQM beliefs

Presented here are universal total quality management beliefs.

- ◆ Owner/customer satisfaction is the measure of quality
- ◆ Everyone has owners/customers; everyone is an owner/customer
- ◆ Quality improvement must be continuous
- ◆ Analyzing the processes used to create products and services is key to quality improvement
- ◆ Measurement, a skilled use of analytical tools, and employee involvement are critical sources of quality improvement ideas and innovations
- ◆ Sustained total quality management is not possible without active, visible, consistent, and enabling leadership by managers at all levels
- ◆ If we do not continuously improve the quality of products and services that we provide our owners/customers, someone else will

Deming's Fourteen Points

Presented below are Deming's fourteen points for total quality management.

<ul style="list-style-type: none">⇒ Create constancy of purpose for improvement of product and service. (Plan to stay in business.)⇒ Adopt the new philosophy. (Stop tolerating poor quality.)⇒ Cease dependence on inspection to achieve quality. (Improve the process.)⇒ End the practice of awarding business on the basis of price tag alone. (Seek longer-term supplier relationships; reduce the number of suppliers.)⇒ Improve constantly and forever every process in the system of planning, production, and service.⇒ Institute modern training (for everybody!).⇒ Institute modern methods of supervision. (The responsibility of foremen must be changed from sheer numbers to QUALITY.)	<ul style="list-style-type: none">⇒ Drive out fear. (Encourage employees to speak up.)⇒ Break down barriers between departments.⇒ Eliminate slogans, exhortations, and targets for the work force.⇒ Eliminate work standards that prescribe numerical quotas.⇒ Remove barriers to pride in workmanship. (Poor supervisors, poor materials, inadequate equipment, lack of training, etc.)⇒ Institute a vigorous program of education and self-improvement for everyone.⇒ Place everybody in the company to work to accomplish the transformation and create a structure in top management that will push every day on the above points.
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The Deming Theory

The Deming Theory of Management is a management philosophy based on four principles: (1) an appreciation for systems, (2) a knowledge of variation, (3) a theory of knowledge, and (4) psychology. Although the principles for continuous improvement are clearly profitable for companies to implement, why has it been difficult to transform the culture of western management to focus on quality? Deming compiled a list of seven *deadly diseases* that have inhibited change in style of management. Although Deming's Encyclopedia Britannica videotape only highlights five, the entire list is presented in figure 1.6.

<ul style="list-style-type: none">⇒ Lack of constancy of purpose to plan product and service that will have a market and keep the company in business and provide jobs.⇒ Emphasis on short-term profits: short-term thinking (just the opposite from constancy of purpose to stay in business), fed by fear of unfriendly takeover, and by push from bankers and owners for dividends.⇒ Personal review system, or evaluation of performance, merit rating, annual review, or annual appraisal, by whatever name, for people in management, the effects of which are devastating. Management by objective, on a go, no-go basis, without a method for accomplishment of the objective, is the same thing by another name. Management by fear would still be better.⇒ Mobility of management: job hopping.⇒ Use of visible figures only for management, with little or no consideration of figures that are unknown or unknowable.⇒ Excessive medical costs.⇒ Excessive costs of liability, fueled by lawyers that work on contingency fees.

Characteristics of Successful TQM Companies

The construction industry has arrived late to TQM, probably due to the tendency to easily brush aside anything in management that is new, or to dismiss TQM as a fad.

Continuous improvement is not a fad but a necessary part of management's obligation to properly run its company. Gone are the boom days when quality did not matter due to the volume of work available and the ease of obtaining work. The attitude of construction managers and contractors was simply to *add it to the bill, because the owner will pay for it*. In other words, in those boom days *Cost plus Profit equaled Price*. Now, however, the new attitude is *Price minus Cost equals Profit*. Owners are now demanding higher quality work, and at a lower cost. In attempting to keep pace with the new attitude, a quality management system that helps keep costs down is well worth implementing.

The characteristics that are common to companies that successfully implement TQM in their daily operations are listed here.

- ◆ Strive for owner/customer satisfaction and employee satisfaction
- ◆ Strive for accident-free jobsites
- ◆ Recognize that the owner/customer provides the revenue while the employees are responsible for the profit
- ◆ Recognize the need for measurement and fact-based decision making
- ◆ Arrange for employees to become involved in helping the company improve
- ◆ Train extensively
- ◆ Work hard at improving communication inside and outside the company
- ◆ Use teams of employees to improve processes
- ◆ Place a strong emphasis on the right kind of leadership, and provide supervisors with a significant amount of leadership training
- ◆ Involve subcontractors and suppliers, requiring them to adopt TQM
- ◆ Strive for **continuous** improvement

Quality principles that successful TQM companies recognize

The quality principles that successful TQM companies recognize and attempt to continually incorporate into their actions are the following:

- ◆ People will produce quality goods and services when the meaning of quality is expressed daily in their relations with their work, colleagues, and organization.
- ◆ Inspection of the *process* is as important as inspection of the *product*. Quality improvement can be achieved *by the workers closest to the process*.
- ◆ Each system with a certain degree of complexity has a *probability of variation*, which can be understood by scientific methods.
- ◆ Workers work *in* the system to improve the system; *managers work on the system to improve the system*.
- ◆ Total quality management is a strategic choice made by top management, and must be *consistently translated* into guidelines provided to the whole organization.
- ◆ Envision what you desire to be as an organization, but *start working from where you actually are*.
- ◆ Studies have indicated that people like working on a quality-managed jobsite especially due to the cleaner site and safer place to work.
- ◆ Accept the responsibility for quality. Establish datums for measurement.
- ◆ Use the principle of *get it right, the first time, every time*.
- ◆ Understand that quality is a journey, not a destination. It consists of steps that form a process that is continuous.

The goal of management is to create a culture of quality across the entire project site--*get the job done right, the first time, every time*. As in the airline industry where 99-percent quality is not

good enough, the construction industry also needs to strive for 100-percent quality. Today, the number of contractors being considered for projects by some owners is growing smaller, and only those contractors who can produce quality work are being asked to bid by these owners. Every effort to incorporate the above principles into the company's actions will further quality production.

How does a construction firm begin implementing the process?

Setting the stages

How can a construction firm begin the continuous improvement process? Outlined briefly here are the overall target stages for establishing a successful continuous improvement strategy.

Start setting goals, and start meeting the goals you have set.	Use measurements to determine how exact your goals are.
Management indicate complete commitment to Continuous Improvement (CI)	Quality can only be achieved when management gives CI a high priority and a clear need. Productivity in the construction industry is estimated to be, at best, 50 percent, with some sources placing it at 35 percent, leaving room for improvement.
Identify stages	The objectives of continuous improvement are to reduce waste, reduce costs, and increase productivity. The starting point is simple but radical. The work at any construction site can be sliced into a series of stages. The stages can begin with groundbreaking and end with completion. At each stage, a team goes to the jobsite and accomplishes its own work. When the work is completed, it can be handed over to another crew or another contractor. This chain of events can be identified as a process.
Establish responsibility	The next step is to establish responsibility for the work. If we define what each team does and establish responsibility for who is to accomplish the task, we have defined a product and an owner/customer. This is the heart of the matter with CI: to define the product and the owner/customer. Each team or crew is responsible for providing a first-class product to its owners/customers. The product must be supplied with no hassles, no concealed errors, and no botched work.
Set the datum	CI goes well beyond the concept of quality assurance. Merely relying on a quality product is not the only responsibility of management. Traditional quality assurance simply fixes the product; however, it is not enough that supervisors simply accept or reject faulty work. CI maintains that when something goes wrong, we must find the root cause of the error and correct that cause. What CI means is the setting of a datum so everyone can evaluate his or her work or product by measuring against the datum. CI then becomes everyone working together to improve the way work is actually completed.
Pre-Plan	The chain actually starts before breaking ground for the building. It actually starts with an owner/customer who wants the building. We must know what our owners/customers who are going to use the building actually want. We can do this by doing a great deal of pre-planning. The pre-planning involves creating a team that is capable of doing the project. We have to ensure that the process used to analyze job segments is in place so we can make the right decisions at the right time and that the flow of information needed to make decisions is in place. A revolutionary idea here is that even the designer can become part of the process of CI from the conceptual stage of the project.
Regard each project as part of a cycle	We can learn something from each project when we regard each project as part of a cycle.
Each worker regard himself or herself as a quality inspector of his or her task	Each worker becomes his or her own quality inspector. In efforts to increase productivity and lower costs, each worker becoming a quality inspector is vital.

Additional goals include:

Each person initiates and personally leads quality improvement projects in his or her area.	Ensure resources are available throughout the organization. Reinforce deliberate process improvement.	Integrate TQM principles into all planning. Require data-based decision making.
Establish organizational performance goals that will provide a benchmark for success.	Constantly communicate and share our vision with all levels in the organization.	Reward quality-focused behavior. Remove cold middle management.
Support teamwork not individualism.	Constantly review policies and decisions to ensure support for TQM implementation.	Lead the organization to establish an aggressive customer-focused culture.

Reasons to Begin Now

The reasons to begin establishing quality improvement processes now are several. Study the various areas below to determine which would affect your company in a positive way. It is believed that all of the following would be of great benefit. Cost reasons are discussed at the end of this section, under *What are the Benefits of TQM?*

For Management	For Employee
<ul style="list-style-type: none"> ◆ Provides an invaluable problem-solving tool for managers and supervisors to use ◆ Dispels negative attitudes ◆ Management becomes more aware of problems that affect the individual's work environment ◆ Employees gain a sense of participation ◆ Increases efficiency and productivity ◆ Reduces turnover rate, tardiness, costs, errors, and scrap & rework ◆ Improves communications within and among all departments ◆ Develops management skills that were never taught, or are long forgotten due to lack of application ◆ Develops overall company awareness and company unity ◆ Rearranges priorities which once seemed locked in place ◆ Builds loyalty to the company ◆ Reveals training requirements in all departments ◆ Lessens the number of defects received from suppliers when they are encouraged to train in quality management 	<ul style="list-style-type: none"> ◆ Provides opportunity for personal growth and development (as a result of team training activities) and the opportunity to develop and present recommendations ◆ Increases innovation (through a greater variety of approaches and perspectives) for solving problems, removing fear of failure ◆ Employees use their knowledge and skills to generate data-driven recommendations that will lead to well-informed decision-making ◆ Encourages decision-making at the most appropriate level ◆ Increases motivation and acceptance of new ideas ◆ Increases job satisfaction (as a result of the opportunity to participate in and have influence over work) ◆ Recognizes employees for their knowledge, skills, and contribution toward improvement ◆ Develops mutual respect among employees, management and customers ◆ Promotes teamwork

Reducing rework to zero is achievable: Using quality management and CI to reduce rework to nearly zero is an achievable goal. The negative cost of quality, which includes errors, delays, rework, etc., is estimated to be 30 percent of the cost of construction. This figure does not include dissatisfied owners/customers who do not come back for repeat business.

How several companies successfully implemented continuous improvement in their firms

Sample Company: As an illustration of quality management in action, one construction company procedure was enacted by establishing a daily foreman's meeting that usually lasts one hour. Although an hour may have appeared to be a long time, the company and its people believe it to be worthwhile. Every person in the company has an opportunity to relate the status of his or her task in the work cycle.

Included among the benefits from conducting this daily foreman's meeting are the elimination of conflicts between crews and crafts at jobsites, work crews not occupying the same space at the same time, and the entire working staff becoming and remaining knowledgeable about all phases and problems which exist at the jobsite. Additional benefits include improved coordination with other trades, increased problem solving, and improved morale and efforts as a result of the ability to directly air concerns.

Mechanical Contractor - \$30 TP 50m volume. A commercial and industrial mechanical contractor has started to implement TQM by forming "Process Teams" to study problem areas. The company is also using strategic planning on a company-wide basis. Some of the areas they are attacking are:

- a. Delays in the field--obtain information to reduce delays
- b. Administrative problems--Billing, accounts payable, invoicing, phones
- c. Develop partnering agreements with suppliers and vendors

Positive results were obtained in accounts payable and invoicing. Time was wasted on invoices due to errors from vendors. The results were that the contractor and vendors were paid promptly, thus improving cash flow. A supplier now warehouses safety equipment for the company.

A General Contractor with a volume of \$200M/yr. This company embarked upon the implementation of the TQM process by hiring a consultant to work with a key person in the company to start TQM. The objective of the process was to provide a more participative management-oriented company. The process is customer-driven and the company has worked hard to involve all employees. Task teams have been formed and are producing solutions to problems. The company feels that a Continuous Improvement Process has been reached. The positive result that has been obtained through TQM is that morale is much improved, helping the company to weather a declining market.

A large General Contractor - volume over \$500M/yr. This contractor is using TQM to improve quality in daily work. The contractor has 80 teams trained and functioning, and a seven-step problem solving technique to solve problems. All participants have been trained in group dynamics.

A large General Contractor with a volume of \$700M/yr. A quality circle program was initiated nine years ago and has resulted in creating a company environment that is conducive to partnering. The company's ability to conduct business using partnering has led to successful new contracts and has been responsible for turning poor jobs into profitable ones. The key to the company's successful partnering process is the utilization of an outside facilitator (a professional psychologist). The facilitator conducts preconstruction sessions on how to communicate with different personalities with varying styles of communication. Partnering has enabled them to obtain significant new amounts of work.

Wal-Mart The expansion of Wal-Mart Stores has been successfully accomplished with the application of the principles of TQM to their Design and Construction process. Wal-Mart could not have expanded with their past system that allowed change orders to average \$1.00/SF. They brought in a designer who committed to them a team of design professionals, and equipment which produce complete construction documents that are biddable and buildable. Decisions on design and construction are now made at the lowest possible level. The result is that change orders were reduced to less than \$0.12/SF.

Bechtel TQM was started in 1987 and has recently been reorganized into CCI (an acronym for Commitment to Continuous Improvement). The initiatives for their TQM process were obtained from their customers by using a simple questionnaire. They use Baldrige criteria to measure success in the CCI process. They do not seek the award, just the benefits of the process. Bechtel's facilitator has worked under the Deming philosophy for four years and has told top management that he does not want to go back to the old way of doing business. Neither do their customers or their employees.

Indianapolis Department of Public Works The Indianapolis Department of Public Works started a TQM process that was modeled after the Florida Power and Light (Qualtec) process. All department employees are involved (approximately 900 people). The process has recently been updated to meet their needs. The result of their TQM process has improved employee morale.

Motorola Motorola has a successfully working TQM process. Motorola's fundamental objective (everyone's overriding responsibility) is Total Customer Satisfaction. They have won the Baldrige award and are corporate leaders in TQM. They will tell you that implementing TQM was a sound business decision and a matter of survival for them. Similar cases are available from other large corporations. They require a working TQM process of all contractors doing work for them.

Rogers-O'Brien Construction Co. - volume of \$30M/yr. This Dallas-based contractor started a TQM process due to exposure to Texas Instruments' TQM process. Texas Instruments is their major client. Rogers-O'Brien feels that TQM has been largely responsible for reducing overall rework expenditures from approximately 7 percent to approximately 1.5 percent of construction costs.

Built-Rite The Built-Rite way is an example of labor-management cooperation using the principles of TQM. Built-Rite is managed by the Philadelphia Area Labor-Management Committee (PALM). PALM is an alliance of construction users, contractors, and building craftspersons who are committed to labor-management teamwork at the jobsite. In the past five years, over \$6 billion in construction projects has been completed without any work stoppages.

Successful companies who have received the Malcolm Baldrige National Quality award

The Malcolm Baldrige National Quality award was established by an act of Congress in 1987. In several ways, it is modeled after the Deming Prize of Japan. The award is jointly administered by the National Institute of Standards and Technology (NIST) and the American Society for Quality Control (ASQC).

The 1992 Award Criteria stipulate that awards are presented annually to recognize those US companies that excel in quality management and quality achievement. Up to two awards may be presented in each of three eligibility categories of manufacturing companies, service companies, and small business firms.

Past award recipients are

1991	Marlow Industries Solectron Corporation Zytec Corporation	1989	Milliken & Company Xerox Business Products and Systems
1990	Cadillac Motor Car Company IBM Rochester Federal Express Corporation Wallace Co., Inc.	1988	Globe Metallurgical Inc. Motorola, Inc. Commercial Nuclear Fuel Division of Westinghouse Electric Corp.

The Pitfalls Successful TQM Companies Must Avoid

The transformation to quality is not without its pitfalls. Many companies have started on the road to quality but failed to achieve success due to several factors:

- ◆ Lack of top management support.
- ◆ Lack of middle management support.
- ◆ Commitment in only one department.
- ◆ Short-term commitment - failure to stay on course.
- ◆ Haphazard approach - a little of this and that with no meaningful change in the system.
- ◆ Failure to acquire the services of a competent statistician or to provide statistical training for employees.
- ◆ Measure success and guide program on the basis of short-term profits.
- ◆ Failure to solicit worker input.
- ◆ Over dependence on computerized quality control.
- ◆ Funding failure - lack of funds to make meaningful changes in the system (i.e., new machinery, training, improved raw materials).
- ◆ No market research. Not knowing what the requirements are.
- ◆ no testing of incoming materials - garbage in - garbage out.
- ◆ Overselling hourly workers - expecting instant pudding.
- ◆ Adversarial management (management by fear).

However, with total commitment and constancy of purpose, these hazards can be overcome.

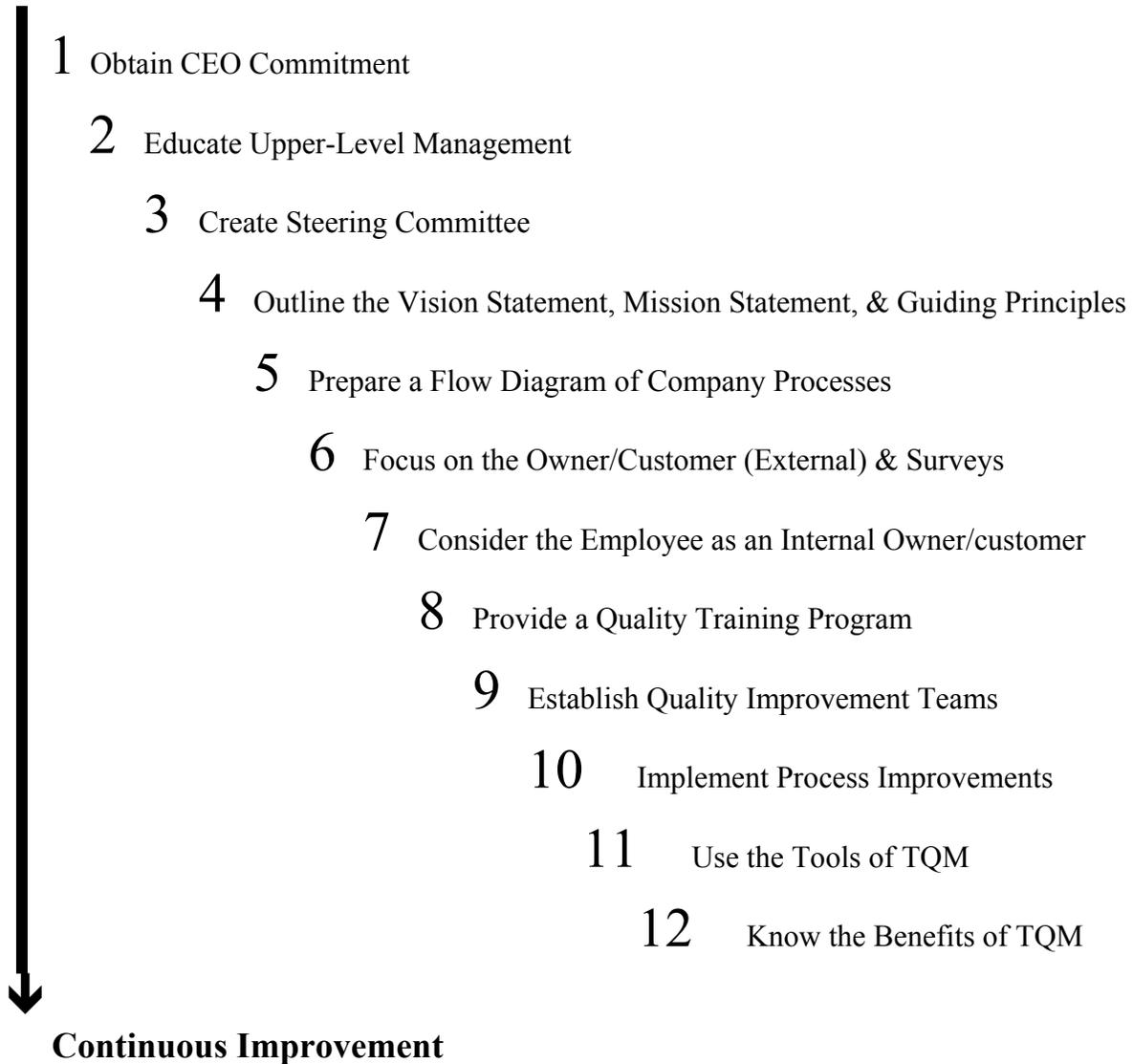
Misconceptions regarding the implementation of the continuous improvement process

Common misconceptions which appear at the beginning of the following paragraphs are discussed.

- ◆ *Every site is different* -- A common mistaken notion about TQM is that it does not readily apply to construction *because every site is different*, and that *construction is a one-time-only industry*. This notion is not true, because the plain fact is that wherever you work, the processes are the same, and so are the methods and techniques.
- ◆ *Errors and delays are different* -- Some maintain that errors and delays can be controlled on a large job [versus a small job]; however, this is not true. Errors and delays are the same on large and small projects, and they have the same negative effects. One example involves a concrete project with the improper placement of anchor bolts. Improper placement of anchor bolts results in a delay in erecting the structural steel. Someone has to pay for this delay that will affect everyone at the jobsite, whether it is a large jobsite or a small jobsite.
- ◆ *It is a typical jobsite problem* -- One might be tempted to say that the delay in the above example is *no big deal, that it is a typical jobsite problem*, but that is precisely the point: Typical problems must be eradicated at jobsites.
- ◆ *It costs too much* -- The cost of implementing quality results from (1) training and (2) the cost associated with transforming a company into the quality mode to follow common ideas and goals. The profits incurred for implementing a continuous improvement process far outweigh the profits gained while not using a continuous improvement process.

It's time to *get started* on Continuous Improvement.
Your competitors may have already started.

Steps in implementing TQM



1 Obtain CEO Commitment, and

2 Educate Upper-Level Management

The first and second steps are . . .

The first step in implementing TQM is to obtain the total commitment, involvement, and leadership of the CEO and upper-level management.

The second step is to teach the CEO and upper-level management how to conduct the following:

- ◆ Undergo quality training
- ◆ Commit to TQM and provide the necessary resources of time and money to permit improvement
- ◆ Assist in the development of the corporate vision statement, mission statement, guiding principles, and objectives
- ◆ Serve as a model of expected behavior
- ◆ Actively lead the way by participating in the activities of the quality steering committee and company training
- ◆ Drive fear out of the organization
- ◆ Provide suitable recognition for those who contribute to the quality mission
- ◆ Drive decision making and problem resolution to the lowest practicable level

CEO and senior management roles are . . .

The roles of the CEO and Senior Management Team are to create an organizational culture in which TQM can exist and flourish. An excellent culture that management can create for TQM to exist and flourish contains the eight cultural elements indicated in the figure below.

Element Number	Cultural Elements Required for TQM
1	Quality information must be used for improvement, not to judge or control people.
2	Authority must be equal to responsibility.
3	There must be rewards for results.
4	Cooperation, not competition, must be the basis for working together.
5	Employees must have secure jobs.
6	There must be a climate of fairness.
7	Compensation should be equitable.
8	Employees should have an ownership stake.

Total Quality Management, by Marshall Sashkin and Kenneth J. Kiser, 1991, Ducochon Press.

3 Create a Steering Committee

Upon completion of upper management's commitment and training, a steering committee must be created to guide the company through the process of implementing TQM. The role of the steering committee and the processes the committee follows are listed here.

Steering committee roles are . . .

- ◆ Review and evaluate customer surveys.
- ◆ Determine processes to be improved, based on customer and employee recommendations, surveys, and a knowledge of existing problems.
- ◆ Appoint task process improvement teams and ensure they receive proper training.
- ◆ Monitor process improvement.
- ◆ Oversee employee recognition for quality improvement.
- ◆ Communicate successes and progress.

The steering committee handles a problem by . . .

1. Problem is brought to the attention of the steering committee
2. Steering committee forms a team to examine the process and make necessary recommendations for improvement
3. Team meets, reviews its mission, and determines how often it will meet. The problem is assigned to the team following the procedures outlined in #10, The Structure Approach to Process Improvement.

4 Outline the Vision Statement, Mission Statement, & Guiding Principles

Establishing guiding principles

In developing the fourth step, important principles to consider including in the company's vision statement, mission statement, and guiding principles are as follows:

- ◆ Owner/customer Satisfaction
- ◆ Improved Safety
- ◆ Elimination of errors and defects
- ◆ Doing things right, the first time
- ◆ Reputation as the best in the field
- ◆ Continuous Improvement
- ◆ Employee Empowerment

Below are sample statements and principles.

Sample Vision Statements

Heartland Professional Construction Services, Lansing, Michigan

To revolutionize the construction industry by achieving new standards of quality and productivity that are significantly above current industry standards.

Brown + Root

We will consider ourselves successful when we are the preferred provider of project services and the favored employer in our industry, and when all of our businesses produce financial results superior to those of their leading competitors.

Sample Mission Statements

The Walbridge Aldinger Company, Detroit, Michigan

We are in the business of providing the best construction-related services that exceed our customers' expectations. This will be achieved through the commitment of a responsive team of experienced professionals.

Sample Guiding Principles

Walbridge Aldinger's Quality Objectives:

- ◆ Provide a logical structure for continuous improvement.
- ◆ Exceed both internal and external owner/customer expectations.
- ◆ Stimulate environment for change.
- ◆ Utilize Quality Improvement Tools to change the results of our actions for the benefit of our owners/customers, employees, and communities.
- ◆ Understand process thinking and value adding.
- ◆ Focus on the process to achieve results.
- ◆ Focus on prevention, not inspection.
- ◆ Secure total employee involvement.
- ◆ Commit a cultural change, beginning with management.

Pepper Construction Company, Chicago, Illinois

Pepper Values

- ◆ **Total Client Service:** Pepper is committed to total client satisfaction.
- ◆ **Skill, Integrity, Quality, and Responsibility:** Pepper is dedicated to maintaining the highest level of skill, integrity, quality, and responsibility in providing professional services to its clients.
- ◆ **People:** Pepper recognizes that the quality of its people is the critical element in achieving its mission. Pepper is committed to the growth and empowerment of its people and to human resources practices based on standards of excellence, fair treatment, and equal opportunity.
- ◆ **Leadership:** Pepper is committed to providing strong leadership to its industry and to the communities in which it does business.
- ◆ **A Fair Profit:** Pepper is in business to receive a profit for its services. Profit objectives are established at fair levels and must be met for the company to continue to exist and serve the needs of its clients and employees.

Defining the meaning of quality

What does one mean when one uses the word *quality*? If you can ask 12 people in an organization what the word quality means, and you receive 12 different answers, then quality management, CI, TQM, *right the first time*, *zero defects*, and *defect free* are only serving as buzzwords within the organization. Quality is only useful and of value when it means the same thing to all the people in an organization. Belief in too many ways to achieve quality can cause serious problems. Quality must consist of well-defined objectives, so that quality means the same to all in the organization.

In defining TQM for construction firms, we could choose the definition: *TQM means keeping the company running smoothly with continuous input from our owners/customers*. In choosing this definition, we accept that the idea is owner-driven and that owners want a new deal from the construction industry. Each job starts out on a new, clean sheet of paper--we build each project on that new sheet of paper to meet the needs of the owner. With each new job and new set of people, we continually carry on the continuous improvement on the new, clean sheet of paper. In addition, the further goal is to make each project or job better than its predecessor.

Owners are under competitive pressure and have endured periods of downsizing, cost-cutting, and quality improvement to become efficiently competitive. Owners view construction as an industry that has been resistant to change and have labeled it as simply non-competitive.

5 Prepare a Flow Diagram of Company Processes

A mechanical contracting firm created the TQM flow diagram illustrated in the figure below to implement quality processes within the company.

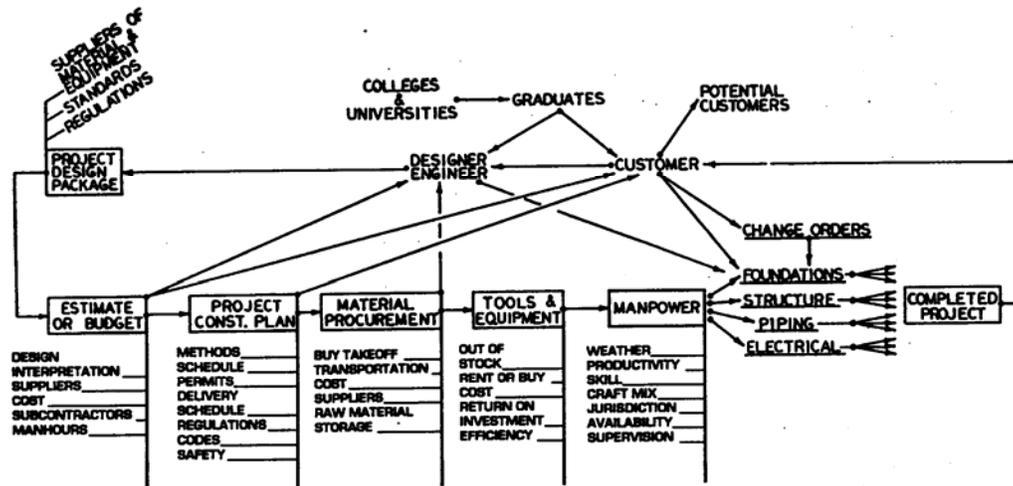


Figure 1.9. Construction service viewed as a system.

6 Focus on the Owner/Customer (External) & Surveys

Focusing on a customer's concerns

Still one of the best ways of accomplishing quality improvement is obtained by focusing on customers' concerns, and by learning what those concerns are through owner/customer surveys. Much can be provided by studying how your owner/customer feels about your service, your attitude, and whether you would be recommended to another owner/customer. Several areas to survey, and to take care to provide or honor, are listed here.

- Safe operating procedures
- Accident experience
- Attitude
- Professional competence of the project manager, superintendent, and project engineers
- Technical competence of the work force
- Overall responsiveness to owner/customer requests
- Degree of communications
- Planning
- Administrative procedures
- Appearance and conduct of the work force
- Condition of equipment
- Coordination and supervision of subcontractors
- Appearance of the jobsite
- Timeliness

The six principal elements of owner/customer satisfaction are:

- Your product/service delivery system
- Your product/service performance
- The general image of your company
- Your people's level of performance
- The perceived price-value relationship of your product/service
- Your competitors' strengths and weaknesses

Surveying the customer

Successful TQM companies have asked their owner/customers the following questions.

1. How well do we deliver what we promise?
2. How often do we do things right the first time?
3. How often do we do things right on time?
4. How quickly do we respond to your request?
5. How accessible are we when you need to contact us?
6. How helpful and polite are we?
7. How well do we speak your language?
8. How well do we listen to you?
9. How hard do you think we work at keeping you a satisfied owner/customer?
10. How much confidence do you have in our products or services?
11. How well do we understand and try to meet your special request?
12. Overall, how would you rate the appearance of our facilities, products, communications, and people?
13. Can you list any specific instances where we have fallen down?
14. Overall, how would you rate the quality of our service?
15. What could we do to improve our service to you?
16. Overall, how would you rate the quality of service provided by our competitor?
17. How willing would you be to recommend us?
18. How willing would you be to buy from us again?
19. Are we doing or not doing anything that bugs you?
20. What do you like best about what we do?
21. What parts of our service are most important for you?
22. What parts of our service are least important to you?

Many of these questions are from LeBouf's, *How to Win Owners/Customers and Keep Them for Life*.

7 Consider the Employee as an Internal Owner/Customer

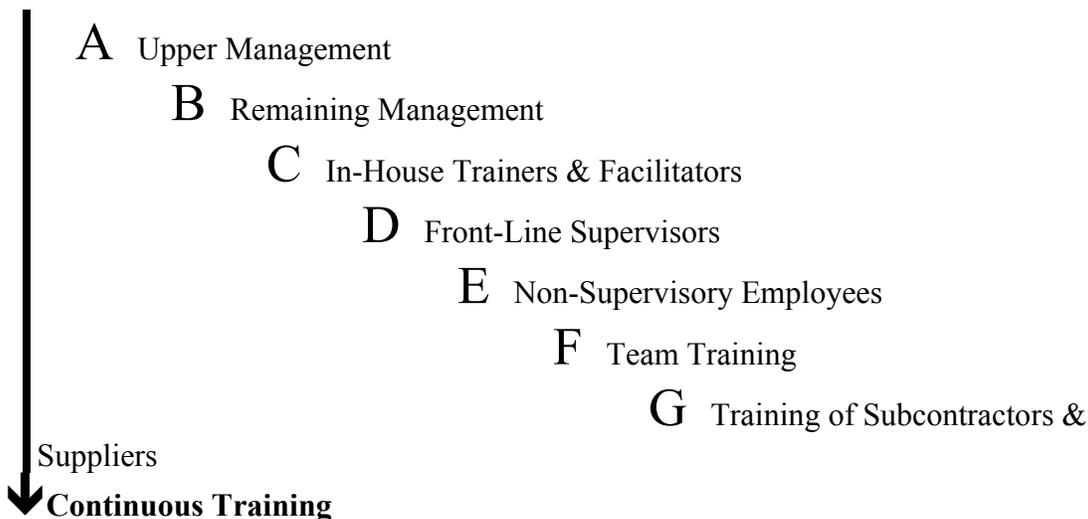
In order to conduct an analysis of the internal processes within the company, the following steps should be applied to the internal processes within a company.

- ◆ List several of your internal owners/customers within your company
- ◆ Choose one of these owners/customers to focus on for the application of this technique
- ◆ Determine the *Outputs* (products, services, information) that must be provided to this internal owner/customer
- ◆ Determine the work *Processes* your company uses to produce these *Outputs*
- ◆ Learn how your customer's expectations are met and how satisfaction is measured

8 Provide a Quality Training Program

Which employees are trained first?

The successful TQM company provides training to employees in the order illustrated in the figure below. The training program must begin with upper management, then training must be provided for the remaining management, and the in-house trainers and facilitators. It cannot be emphasized enough that if upper management is not trained and is not a viable, visible participant from the beginning, then the program will not survive.



To train employees in the order presented above, the following is recommended.

Areas of Training	Topics to cover
A, B, C Management Training	<p>Cover basic <i>awareness</i> topics such as understanding quality, the importance of owner/customer satisfaction, definitions, historical background, principles of the gurus (Deming, Crosby, Juran, Ishikawa), overview of TQM, benefits of TQM</p> <p>Cost of quality: Identifying It and Tracking It</p> <p>The role of management</p> <p>Changing leadership styles in a TQM environment; internal owner/customer concept</p>

	<p>Steps in implementing TQM</p> <p>Structure needed, i.e., steering committee, process improvement teams, facilitator(s), trainer(s), possibly a corporate coordinator</p> <p>Principles of team building</p> <p>Formalized process improvement</p> <ul style="list-style-type: none"> understanding variation measurement what, why, how the seven tools of quality quality improvement teams <p>Owner/customer and employee surveys</p> <p>Employee empowerment</p> <p>Malcolm Baldrige Award criteria</p>
<p>D</p> <p>Front-Line Supervision Training</p>	<p>Need for quality, some definitions, overview of TQM, i.e., the ten elements or their equivalent, benefits of TQM</p> <p>Company vision, mission, guiding principles</p> <p>Company-planned steps for implementing TQM</p> <p>Cost of quality: Identifying It and Tracking It</p> <p>Changing leadership styles in a TQM environment, employee empowerment, the role of the front-line supervisor</p> <p>Overview of formalized process improvement, role of the steering committee, process improvement teams, facilitators</p>
<p>E</p> <p>Training of Non-Supervisory Employees</p>	<p>Need for quality, some definitions, overview of TQM, i.e., the ten elements or their equivalent, benefits of TQM</p> <p>Company vision, mission, guiding principles</p> <p>Company-planned steps for implementing TQM</p> <p>Treating others as owners/customers</p> <p>Employee involvement</p>
<p>F</p> <p>Team Training</p>	<p>How to operate as a team</p> <p>Team-building exercises</p> <p>Brainstorming</p> <p>Understanding variation</p> <p>Process improvement procedure</p> <p>Seven tools of quality</p> <p>Reaching consensus</p> <p>Improvement exercise using actual company process</p>
<p>G</p> <p>Training of Subcontractors and Suppliers</p>	<p>Subcontractors and suppliers conduct in-house training.</p>

How are management and other employees trained?

In order to implement the training mentioned above, the following process should be undertaken:

1. Select a consultant, community college, or other training
2. Train management
3. Select trainer, facilitator
4. Send trainer, facilitator to training
5. Trainer trains front-line supervisors
6. Trainer trains remaining employees
7. Establish a training committee
8. Orient short-term hires and new employees
9. Facilitator or trainer provides team training
10. Establish long-term, continuing program for training in quality management, leadership, communication, technical skills
11. Evaluate all training
12. Improve training

9 Establish quality improvement teams

Quality improvement teams focus on . . .

In establishing quality improvement teams, a smaller company might assign one quality improvement team. Larger firms might assign several, possibly with one quality lead team as a guide for the other teams. Areas where quality improvement teams could begin investigating for possible improvement are:

- ◆ Increased Employee Value
- ◆ Informed Employees
- ◆ Technical Training
- ◆ Quality Training
- ◆ Employee Suggestions
- ◆ Employee Participation
- ◆ Higher Quality of Artistry
- ◆ Personal Development

Good QIT member qualities are . . .

Representatives who are selected to be quality-lead team members should possess the following attributes:

- ◆ commitment to quality, customer satisfaction, and the success of the organization
- ◆ good communication and interpersonal skills
- ◆ a “big picture” view of the organization and of the industry
- ◆ a strong commitment to learning and change
- ◆ representation of a different area and level of the organization
- ◆ good organizational skills

Quality improvement team tasks are . . .

Quality improvement teams are active in the following task areas:

- ◆ Identify the customers of the process
- ◆ Determine customer expectations
- ◆ Flowchart the process
- ◆ Identify all of the inputs and interfaces
- ◆ Identify the output(s)
- ◆ Systematically review the procedures currently being used in the process
- ◆ Collect and analyze available quantitative data
- ◆ Determine the need for additional data
- ◆ Identify the problem(s)
- ◆ Determine the root cause of the problem
- ◆ Determine potential solutions
- ◆ Select a trial solution
- ◆ Present recommendations to the steering committee
- ◆ Implement the solution on a pilot-project basis
- ◆ Analyze the data to discern if there has been improvement
- ◆ The quality improvement team (QIT) is responsible for planning and managing the TQM implementation process for the organization. The QIT is responsible for **making TQM happen**.
- ◆ The QIT must take the lead in managing the cultural changes that TQM will require.
- ◆ At least one member of the Senior Management Team (SMT) should be a member of the QIT.
- ◆ The QIT reports to the Chief Executive Officer (CEO) and the SMT.
- ◆ The QIT and SMT should hold a joint meeting to review the TQM effort at least quarterly.

Quality improvement team structure is . . .

A quality improvement team (QIT) meets on a regular basis. During the first months of the TQM effort, the QIT will probably wish to meet once per week for 3 to 5 hours. In addition, QIT members will spend an additional 6 to 10 hours per week on training, education, and QIT assignments. After the TQM implementation plan is complete and underway, the QIT should meet once or twice per month.

The QIT determines and defines the duties of each QIT member. Typical positions for members are TQM Director or Coordinator; Communications, Education, and Training Coordinator; Quality Measurement; Customer Satisfaction; and Employee Involvement and Satisfaction. The types of quality improvement teams are permanent, temporary, preparation, planning, and implementation. Facilitators hold an extremely important role in the success of implementation.

In the order presented here, the QIT plans the ongoing TQM education for: (1) QIT and SMT members, (2) facilitators and supervisors, and (3) all employees.

The QIT reviews, approves and helps implement quality improvement plans, establishes the TQM organizational structure and team structure for the company, procures (from management) and manages the resources required for TQM implementation, solicits and evaluates Quality Improvement Opportunities (QIOs), selects and commissions teams to work on QIOs, and proffers rewards and recognition.

The permanent teams of the quality improvement process are based on the following areas of concern:

- ◆ Key Objective Teams
 - Customer Satisfaction
 - Employee Morale/Satisfaction
 - Stakeholder Relationships
- ◆ Functional Area QI Teams
- ◆ Employee Involvement Teams
- ◆ Natural Work Teams

The temporary teams of the quality improvement process are:

- ◆ Task Force QITs
- ◆ Project Quality Teams

The facilitators of the quality improvement process should retain the following characteristics:

Qualities of a good facilitator:

- Is respected by people at all levels of the organization
- Is organized
- Is a good listener and communicator
- Understands TQM principles and philosophies
- Is objective and open-minded
- Is a team player, one who likes to accomplish things through others

Roles and duties

- Organizes team meetings
- Keeps meetings on track
- Is record keeper
- Procures needed resources and outside support
- Communicates progress to QIT

Quality improvement teams address these special needs . . .

The principal items that quality improvement teams should address are discussed here. Note that the items can be added or deleted as necessary, and are not listed in a particular order.

TIME	All participants, from the members to the steering committee, need time to prepare and participate in these team activities.
LOCATION	Consideration must be planned for where the meetings will be held, and where members can prepare for these meetings. It should be a quiet area away from the work station.
SCHEDULE	Meetings should be on a regular schedule and, if missed, then rescheduled within three working days for the sake of continuity and to show the importance of these meetings.
STEERING COMMITTEE	It must oversee and nurture, not drive, the program. An analogy to this is how do you bring up your children to be confident, respected and healthy, and to eventually become independent and make wise decisions.
UNIONS	Get union members involved at the outset of a program. Ask them to be participants in the steering committee.
PATIENCE	This is a long-range program and results come slowly. Patience must be exercised continually.
VOLUNTEER	This is highly important. Members must want to join or depart from teams freely.
ADVERTISE	Be consistent in the mode of advertising activities. Think it out before implementing it to avoid a paper mill trap. Get all company employees educated about teams - not a select few.

TRACKING	Some form of tracking is required but can become another paper mill which consumes too much time. Serious consideration for minimizing paperwork must be given at the outset of your program and modified as required.
TRUST	Lack of it, by management, will demotivate teams quicker than anything. Likewise, the team members must trust those involved in the program not to steal their problems or solutions.
LOYALTY	It can be secured if properly nurtured. Obtaining this must be a goal of management.
TRAINING	This is so basic, but can delay a successful program needlessly by lack of a good, practical training program. Every attempt must be made to follow the training program, at all levels, once it has been documented and approved.

10 Implement Process Improvements

- ◆ Management interest and support
- ◆ Focus on customer satisfaction
- ◆ Identification of areas needing improvement
- ◆ Employee involvement
- ◆ Cooperative attitude between elements of the company
- ◆ Viewing every person who is on the receiving end of a process as a customer
- ◆ Fear driven from the company
- ◆ Correctly composed teams
- ◆ A system for selecting processes to be improved
- ◆ Training for all employees in quality awareness
- ◆ Training for teams in team procedures and disciplined problem solving
- ◆ Improved communications outside the company

The structure approach to process improvement

1. Problem is brought to the attention of the steering committee
2. Steering committee forms a team to examine the process and make necessary recommendations for improvement
3. Team meets, reviews its mission, and determines how often it will meet
4. Training is initiated for team members
5. Team meets weekly for an hour or two to analyze the problem and develop a solution
6. Solution is initiated on a pilot basis
7. Results of pilot study are examined
8. Solution is implemented company-wide

Process Improvement

Suggested areas where quality improvement could begin are presented below.

Administrative	Project Management and Engineering	Logistical	Construction
<ul style="list-style-type: none"> ◆ Payroll ◆ Invoices ◆ Personnel actions ◆ Investments ◆ Insurance ◆ Marketing ◆ Training (safety, quality, technical) 	<ul style="list-style-type: none"> ◆ Subcontracts ◆ Partial payment requests ◆ Progress review meetings ◆ Estimating ◆ Scheduling ◆ Interfacing with architect/engineer ◆ Shop drawing review ◆ Survey and layout ◆ Testing 	<ul style="list-style-type: none"> ◆ Storage ◆ Warehousing ◆ Delivery ◆ Maintenance 	<ul style="list-style-type: none"> ◆ Layout ◆ Rough grading ◆ Forming ◆ Placing concrete ◆ Placing reinforcing ◆ Erecting precast panels ◆ Framing drywall ◆ Pulling electrical cable ◆ Hanging ductwork

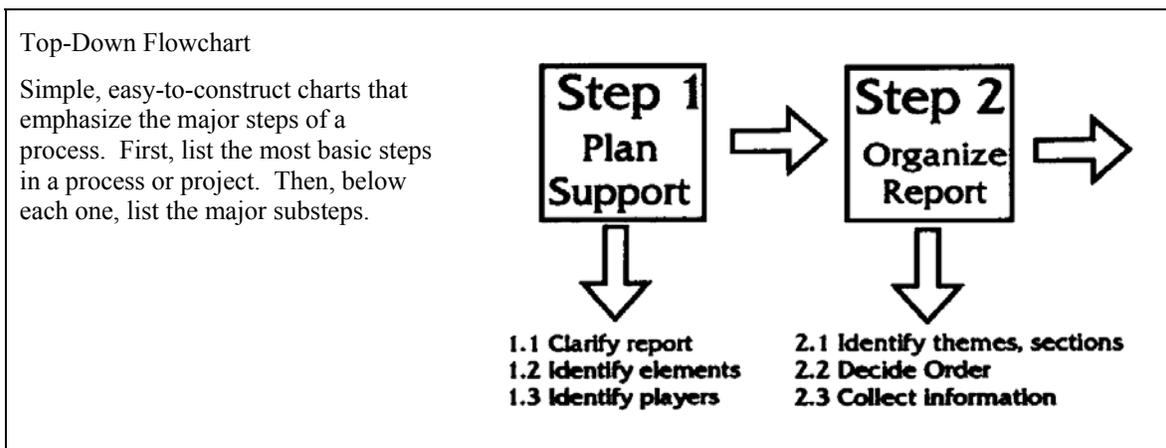
11 Use the Tools of TQM

Seven *classical* tools of quality and process improvement, plus one, are presented below.

Tool	Use
Flowchart	Portrays all the steps in a process. Helps understand the process.
Cause and Effect Diagram	Portrays possible causes of a process problem. Helps determine root cause.
Control Chart	Shows if a process has too much variation.
Histogram	Portrays the frequency of occurrence.
Check Sheet	Tabulates frequency of occurrence.
Pareto Diagram	Visually portrays problems and causes in order of severity or frequency. Helps determine which problem or cause to tackle first.
Scatter Diagram	Helps determine if two variables are related.
Run Chart	Shows variation and trends with time. Provides baseline data, and helps to determine if a process is improving or not.

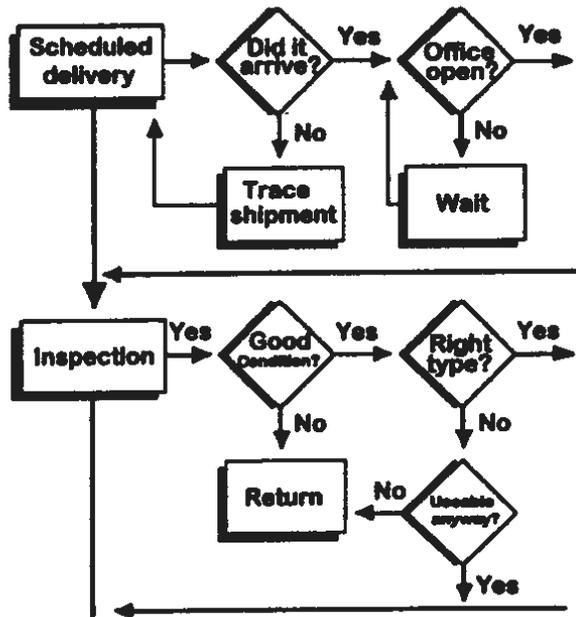
Presented here is an alphabetical listing of several quality improvement tools, followed by a presentation of a few sample charts and diagrams.

Activity network diagram	Force field analysis	Process capability analysis
Affinity diagram	Histograms	Process decision program chart
Benchmarking	Is/Is-Not analysis	Productivity charting
Brainstorming	Interrelationship Diagram	Quality function deployment
Checksheets	Interviews: Employee, Customer, Stakeholder	Regression analysis
Control charts: statistical process control (SPC)	Matrix diagram	Root-cause evaluation matrix
Cost-Benefit analysis	Motivating technique	Run chart
Cost of quality analysis	Nominal group technique	Sampling
Cause-and-effect diagrams	Operational definitions	Scatter diagrams
Customer surveys	Pareto charts	Solution-selection matrix
Dot plot	Pie chart	Stakeholder surveys
Employee surveys	Plus - Delta	Stratification
Fishbone diagram	Prioritization matrices	Time plots
Flowcharts		Tree diagram
Focus group interviews		Value engineering



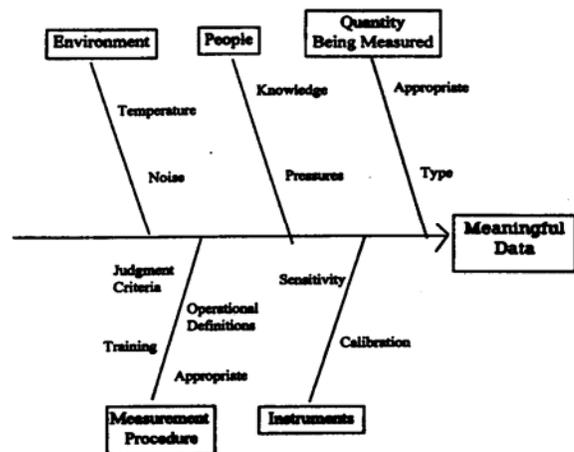
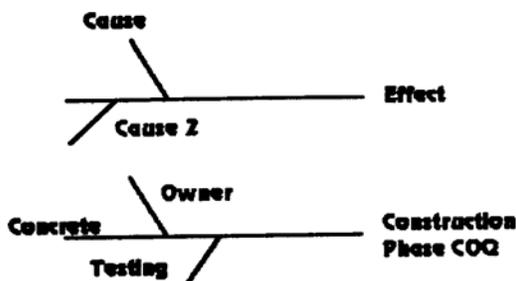
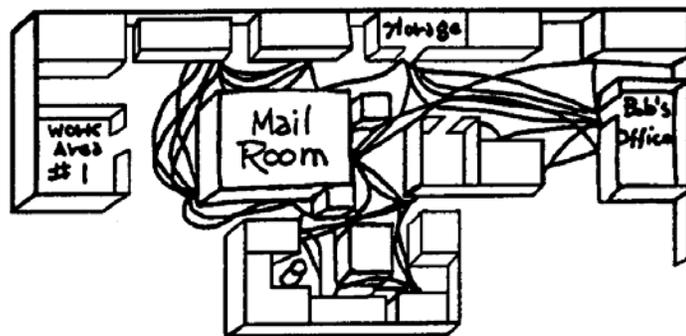
Detailed Flowchart

Describe most or all of the steps in a process, with varying levels of detail. When needed, have the team as a whole develop a top-down version, then have smaller groups add levels of detail.



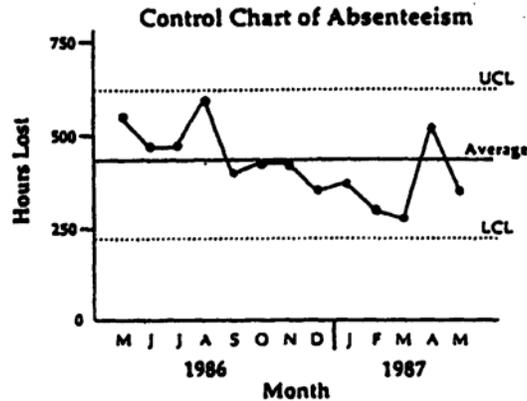
Work Flow Diagram

Show the movement of materials, people, or information within any space. It is created by tracing these movements on a sketch of the floor plan or some similar map of the workspace (or document).

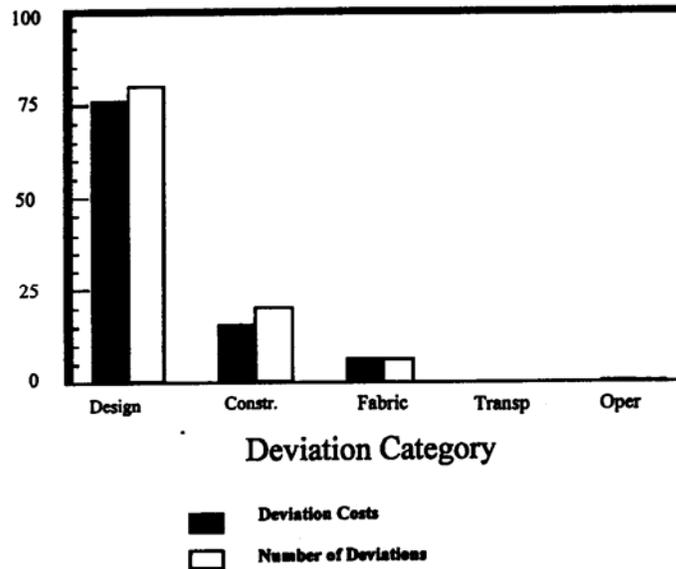


Fishbone cause and effect diagrams.

Control charts are time plots that also indicate the range of variation built into the system. They are used to monitor a process to see whether it is in statistical control.



A histogram is a bar graph of a frequency distribution in which the widths of the bars are proportional to the classes into which the variable has been divided and the heights of the bars are proportional to the class frequencies.



Checksheets are structured forms that make it easy to record and analyze data. The best checksheets are simple to use, make use of your operational definitions, and visually display the data to reveal underlying patterns.

Date _____

Shift _____

(Place a check where you observe carton damage.)

Process Step
(check one)

warehouse

mfg/assembly

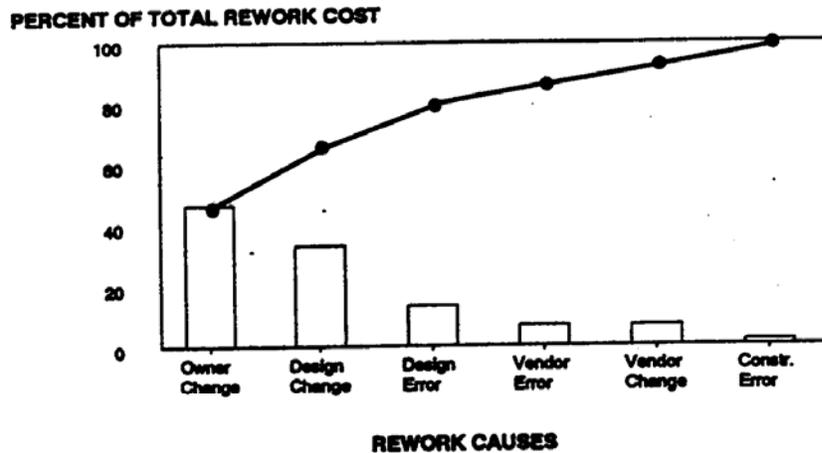
packaging

storage

shipping

PARETO DIAGRAMS graphically illustrate the relationship of two variables such as *rework causes* versus *percent of total rework cost* (for each cause), with the cause of rework averaging the largest percent and being placed first on the graph (nearest the Y axis), the second most cause being placed second, and so forth. Then, a line is drawn showing the accumulated effect as one moves from the left to the right.

In this PARETO DIAGRAM, *owner changes* caused the greatest impact (45%), and *design change* caused the second greatest impact (30%), with the cumulative effect of both being 75%, and so forth.



PARETO CHARTS focus improvement efforts by ranking problems or their causes. A PARETO CHART is a series of bars whose heights reflect the frequency or impact of problems. The bars are arranged from left to right in descending order of height, so that the most frequent or severe problems will always appear on the left side of the chart.

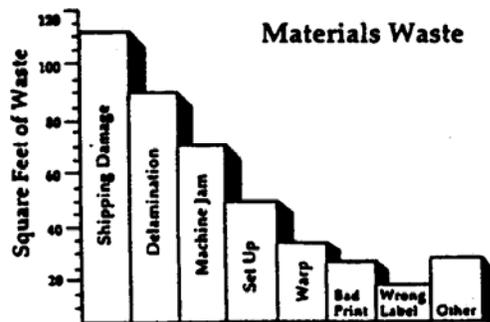


Figure 17: Examples of Pareto Analysis

12 What are the benefits of TQM?

The cost of quality

Why do we implement the above information into our companies? To make more money and/or to stay in business. If you don't implement TQM/CI, it will cost your firm money. It's management's choice to obtain these improvements. Failure to implement quality processes results in a status quo situation where unnecessary costs remain and improvements are not implemented. Noted here are the costs of nonconformance.

$$\text{Cost of Quality} = \text{Cost of Nonconformance} + \text{Cost Prevention}$$

<p>The Cost of nonconformance</p> <p>Accidents</p> <p>Omissions</p> <p>Errors</p> <p>Poor Product Quality</p> <p>Being Late</p> <p>Lead us to </p>	<p>Rework</p> <p>Recalls</p> <p>Expediting</p> <p>Removal of punch list items</p> <p>Time extensions</p> <p>Litigation costs and damages</p> <p>Penalties and liquidated damages</p> <p>Increased insurance costs</p>
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Areas where savings can be derived by making improvements are noted here.

Inspection of direct hire work	Review of shop drawings	Meetings of the steering committee and quality improvement teams
Inspection of subcontractor work	All training costs, including safety	Administration of the quality management program
Inspection at vendor source of supply	Facilitator costs	Reward system
Inspection of shipments	Salary of quality coordinator, if needed	

“What’s it going to cost us to do TQM?” you ask. Well, what is it costing you now NOT to do it? . . . What is your cost of quality? IF you don’t have the “real” facts, the truth is you really don’t know, . . . but you probably sense what your cost of quality is costing you. You can feel it, and it’s not a comfortable feeling.

Cost-Categories for unacceptable work

Work areas that affect cost are listed here:

- ◆ Rework/revisions
- ◆ Complaint resolution
- ◆ Insurance premiums/coverage
- ◆ Remove/replace
- ◆ Bonding limits and costs
- ◆ Write-offs
- ◆ Unbilled charges
- ◆ Overdue receivables
- ◆ Claim defense
- ◆ Change order redesign (engineers and architects)
- ◆ Ineffective interdisciplinary coordination
- ◆ Accept as-is, with credit to client
- ◆ Ineffective trade coordination

- ◆ Unplanned field services
- ◆ Call-backs
- ◆ Unrecorded time
- ◆ Unplanned premium overtime
- ◆ Disputed invoices
- ◆ Unpaid time
- ◆ Repetitive quality assurance
- ◆ Invoice errors
- ◆ Unpaid invoices
- ◆ Accept as-is, with no extra compensation

The high cost of poor quality

Facts to consider when counting the high cost of poor quality are:

What is poor quality costing you?

Waste is the opposite of quality.

The tangible costs of poor quality include rework, accidents, missed schedules, unused labor, liability and insurance, and scrapped materials.

The intangible costs of poor quality include lost customers, “never-had” customers who went elsewhere because of what they heard from unhappy customers, and poor morale among employees and stakeholders.

Four types of quality cost

The four types of quality cost are:

Prevention cost All costs associated with error prevention in a product, process or service.

Appraisal cost All costs associated with the assurance to conformance of quality standards/requirements, inspection, testing, observation, etc.

Internal failure cost All costs associated with the evaluation and correction of the design before it is released for construction, and all costs for rework on a project before it is turned over to the owner.

External failure cost Similar to internal failure costs except that they occur after the “output” has been turned over to the next processor or user. External failure costs often include significant intangible costs of lost reputation and good will.

Summary

The highly competitive economic conditions that exist in today’s construction industry require that construction companies seek to achieve excellence to remain competitive. This excellence can be achieved with a new style of management that focuses on customer satisfaction, the elimination of waste, continuous improvement, and employee involvement.

To be competitive in today’s market, it is essential for construction companies to provide more consistent quality and value to their owners/customers. Now is the time to place behind us the old *adversarial* approach to managing construction work. It is time to develop better and more direct relationships with our owners/customers, to initiate more teamwork at the jobsite, and to produce better quality work.

Such goals demand that a continuous improvement (CI) process be established within the company in order to provide quality management.

Meeting owner/customer requirements (providing customer satisfaction) is a primary objective of quality management, and contractors who are the suppliers of construction services must address owner/customer requirements if they are to succeed. The construction industry exists to provide a service to its owners/customers who are becoming more demanding and are seeking higher quality, better value, and lower costs. These owner/customer requirements mirror the economic pressures they face in their own businesses. Implementing total quality management / continuous improvement in managing everyday construction activities is relevant to all those who participate in and contribute to the construction process.

