

Chapter 2 Concept of Total Quality Management⁴

2.1 Introduction

This chapter focuses on the identification of the concept of TQM on the basis of the literature review. Section 2.2 presents the concept of TQM from quality gurus. Section 2.3 describes the three well recognized quality award models. Section 2.4 discusses the TQM concept from a number of researchers in the field of TQM. Section 2.5 presents the TQM concept adopted in this study and the detailed explanations of the 11 TQM implementation constructs. Finally, section 2.6 summarizes this chapter.

2.2 Concept From Quality Gurus

An extensive review of literature was carried out to identify the concept of TQM from quality gurus such as Deming (1986), Juran (Juran and Gryna, 1993), Crosby (1979), Feigenbaum (1991), and Ishikawa (1985). Their propositions are the foundation for understanding the concept of TQM. The following subsections present the main principles and practices of TQM proposed by these quality gurus.

2.2.1 Deming's Approach to TQM

The theoretical essence of the Deming approach to TQM concerns the creation of an organizational system that fosters cooperation and learning for facilitating the implementation of process management practices, which, in turn, leads to continuous improvement of processes, products, and services as well as to employee fulfillment, both of which are critical to customer satisfaction, and ultimately, to firm survival (Anderson et al., 1994a). Deming (1986) stressed the responsibilities of top management to take the lead in changing processes and systems. Leadership plays in ensuring the success of quality management, because it is the top management's responsibility to create and communicate a vision to move the firm toward continuous improvement. Top management is responsible for most quality problems; it should give employees clear standards for what is considered acceptable work, and provide the methods to achieve it. These methods include an appropriate working environment and climate for work-free of faultfinding, blame or fear. Deming (1986) also emphasized the importance of identification and measurement of customer requirements, creation of supplier partnership, use of functional teams to identify and solve quality problems, enhancement of employee skills, participation of employees, and pursuit of continuous improvement. Anderson et al. (1994a) developed a theory of quality management underlying the Deming management method. They proposed that: The effectiveness of the Deming management method arises from leadership efforts toward the simultaneous creation of a cooperative and learning organization to facilitate the

⁴ Parts of this chapter were published in Zhang (1997b, 1999b) and Zhang et al. (2000).

implementation of process-management practices, which, when implemented, support customer satisfaction and organizational survival through sustained employee fulfillment and continuous improvement of processes, products, and services.

The means to improve quality lie in the ability to control and manage systems and processes properly, and in the role of management responsibilities in achieving this. Deming (1986) advocated methodological practices, including the use of specific tools and statistical methods in the design, management, and improvement of process, which aim to reduce the inevitable variation that occurs from “common causes” and “special causes” in production. “Common causes” of variations are systemic and are shared by many operators, machines, or products. They include poor product design, non-conforming incoming materials, and poor working conditions. These are the responsibilities of management. “Special causes” relate to the lack of knowledge or skill, or poor performance. These are the responsibilities of employees. Deming proposed 14 points as the principles of TQM (Deming, 1986), which are listed below:

- (1) Create constancy of purpose toward improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.
- (2) Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change.
- (3) Cease dependence on mass inspection to quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.
- (4) End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.
- (5) Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs.
- (6) Institute training on the job.
- (7) Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers.
- (8) Drive out fear, so that people may work effectively for the company.
- (9) Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service.
- (10) Eliminate slogans, exhortations, and targets for the workforce asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, as the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the workforce.
- (11) (a) Eliminate work standards (quotas) on the factory floor. Substitute leadership.
(b) Eliminate management by objective. Eliminate management by numbers, numerical goals. Substitute leadership.
- (12) (a) Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from sheer numbers to quality. (b) Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual or merit rating and of management by objective.

- (13) Institute a vigorous program of education and self-improvement.
- (14) Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job.

2.2.2 Juran's Approach to TQM

TQM is the system of activities directed at achieving delighted customers, empowered employees, higher revenues, and lower costs (Juran and Gryna, 1993). Juran believed that main quality problems are due to management rather than workers. The attainment of quality requires activities in all functions of a firm. Firm-wide assessment of quality, supplier quality management, using statistical methods, quality information system, and competitive benchmarking are essential to quality improvement. Juran's approach is emphasis on team (QC circles and self-managing teams) and project work, which can promote quality improvement, improve communication between management and employees coordination, and improve coordination between employees. He also emphasized the importance of top management commitment and empowerment, participation, recognition and rewards.

According to Juran, it is very important to understand customer needs. This requirement applies to all involved in marketing, design, manufacture, and services. Identifying customer needs requires more vigorous analysis and understanding to ensure the product meets customers' needs and is fit for its intended use, not just meeting product specifications. Thus, market research is essential for identifying customers' needs. In order to ensure design quality, he proposed the use of techniques including quality function deployment, experimental design, reliability engineering and concurrent engineering.

Juran considered quality management as three basic processes (Juran Trilogy): Quality control, quality improvement, and quality planning. In his view, the approach to managing for quality consists of: The sporadic problem is detected and acted upon by the process of quality control; The chronic problem requires a different process, namely, quality improvement; Such chronic problems are traceable to an inadequate quality planning process. Juran defined a universal sequence of activities for the three quality processes, which is listed in Table 2.1.

Juran defined four broad categories of quality costs, which can be used to evaluate the firm's costs related to quality. Such information is valuable to quality improvement. The four quality costs are listed as follows:

- Internal failure costs (scrap, rework, failure analysis, etc.), associated with defects found prior to transfer of the product to the customer;
- External failure costs (warranty charges, complaint adjustment, returned material, allowances, etc.), associated with defects found after product is shipped to the customer;
- Appraisal costs (incoming, in-process, and final inspection and testing, product quality audits, maintaining accuracy of testing equipment, etc.), incurred in determining the degree of conformance to quality requirements;
- Prevention costs (quality planning, new product review, quality audits, supplier quality evaluation, training, etc.), incurred in keeping failure and appraisal costs to a minimum.

Table 2.1 Universal Processes for Managing Quality

Quality planning	Quality control	Quality improvement
Establish quality goals	Choose control subjects	Prove the need
Identify customers	Choose units of measure	Identify projects
Discover customer needs	Set goals	Organize project teams
Develop product features	Create a sensor	Diagnose the causes
Develop process features	Measure actual performance	Provide remedies, prove remedies are effective
Establish process controls, transfer to operations	Interpret the difference Take action on the difference	Deal with resistance to change Control to hold the gains

2.2.3 Crosby's Approach to TQM

Crosby (1979) identified a number of important principles and practices for a successful quality improvement program, which include, for example, management participation, management responsibility for quality, employee recognition, education, reduction of the cost of quality (prevention costs, appraisal costs, and failure costs), emphasis on prevention rather than after-the-event inspection, doing things right the first time, and zero defects. Crosby claimed that mistakes are caused by two reasons: Lack of knowledge and lack of attention. Education and training can eliminate the first cause and a personal commitment to excellence (zero defects) and attention to detail will cure the second. Crosby also stressed the importance of management style to successful quality improvement. The key to quality improvement is to change the thinking of top managers-to get them not to accept mistakes and defects, as this would in turn reduce work expectations and standards in their jobs. Understanding, commitment, and communication are all essential. Crosby presented the quality management maturity grid, which can be used by firms to evaluate their quality management maturity. The five stages are: Uncertainty, awakening, enlightenment, wisdom and certainty. These stages can be used to assess progress in a number of measurement categories such as management understanding and attitude, quality organization status, problem handling, cost of quality as percentage of sales, and summation of firm quality posture. The quality management maturity grid and cost of quality measures are the main tools for managers to evaluate their quality status. Crosby offered a 14-step program that can guide firms in pursuing quality improvement. These steps are listed as follows:

- (1) Management commitment: To make it clear where management stands on quality.
- (2) Quality improvement team: To run the quality improvement program.
- (3) Quality measurement: To provide a display of current and potential nonconformance problems in a manner that permits objective evaluation and corrective action.
- (4) Cost of quality: To define the ingredients of the cost of quality, and explain its use as a management tool.

- (5) Quality awareness: To provide a method of raising the personal concern felt by all personnel in the company toward the conformance of the product or service and the quality reputation of the company.
- (6) Corrective action: To provide a systematic method of resolving forever the problems that are identical through previous action steps.
- (7) Zero defects planning: To investigate the various activities that must be conducted in preparation for formally launching the Zero Defects program.
- (8) Supervisor training: To define the type of training that supervisors need in order to actively carry out their part of the quality improvement program.
- (9) Zero defects day: To create an event that will make all employees realize, through a personal experience, that there has been a change.
- (10) Goal setting: To turn pledges and commitment into actions by encouraging individuals to establish improvement goals for themselves and their groups.
- (11) Error causal removal: To give the individual employee a method of communicating to management the situation that makes it difficult for the employee to meet the pledge to improve.
- (12) Recognition: To appreciate those who participate.
- (13) Quality councils: To bring together the professional quality people for planned communication on a regular basis.
- (14) Do it over again: To emphasize that the quality improvement program never ends.

2.2.4 Feigenbaum's Approach to TQM

Feigenbaum (1991) defined TQM⁵ as: An effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of the various groups in a firm so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction. He claimed that effective quality management consists of four main stages, described as follows:

- Setting quality standards;
- Appraising conformance to these standards;
- Acting when standards are not met;
- Planning for improvement in these standards.

The quality chain, he argued, starts with the identification of all customers' requirements and ends only when the product or service is delivered to the customer, who remains satisfied. Thus, all functional activities, such as marketing, design, purchasing, manufacturing, inspection, shipping, installation and service, etc., are involved in and influence the attainment of quality. Identifying customers' requirements is a fundamental initial point for

⁵ Feigenbaum used the term TQC (total quality control) instead of TQM in his book. He claimed that it permits what might be called total quality management to cover the full scope of the product and service "life cycle" from product conception through production and customer service. According to ISO 8402 – Quality management and quality assurance – vocabulary, TQM is sometimes called "total quality", "company-wide quality control", "total quality control", etc.

achieving quality. He claimed that effective TQM requires a high degree of effective functional integration among people, machines, and information, stressing a system approach to quality. A clearly defined total quality system is a powerful foundation for TQM. Total quality system is defined as follows:

The agreed firm-wide operating work structure, documented in effective, integrated technical and managerial procedures, for guiding the coordinated actions of the people, the machines, and the information of the firm in the best and most practical ways to assure customer quality satisfaction and economical costs of quality.

Feigenbaum emphasized that efforts should be made toward the prevention of poor quality rather than detecting it after the event. He argued that quality is an integral part of the day-to-day work of the line, staff, and operatives of a firm. There are two factors affecting product quality: The technological-that is, machines, materials, and processes; and the human-that is, operators, foremen, and other firm personnel. Of these two factors, the human is of greater importance by far. Feigenbaum considered top management commitment, employee participation, supplier quality management, information system, evaluation, communication, use of quality costs, use of statistical technology to be an essential component of TQM. He argued that employees should be rewarded for their quality improvement suggestions, quality is everybody's job. He stated that effective employee training and education should focus on the following three main aspects: Quality attitudes, quality knowledge, and quality skills.

2.2.5 Ishikawa's Approach to TQM

Ishikawa⁶ (1985) argued that quality management extends beyond the product and encompasses after-sales service, the quality of management, the quality of individuals and the firm itself. He claimed that the success of a firm is highly dependent on treating quality improvement as a never-ending quest. A commitment to continuous improvement can ensure that people will never stop learning. He advocated employee participation as the key to the successful implementation of TQM. Quality circles, he believed, are an important vehicle to achieve this. Like all other gurus he emphasized the importance of education, stating that quality begins and ends with it. He has been associated with the development and advocacy of universal education in the seven QC tools (Ishikawa, 1985). These tools are listed below:

- Pareto chart;
- Cause and effect diagram (Ishikawa diagram);
- Stratification chart;
- Scatter diagram;
- Check sheet;
- Histogram;

⁶ Ishikawa used the term TQC (total quality control) instead of TQM in his book. According to ISO 8402 – Quality management and quality assurance – vocabulary, TQM is sometimes called “total quality”, “company-wide quality control”, “total quality control”, etc.

- Control chart.

Ishikawa (1985) suggested that the assessment of customer requirements serves as a tool to foster cross-functional cooperation; selecting suppliers should be on the basis of quality rather than solely on price; cross-functional teams are effective ways for identifying and solving quality problems. Ishikawa's concept of TQM contains the following six fundamental principles:

- Quality first-not short-term profits first;
- Customer orientation-not producer orientation;
- The next step is your customer-breaking down the barrier of sectionalism;
- Using facts and data to make presentations-utilization of statistical methods;
- Respect for humanity as a management philosophy, full participatory management;
- Cross-functional management.

2.2.6 Results From Quality Gurus

After the approaches to TQM of the five quality gurus have been reviewed, it has become evident that each has his own distinctive approach. Nevertheless, the principles and practices of TQM proposed by these quality gurus do provide the author with a better understanding of the concept of TQM. Their insights offer a solid foundation for conducting this study. Although their approaches to TQM are not totally the same, they do share some common points which are summarized as follows:

- (1) It is management's responsibility to provide commitment, leadership, empowerment, encouragement, and the appropriate support to technical and human processes. It is top management's responsibility to determine the environment and framework of operations within a firm. It is imperative that management foster the participation of the employees in quality improvement, and develops a quality culture by changing perception and attitudes toward quality.
- (2) The strategy, policy, and firm-wide evaluation activities are emphasized.
- (3) The importance of employee education and training is emphasized in changing employees' beliefs, behavior, and attitudes; enhancing employees' abilities in carrying out their duties.
- (4) Employees should be recognized and rewarded for their quality improvement efforts.
- (5) It is very important to control the processes and improve quality system and product design. The emphasis is on prevention of product defects, not inspection after the event.
- (6) Quality is a systematic firm-wide activity from suppliers to customers. All functional activities, such as marketing, design, engineering, purchasing, manufacturing, inspection, shipping, accounting, installation and service, should be involved in quality improvement efforts.

2.3 Review of Quality Award Models

Worldwide, there are several Quality Awards, such as the Deming Prize in Japan (1996), the European Quality Award in Europe (1994), the Malcolm Baldrige National Quality Award in the United States of America (1999). The broad aims of these awards are described as follows (Ghobadian and Woo, 1996):

- Increase awareness of TQM because of its important contribution to superior competitiveness;
- Encourage systematic self-assessment against established criteria and market awareness simultaneously;
- Stimulate sharing and dissemination of information on successfully deployed quality strategies and on benefits derived from implementing these strategies;
- Promote understanding of the requirements for the attainment of quality excellence and successful deployment of TQM;
- Encourage firms to introduce a continuous improvement process.

Each award model is based on a perceived model of TQM. The award models do not focus solely on either product or service perfection or traditional quality management methods, but consider a wide range of management activities, behavior and processes that influence the quality of the final offerings. They provide a useful audit framework against which firms can evaluate their TQM implementation practices, seek improvement opportunities, and the end results.

2.3.1 The Deming Prize

The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers in 1951. Its main purpose is to spread the quality gospel by recognizing performance improvements flowing from the successful implementation of firm-wide quality control based on statistical quality control techniques (Ghobadian and Woo, 1996). The Deming Prize proved an effective instrument for spreading TQM philosophy throughout the Japanese industries.

There are ten primary elements in the Deming Application Prize (1996), as well as a checklist that is used to evaluate the performance of senior executives. This checklist emphasizes the importance of top management's active participation in quality management activities and understanding of the main requirements of quality improvement programs. It is also provides senior executives with a list of what they need to do. The primary elements in the Deming Application Prize and the checklist used to evaluate senior executives are listed below:

(1) Policies

- Quality and quality control policies and their place in overall business management;
- Clarity of policies (targets and priority measures);
- Methods and processes for establishing policies;
- Relationship of policies to long- and short-term plans;

- Communication (deployment) of policies, and grasp and management of achieving policies;
- Executives' and managers' leadership.

(2) Organization

- Appropriateness of the organizational structure for quality control and status of employee involvement;
- Clarity of authority and responsibility;
- Status of interdepartmental coordination;
- Status of committee and project team activities;
- Status of staff activities;
- Relationships with associated companies (group companies, vendors, contractors, sales companies, etc.).

(3) Information

- Appropriateness of collecting and communicating external information;
- Appropriateness of collecting and communicating internal information;
- Status of applying statistical techniques to data analysis;
- Appropriateness of information retention;
- Status of utilizing information;
- Status of utilizing computers for data processing.

(4) Standardization

- Appropriateness of the system of standards;
- Procedures for establishing, revising and abolishing standards;
- Actual performance in establishing, revising and abolishing standards;
- Contents of standards;
- Status of utilizing and adhering to standards;
- Status of systematically developing, accumulating, handing down and utilizing technologies.

(5) Human resources

- Education and training plans and their development and results utilization;
- Status of quality consciousness, consciousness of managing jobs, and understanding of quality control;
- Status of supporting and motivating self-development and self-realization;
- Status of understanding and utilizing statistical concepts and methods;
- Status of QC circle development and improvement suggestions;
- Status of supporting the development of human resources in associated companies.

(6) Quality assurance

- Status of managing the quality assurance activities system;
- Status of quality control diagnosis;
- Status of new product and technology development (including quality analysis, quality deployment and design review activities);
- Status of process control;
- Status of process analysis and process improvement (including process capability studies);

- Status of inspection, quality evaluation and quality audit;
- Status of managing production equipment, measuring instruments and vendors;
- Status of packaging, storage, transportation, sales and service activities;
- Grasping and responding to product usage, disposal, recovery and recycling;
- Status of quality assurance;
- Grasping of the status of customer satisfaction;
- Status of assuring reliability, safety, product liability and environmental protection.

(7) Maintenance

- Rotation of management (PDCA) cycle control activities;
- Methods for determining control items and their levels;
- In-control situations (status of utilizing control charts and other tools);
- Status of taking temporary and permanent measures;
- Status of operating management systems for cost, quantity, delivery, etc.;
- Relationship of quality assurance system to other operating management systems.

(8) Improvement

- Methods of selecting themes (important activities, problems and priority issues);
- Linkage of analytical methods and intrinsic technology;
- Status of utilizing statistical methods for analysis;
- Utilization of analysis results;
- Status of confirming improvement results and transferring them to maintenance/control activities;
- Contribution of QC circle activities.

(9) Effects

- Tangible effects (such as quality, delivery, cost, profit, safety and environment);
- Intangible effects;
- Methods for measuring and grasping effects;
- Customer satisfaction and employee satisfaction;
- Influence on associated companies;
- Influence on local and international communities.

(10) Future plans

- Status of grasping current situations;
- Future plans for improving problems;
- Projection of changes in social environment and customer requirements and future plans based on these projected changes;
- Relationships among management philosophy, vision and long-term plans;
- Continuity of quality control activities;
- Concreteness of future plans.

The checklist used to evaluate the performance of senior executives is listed as follows:

(1) Understanding

- Are the objectives of quality control and enthusiasm introduction and promotion clearly defined and well understood?

- How well do they understand quality control, quality assurance, reliability, product liability, etc.?
- How well do they understand the importance of the statistical way of thinking and the application of quality control techniques?
- How well do they understand QC circle activities?
- How well do they understand the relationship of quality control and the concepts and methods of other management activities?
- How enthusiastic are they in promoting quality control? How well are they exercising leadership?
- How well do they understand the status and the characteristics of their company's quality and quality control?

(2) Policies

- How are quality policies and quality control policies established? Where and how do these policies stand in relation to overall business management?
- How are these policies related to short- and long-term plans?
- How are these policies deployed throughout the company for their achievement?
- How do they grasp the status of policy achievement? Are they taking appropriate corrective actions when needed?
- How do they grasp priority quality issues (priority business issues)? Do they make effective use of diagnostic methods such as top management diagnosis?
- How well are targets and priority measures aligned with policies?
- What kind of policies do they employ for establishing cooperative relationships with associated companies?

(3) Organization

- How is the company organized and managed so that human resources can effectively and efficiently practice quality control?
- How are the authorities and responsibilities in the organization established?
- Is the allocation of human resources suitable for the organization?
- How do they strive to make employees happy and satisfied?
- How do they grasp and evaluate employees' capability and motivation levels?
- How do they strive for interdepartmental cooperation? How do they utilize committees and project teams?
- How do they relate to associated companies?

(4) Human resources

- How clear is the philosophy for hiring, developing and utilizing human resources?
- How appropriate are the employee education and training plans? Are the necessary budget and time allocated?
- How do they communicate the policies for quality control education and training and how do they grasp the status achieving their policies?
- How do they provide education and training specific to the company's business needs?
- How well do they understand the importance of employee self- and mutual-development? How do they support this effort?
- How do they strive to develop QC circle activities?
- How interested are they in developing human resources in associated companies?

(5) Implementation

- What kind of measures do they have for the evaluation, and effective and efficient implementation, of quality control?
- How well is the overall coordination of quality control and other management systems?
- How do they grasp the status of improvement in the business processes and the individual steps of these processes so as to provide products and services that satisfy the customer needs? Are they taking necessary corrective actions?
- How well are the systems for developing new products and services, new technologies and new markets established and managed?
- How well are the necessary resources secured and allocated for establishing and operating management and information systems?
- How do they grasp the effects and contributions of quality control to the improvement of business performance?
- How do they evaluate their employees' efforts?

(6) Corporate social

- Is the company structured to ensure appropriate profits for a long time?
- How well do they regard employee well-being (wage levels, working hours, etc.)?
- How well do they regard employee self-realization?
- How well do they strive for co-existence and co-prosperity with associated companies?
- How well does the company contribute to the local community?
- How well does the company exert efforts to protect the environment?
- How well does the company positively impact the international community?

(7) Future visions

- How do they assure the continuity of, and future plans for, quality control?
- How do they anticipate and cope with changes in surrounding business environment and progress in science and technology?
- How do they grasp and cope with changes in customer requirements?
- How do they consider their employees and help them achieve happiness and satisfaction?
- How do they consider and manage relationships with associated companies?
- How do they plan for the future to cope with the items above?
- How do they utilize quality control to achieve the future plans?

2.3.2 The European Model for TQM

The European Quality Award was officially launched in 1991. The primary purpose of the award is to support, encourage, and recognize the development of effective TQM by European firms. The model of the European Quality Award is divided into two parts, Enablers and Results. The enablers are leadership, people management, policy & strategy, resources, and processes. These five aspects steer the business and facilitate the transformation of inputs to outputs. The results are people satisfaction, customer satisfaction, impact on society, and business results (the measure of the level of output attained by the firm). The European Quality Award model (1994) consists of nine primary

elements, which are further divided into a number of secondary elements. The primary and secondary elements are listed below:

(1) Leadership

- Visible involvement in leading total quality;
- A consistent total quality culture;
- Timely recognition and appreciation of the effects and successes of individuals and teams;
- Support of total quality by provision of appropriate resources and assistance;
- Involvement with customers and suppliers;
- Active promotion of total quality outside the organization.

(2) Policy and strategy

- How policy and strategy are based on the concept of total quality;
- How policy and strategy are formed on the basis of information that is relevant to total quality;
- How policy and strategy are the basis of business plans;
- How policy and strategy are communicated;
- How policy and strategy are regularly reviewed and improved.

(3) People management

- How continuous improvement in people management is accomplished;
- How the skills and capabilities of the people are preserved and developed through recruitment, training and career progression;
- How people and teams agree on targets and continuously review performance;
- How the involvement of everyone in continuous improvement is promoted and people are empowered to take appropriate action;
- How effective top-down and bottom-up communication is achieved.

(4) Resources

- Financial resources;
- Information resources;
- Material resources and fixed assets;
- The application of technology.

(5) Processes

- How processes critical to the success of the business are identified;
- How the organization systematically manages its processes;
- How process performance measurements, along with all relevant feedback, are used to review processes and to set targets for improvement;
- How the organization stimulates innovation and creativity in process improvement;
- How the organization implements process changes and evaluates the benefits.

(6) Customer satisfaction.

(7) People satisfaction.

(8) Impact on society.

(9) Business results.

2.3.3 The Malcolm Baldrige National Quality Award

In 1987, the US Congress passed the Malcolm Baldrige National Quality Improvement Act, and thus established an annual quality award in the US. The aim of the award is to encourage American firms to improve quality, satisfy customers, and improve overall firms' performance and capabilities. The model framework can be used to assess firms' current quality management practices, benchmark performance against key competitors and world-class standards, and improve relations with suppliers and customers. The Malcolm Baldrige National Quality Award model framework (1999) is listed as follows:

- (1) Leadership
 - Organizational leadership;
 - Public responsibility and citizenship.
- (2) Strategic planning
 - Strategy development;
 - Strategy deployment.
- (3) Customer and market focus
 - Customer and market knowledge;
 - Customer satisfaction and relationships.
- (4) Information and analysis
 - Measurement of organizational performance;
 - Analysis of organizational performance.
- (5) Human resource focus
 - Work systems;
 - Employee education, training, and development;
 - Employee well-being and satisfaction.
- (6) Process management
 - Product and service processes;
 - Support processes;
 - Supplier and partnering processes.
- (7) Business results
 - Customer focused results;
 - Financial and market results;
 - Human resource results;
 - Supplier and partner results;
 - Organizational effectiveness results.

2.3.4 Results from Quality Awards

The three quality award models provide a universal framework for evaluating aspects of TQM practices in a firm. They also provide a framework for identifying a range of intangible and tangible processes that influence the firm's TQM implementation and the end results. Although each award has its own unique categories and emphasis, there are some common areas. (1) Each award model has two parts: One is TQM implementation (that is, the enablers); the other is the overall business results. TQM implementation makes overall business results happen. (2) All three award models emphasize the importance of leadership, human resources management, employee participation, employee education and training, process management, strategy and policy, information, supplier quality management, and customer focus.

The three quality award models provide firms with a means to measure their position against a set of universal criteria, and to identify their strengths and weaknesses in the areas of quality management practices and business results. These models provide an insight into the practical way of applying TQM, as well as a solid foundation for this research, and give the author a better understanding of the concept of TQM. According to Hackman and Wageman (1995), it is safe to assume that Baldrige Award winners actually have implemented the full TQM package. Based on their statement, it can be assumed that the three award winners have fully implemented TQM⁷.

2.4 Review of Other Research

Worldwide, much research has been conducted in the field of TQM implementation. After a review of the relevant TQM literature, it has been found that different researchers adopted different TQM definitions and frameworks based on their own understanding of TQM and research objectives. Consequently, there is less consensus on what TQM is and what constitutes it.

TQM can be defined as a set of techniques and procedures used to reduce or eliminate variation from a production process or service-delivery system in order to improve efficiency, reliability, and quality (Steingard and Fitzgibbons, 1993). It integrates fundamental management techniques, existing improvement efforts, and the technical tools under a disciplined approach focused on continuous improvement (Department of Defense, 1988). According to Kanji and Asher (1996), TQM is a continuous process of improvement for individuals, groups of people, and whole firms; it encompasses a set of four principles (delight the customer, management by fact, people-based management, and continuous improvement) and eight core concepts (customer satisfaction, internal customers are real, all work is process, measurement, teamwork, people make quality, continuous improvement cycle, and prevention). TQM can also be defined as the application of quality principles for the integration of all functions and processes within the firm (Ross, 1993). There is another definition of TQM, which is a management approach for an organization, centered on

⁷ Strictly speaking, this assumption is very limited. In reality, no firms can fully implement TQM. TQM is a continuous improvement process and is thus never ending.

quality, based on the participation of all its members and aiming at long-term success through customer satisfaction and benefits to all members of the organization and to society (ISO 8402, 1994). Flynn et al. (1994) defined TQM as: An integrated approach to achieving and sustaining high quality output, focusing on the maintenance and continuous improvement of processes and defect prevention at all levels and in all functions of the firm, in order to meet or exceed customer expectations. According to Ho and Fung (1994), TQM is a way of managing to improve the effectiveness, flexibility, and competitiveness of a business as a whole. It is also a method of removing waste, by involving everyone in improving the way things are done. According to Vuppalapati et al. (1995), TQM is an integrative philosophy of management for continuously improving the quality of products and processes to achieve customer satisfaction. Hackman and Wageman (1995) systematically reviewed the three quality gurus' (Deming, Juran, and Ishikawa) propositions about TQM. According to their review results, the following five interventions are the core of TQM: Explicit identification and measurement of customer wants and needs; creation of supplier partnership; use of functional teams to identify and solve quality problems; use of scientific methods to monitor performance and identify points of high leverage for performance improvement; use of process management heuristics to enhance team effectiveness. Dean and Bowen (1994) defined TQM as a philosophy or approach to management that can be characterized by its principles, practices, and techniques. Its three principles are customer focus, continuous improvement, and teamwork. Each principle is implemented through a set of practices, which are simply activities such as collecting customer information or analyzing processes. The practices are, in turn, supported by a wide array of techniques.

Choi and Eboch (1998) studied the TQM paradox using management of process quality, human resources management, strategic quality planning, and information and analysis as the constructs of TQM implementation. Black and Porter (1996) identified ten critical factors of TQM: People and customer management, supplier partnership, communication of improvement information, customer satisfaction orientation, external interface management, strategic quality management, teamwork structure for improvement, operational quality planning, quality improvement measurement systems, and corporate quality culture. In Powell's 1995 study, the following elements were identified as TQM framework: Executive commitment, adopting the philosophy, closer to customers, closer to suppliers, benchmarking, training, open organization, employee empowerment, zero-defects mentality, flexible manufacturing, process improvement, and measurement. Ho and Fung (1994) identified ten TQM elements: Leadership, commitment, total customer satisfaction, continuous improvement, total involvement, training and education, ownership, reward and recognition, error prevention, and cooperation and teamwork. Waldman (1994) identified eight key TQM elements as: Top management commitment to place quality as a top priority, a broad definition of quality as meeting customers' expectations, TQM values and vision, the development of a quality culture, involvement and empowerment of all organizational members in cooperative efforts to achieve quality improvements, an orientation toward managing-by-fact, the commitment to continuously improve employees' capabilities and work processes through training and benchmarking, attempts to get external suppliers and customers involved in TQM efforts. Mann and Kehoe (1994) divided TQM into ten elements. They are supplier improvement, process control and improvement, internal customer focus, measurement and reporting, leadership, quality system, participation, recognition, education and training, and external customer focus.

Although much research has been conducted in the field of TQM implementation, no universally accepted TQM definition or elements presently exist. Actually, researchers have different ideas about TQM concept and elements. However, most agree that TQM is a philosophy or approach to management focusing on continuous improvement, customer focus, systematic process management, supplier partnership, and teamwork. The implementation of such a management philosophy requires a set of practices.

2.5 TQM Concept in This Study

2.5.1 Definition of TQM

Before the concept of TQM is defined, it is necessary to define the concept of quality management. According to ISO 8402 (1994), quality management can be defined as follows:

All activities of the overall management function that determine the quality policy, objectives and responsibilities, and implement them by means such as quality planning, quality control, quality assurance and quality improvement within the quality system.

The extensive TQM literature review suggests that TQM encompasses a vast spectrum of topics and perspectives. In the field of TQM implementation, there are three commonly referenced articles written by Saraph et al. (1989), Flynn et al. (1994), and Ahire et al. (1996), respectively. Ahire et al. (1996) strongly recommended that a combination of the three frameworks be undertaken for future research on TQM. In fact, the present study followed this suggestion, attempting to integrate their TQM constructs as much as possible. Table 2.2 lists the 11 TQM elements in this study and the TQM elements in their frameworks. The two elements “Product quality” and “Supplier performance” in the Ahire et al. framework were not included in this framework since they represented TQM outcomes. “Role of quality department” in the Saraph et al. framework was excluded in this framework since every department in any organization was involved in quality management. “Benchmarking” and “Internal quality information usage” in the Ahire et al. framework were similar with the element of “Evaluation” in this study. “Process control” and “Cleanliness and organization” in the Flynn et al. framework were relatively the same as the element of “Process control and improvement” adopted in this study. This study included two more elements, “Quality system improvement” and “Vision and plan statement”, which were not found in their frameworks. Therefore, this TQM concept covers a broader scope of TQM in comparison with their frameworks. In this study, TQM is defined as follows:

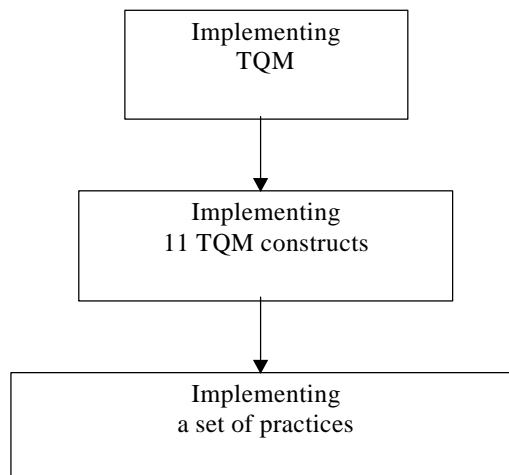
A management philosophy for continuously improving overall business performance based on leadership, supplier quality management, vision and plan statement, evaluation, process control and improvement, product design, quality system improvement, employee participation, recognition and reward, education and training, and customer focus.

Table 2.2 Framework Comparison

This framework	1: Leadership; 2: Supplier quality management; 3: Vision and plan statement; 4: Evaluation; 5: Process control and improvement; 6: Product design; 7: Quality system improvement; 8: Employee participation; 9: Recognition and reward; 10: Education and training; 11: Customer focus.
Saraph et al. framework	1: Role of divisional top management and quality policy; 2: Role of quality department; 3: Training; 4: Product/service design; 5: Supplier quality management; 6: Process management/operating; 7: Quality data and reporting; 8: Employee relations.
Flynn et al. framework	1: Quality leadership; 2: Quality improvement rewards; 3: Process control; 4: Feedback; 5: Cleanliness and organization; 6: New product quality; 7: Interfunctional design process; 8: Selection for teamwork potential; 9: Teamwork; 10: Supplier relationship; 11: Customer involvement.
Ahire et al. framework	1: Top management commitment; 2: Customer focus; 3: Supplier quality management; 4: Design quality management; 5: Benchmarking; 6: SPC usage; 7: Internal quality information usage; 8: Employee empowerment; 9: Employee involvement; 10: Employee training; 11: Product quality; 12: Supplier performance.

Thus, TQM consists of 11 constructs. To implement TQM is merely to implement these constructs, which occurs through a set of practices such as using certain quality tools or techniques. Figure 2.1 displays the decomposition of TQM implementation. There are practices that can support the implementation of each of the 11 constructs. The conceptual definitions of the constructs and the practices that support their implementation are presented in the following subsection.

Figure 2.1 A Decomposition Model of TQM Implementation



2.5.2 TQM Constructs

Leadership

Leadership is the ability to inspire confidence and support among those needed to achieve organizational goals (DuBrin, 1995). Anderson et al. (1994a) explained the concept of leadership as: The ability of top management to establish, practice, and lead a long-term vision for the firm, driven by changing customer requirements, as opposed to an internal management control role. Leadership is thus exemplified by clarity of vision, long-term orientation, coaching management style, participative change, employee empowerment, and planning and implementing organizational change. According to Juran and Gryna (1993), certain roles of top management can be identified as: Establish quality policies, establish and deploy quality goals, provide resources, provide problem-oriented training, and stimulate improvement. The European Quality Award (1994) and the Malcolm Baldrige Quality Award (1999) recognize the crucial role of leadership in creating the goals, values and systems that guide the pursuit of continuous performance improvement. Recognition of the critical role of leadership and its responsibility in pursuit of continuous quality improvement echoes the arguments put forward by quality gurus such as Deming (1986), Juran (Juran and Gryna, 1993), and Crosby (1979). Thus, the concept of leadership in this study can be defined as the ability of top management to lead the firm in continuously pursuing long-term overall business success. This is exemplified by top management participation, top management encouragement, employee empowerment, top management learning, top management commitment to employee education and training, and top management pursuit of product quality and long-term business success.

A predominant theme in quality management literature is that strong commitment from top management is vital. The foundation of an effective leadership effort is top commitment. Demonstrating such commitment is therefore a primary leadership principle for achieving TQM. Lack of top management commitment is one of the reasons for the failure of TQM efforts (Brown et al., 1994). However, top management commitment itself is not sufficient. It is more important that top management personally participate in various quality management activities. Furthermore, it should strongly encourage employee involvement in quality management activities. According to DuBrin (1995), an important leadership practice is to encourage people to assess the level of quality.

To be an effective leader in most modern firms, the top manager must continue to develop and learn. Knowledge of the business and continual learning are essential prerequisites to effective leadership (DuBrin, 1995). The extensive literature review by Anderson et al. (1994a) suggested that if leadership wants to create organizational cultures that will themselves be more amenable to learning, they must set the example by becoming learners themselves and involving others in the learning process. Thus, a learning organization will be established.

Empowerment is the process of delegating decision-making authority to lower levels within the firm. Particularly dramatic is empowerment of the workforce (Juran and Gryna, 1993), which is valuable because it may release creative energy (DuBrin, 1995). In order to effectively lead the firm, top management must empower employees to solve the problems

they encounter. Thus, employees can have the authority to fix problems and prevent their further occurrence.

In order to effectively lead the firm, top management must be committed to providing sufficient resources for employees' education and training, building trustful relationships with employees, and regarding them as valuable resources of the firm. Top management must be committed to allocating sufficient resources to prevent, as well as repair, quality problems. Top management should discuss quality frequently; for example, by giving speeches on the topic and asking questions about quality at every staff meeting. In fact, people make things happen. Therefore, top management must train and coach employees to assess, analyze, and improve work processes (Dale and Plunkett, 1990; Deming, 1986).

The study conducted by Garvin (1986) suggested that high levels of quality performance were always accompanied by an organizational commitment to that goal; high product quality did not exist without strong top management commitment. Many such empirical studies have also found that top management support for quality was a key factor in quality improvement. Therefore, it is essential that top management focus on product quality rather than yields alone. More importantly, it is critical for the firm to pursue long-term business success. Pursuing short-term business success places quality behind yield, costs, and meeting delivery schedules, according to this study's author⁸.

Supplier Quality Management

Supplier quality management can be defined as the set of supplier-related quality management practices for improving suppliers' quality of products and services. This is exemplified by firm-supplier partnership, product quality as the criterion for supplier selection, participation in suppliers, communication with suppliers, understanding of supplier performance, and supplier quality audit (Mann, 1992; Zhang, 2000a).

In modern industrial production, the interdependence of buyers and suppliers has increased dramatically. The supplier becomes an extension of the buyer's organization to a certain extent. A revolution in the relationship between buyers and suppliers has emerged in the form of supplier partnership (Juran and Gryna, 1993). According to the review by Hackman and Wageman (1995), developing partnerships with suppliers is one of the major TQM implementation practices. The extensive literature review by Anderson et al. (1994a) indicated that external cooperation between a firm and its suppliers has merits in the just-in-time purchasing systems. Working collaboratively with suppliers on a long-term basis is truly beneficial. Deming (1986) strongly recommended working with the supplier as a partner in a long-term relationship of loyalty and trust to improve the quality of incoming materials and decrease costs. A long-term relationship between purchaser and supplier is necessary for the best economy.

Deming (1986) and Ishikawa (1985) suggested that firms select their suppliers on the basis of quality, rather than solely on price. According to Deming (1986), price has no meaning without a measure of the quality being purchased. Without adequate measures of quality,

⁸ This was obtained from the author's previous publication: Zhang (2000b).

business drifts to the lowest bidder, low quality and high cost being the inevitable result. The firm must change its focus from lowest initial cost of material purchased to lowest total cost. Firms should try to minimize average total cost for inspection of incoming materials. According to Juran and Gryna (1993), it is an effective practice to optimize quality costs when a purchasing decision is made. To the purchasing price, the buyer must add a whole array of quality-related costs: Incoming inspection, materials review, production delays, downtime, extra inventories, internal failure costs, and external failure costs. The lowest purchasing price does not always result in the lowest total costs.

Deming (1986) and Ishikawa (1985) recommended that firms work directly with suppliers to ensure that their materials are of the highest possible quality. Firms should participate directly in supplier activities related to quality, such as supplier improvement projects and supplier training (Mann, 1992; Zhang, 2000a).

Evaluating suppliers is an important activity to assure the dependable high quality of incoming materials in the firm (Feigenbaum, 1991). Supplier rating is a technique to provide supplier assessment. Each supplier is measured against another specific supplier or group of suppliers, for price, quality, delivery, and other important performance measures. Supplier performance rating involves objective appraisal of one supplier's performance, which can feed back to that supplier. In the case of a poor quality situation, such information can be used by the supplier to formulate corrective action. Supplier quality rating also provides a quantitative summary of supplier quality over a period of time (Juran and Gryna, 1993). Incoming material control is very important for supplier quality management. Specifications and standards should be established as criteria for acceptance of raw materials, parts, and components. Techniques such as acceptance sampling inspection and 100% inspection, can be used to provide acceptance at most economical levels (Feigenbaum, 1991).

Firms need to have detailed information about supplier quality information such as drawings, specifications, and other necessary data. It is also very important to establish a supplier information feedback system, which can be used for giving feedback to suppliers about their product performance. Such information may be used to further improving supplier performance. A purchasing system includes three key activities: Specification of requirements, selection of a supplier, and contract management. The overall quality objective is to meet the needs of the firm with a minimum of incoming inspection or later corrective action (Feigenbaum, 1991; Juran and Gryna, 1993).

Supplier quality audit is an organized evaluation of supplier capabilities to furnish materials of the necessary quality and quantity is an important basis for initial supplier selection and ongoing supplier quality surveillance (Feigenbaum, 1991). Surveillance can take several forms: Inspection of product, meetings with suppliers to review quality status, audits of elements of the supplier, review of SPC data, and witnessing of specific operations or tests (Juran and Gryna, 1993). What one firm buys from another is not just material: It buys something more important, namely, engineering and capability (Deming, 1986). These requirements of a supplier must be established long before it produces any material.

Vision and Plan Statement

Vision and plan statement has two aspects: Vision statement and plan statement, which are explained as follows:

A vision statement describes how a firm wants to be seen in its chosen business. As such, it describes standards, values, and beliefs. Above all, a vision is the advertisement of the intention to change. As such, it propels the firm forward and acts against complacency. All employees should be able to realize how they can contribute to the vision. A statement of values and behavior is a powerful motivating force that can be used to drive a process of change forward (Kanji and Asher, 1993). The intent of a vision statement is to communicate the firm's values, aspirations and purpose, so that employees can make decisions that are consistent with and supportive of these objectives (Meredith and Shafer, 1999). An effective vision statement tends to be written using language that can inspire employees to high levels of performance, and further, to foster their commitment. Therefore, a firm should have a long-term vision statement. A quality policy is overall intentions and direction of an organization with regard to quality, as formally expressed by top management (ISO 8402, 1994). Similarly, a quality policy describes how a firm wants to be seen regarding its quality. In this regard, a quality policy is a quality "vision statement". A variety of employees should be involved in the development of the vision statement and quality policy, which in return, should be well communicated to employees at different levels to stimulate commitment. In fact, a vision statement usually cascades down to mission statements that detail short-term firm goals or departmental aims. In order to realize a vision statement, a firm must make plan statements that support the realization of its vision (Mann, 1992).

A plan statement is a formalization of what is intended to happen at some time in the future. A plan cannot guarantee that an event will actually happen; it is a statement of intention that "will happen" (Slack et al., 1995). In a firm, there are many kinds of plans, including a strategic business performance plan, quality goal plan, and quality improvement plan. A strategic business performance plan can be divided into long- and short-term business performance plans that include, for example, market share, profits, annual sales, exports, and sales growth. A quality goal plan can involve, for example, conformity rate, defect rate, internal failure costs, external failure costs, performance, reliability, and durability. A quality improvement plan aims for quality improvement, which is actions taken throughout the organization to increase the effectiveness and efficiency of activities and processes in order to provide added benefits to both the organization and its customers (ISO 8402, 1994). Employees at different levels should be involved in drawing up these plans, which should be well communicated to employees, in turn encouraging their commitment to the realization of these plans (Mann, 1992).

Evaluation

The concept of evaluation can be defined as systematic examination of the extent to which an entity is capable of fulfilling specified requirements (ISO 8402, 1994). Juran and Gryna (1993) stated that a formal evaluation of quality offers a starting point by providing an understanding of the size of the quality issue and the areas demanding attention. Evaluation can identify the difference between actual performance and the goal. Evaluating the situation

in a firm's quality management practices provides an important base for the firm to improve its quality management practices. Such evaluation information should be communicated to employees in order to encourage employees to make things better. Hackman and Wageman (1995) proposed that evaluation of variability is a change principle. Uncontrolled variance in processes or outcomes is the primary cause of quality problems and must be evaluated and controlled by those who perform the firm's front-line work. Only when the root causes of variability have been identified are employees in a position to take appropriate steps to improve work processes. There is a set of practices that can support the implementation of evaluation.

A firm operates in a dynamic and turbulent environment. In order to maintain competitive advantages in the marketplace, the firm should continuously evaluate its various business strategies. Business strategy is a set of objectives, plans, and policies for the firm to compete successfully in its markets (Meredith and Shafer, 1999). In effect, the business strategy specifies what the firm's competitive advantage will be and how this advantage will be achieved and sustained. Based on such evaluation activities, the firm can adjust its business strategy in order to keep it dynamic (Mann, 1992).

Quality audit is systematic and independent examination to determine whether quality activities and related results comply with planned arrangements, and whether these arrangements are implemented effectively and are suitable to achieve objectives. Quality audit can be used for quality system, processes, products, and services. One purpose of a quality audit is to evaluate the need for improvement or corrective action (ISO 8402, 1994).

Benchmarking is a powerful tool to use as a continuous process of evaluating a firm's products, services, and processes against those of its toughest competitors or of firms renowned as world-class or industry leaders. A benchmarking is a point of reference by which performance is judged or measured; Competitive benchmarking is the continuous process of measuring products, services, and practices against those of the toughest competitors or leading firms (DuBrin, 1995). According to Slack et al. (1995), there are many types of benchmarking such as internal, external, non-competitive, competitive, performance, and practice. Benchmarking is able to judge how well an operation is performing, and can be seen as one approach to setting realistic performance standards. It is also concerned with searching out new ideas and practices that might be able to be copied or adapted. Benchmarking is an effective tool for guiding the establishment of quality improvement goals, evaluating various activities within the firm, and assessing customer requirements (Hackman and Wageman, 1995).

Quality costs can be divided into four categories: Internal failure, external failure, appraisal, and prevention (Juran and Gryna, 1993). According to Feigenbaum (1991), the periodic collection and analysis of quality-related costs monitors the cost effectiveness of the quality system. The objective is to track quality-cost trends in both total, as well as individual, quality-cost fields. Timely measurement and reporting of quality level data are used in assessing quality performance, setting quality-level goals, and evaluating corrective-action efforts. Such information is becoming the basis for establishing improvement goals, priority schedules and so on. The objective of evaluation of quality-related costs is to formulate opportunities for reducing cost and reducing customer dissatisfaction. The analysis of

quality-related costs helps to identify those opportunities for improvement that offer the largest cost savings (Ishikawa, 1985).

In order to encourage employees to pay attention to quality, quality-related data should be used for evaluating employee performance. Quality-related indices should be combined with general employee performance standards. Quality-related data should also be used to evaluate the performance of employees at different levels and the performance of the whole firm, and should be displayed at the shop floor in order to make employees understand what happens concerning quality. Please note that the major aim of evaluation is improvement, not criticism. In order to have an effective evaluation, a quality information system is truly necessary, as it is an organized method of collecting, storing, analyzing, and reporting information on quality to assist decision-makers at all levels (Juran and Gryna, 1993; Mann, 1992).

Process Control and Improvement

Process refers to certain unique combinations of machines, tools, methods, materials, and people engaged in production. Process control and improvement⁹ connotes a set of methodological and behavioral practices, which are implemented to control and improve processes that produce products and services (Juran and Gryna, 1993). In fact, process control and improvement can make the manufacturing process operate as expected, without breakdowns, missing materials, fixtures, tools, etc., and despite workforce variability (Flynn et al., 1994). A set of practices of process control and improvement is described in the following paragraphs.

The Japanese strongly believe that an atmosphere of cleanliness adds to quality, thus, shop floor management is highly emphasized by Japanese firms (Deming, 1986). It is a very important practice to keep the firm neat and clean at all times, which can contribute to effective process control and improvement (Ho, 1999).

An important matter in process control and improvement is the maintenance of process capability to meet production requirements. Process capability is largely independent of specification tolerances for parts to be manufactured within the process. It is important to determine these capabilities as fundamental to product-control standards setting (Feigenbaum, 1991). Process capability study provides a basis for this determination and its related assignment of parts to those facilities that can economically maintain the required tolerances (Gitlow et al., 1989).

One aspect of process control and improvement is equipment maintenance, which ensures that variation is kept within acceptable bounds, keeping the manufacturing process running

⁹ Process control and improvement is sometimes called process management. The two terms are interchangeable.

smoothly. Process capability is the measured, inherent variation of the product turned out by a process, and provides a quantified prediction of process adequacy (Juran and Gryna, 1993). According to Feigenbaum (1991), manufacturing equipment inevitably wears under constant use, a result of which would be poor-quality products. A program of preventive maintenance is an important quality management practice since it enables a regularly scheduled examination of processing facilities before they break down. According to Deming (1986), Japanese machine operators regularly make minor repairs, perform maintenance work, and record machine performance data.

Deming (1986) stated that improving product quality should not be dependent on mass inspection. Inspection to improve quality is too late, ineffective, and costly. Quality comes not from inspection, but from improvement of the production process. In this regard, a firm should try to implement effective inspection activities in order to reduce any non-value-added activities.

A firm should try to design its process to be “foolproof” in order to minimize the chance of employee error. Foolproofing describes methods, such as poka-yoke, which ensure that activities or operations can only be performed the correct way. Foolproofing methods can be divided into two types: Alarms and controls. Alarm devices may light a red lamp, sound a buzzer, or flash an alarm light if a mistake is detected. Control devices may interrupt work by activating a clamp, stopping a machine, or halting a conveyor if a mistake occurs so that a defect does not move on to the next process (Slack et al., 1995).

Statistical process control is the application of statistical methods to the measurement and analysis of variation in any process (Juran and Gryna, 1993). Statistical process control can be used to achieve process stability, provide guidance on how the process may be improved by the reduction of variation, assess the performance of a process, and provide information to assist with management decision-making (Dale, 1999). Without statistical control, the process is in chaos, the noise of which will mask the effect of any attempt to bring improvement (Deming, 1986).

A number of quality tools or techniques can be implemented to control and improve processes. These methods include the seven QC tools and the seven new QC tools. The PDCA cycle is essentially the scientific method applied to continuous process improvement (Dale, 1999; Deming, 1986; Mann, 1992).

Product Design

Product design translates customer expectations for functional requirements into specific engineering and quality characteristics, which can be called specifications. Sound product design can contribute to the improvement of product quality to be better than that of competitors, increasing a firm’s competitive advantage in the marketplace (Juran and Gryna, 1993). There is a set of practices that can be used to design products.

In order to have effective product design, design engineers are required to have some shop floor experience such as processing technology, understanding of performance of production equipment, skill for operating production equipment, and production process. Such

knowledge can contribute to robust product design. Thus, fewer problems will occur during the process of production (Feigenbaum, 1991; Juran and Gryna, 1993; Slack et al., 1995).

In fact, product design starts with market research. Therefore, it is an important practice for design engineers to have some marketing experience and knowledge, making it easier for them to understand customer needs, expectations, and future requirements. As a result, product design will be more market-oriented (Feigenbaum, 1991; Juran and Gryna, 1993).

Customer requirements and expectations should be thoroughly considered during the process of product design. It is important that design department obtain detailed information from the field. Field failure data and customer complaints should be sufficiently detailed to provide a means for analyzing the causes, so that proper corrective action can be taken toward improving product design (Feigenbaum, 1991; Juran and Gryna, 1993).

Different departments in a firm should participate in new product design. Such design teams composed of people from such departments as design, engineering, production, and sales can contribute to improvement of product design and design for the future (Deming, 1986). The participation of different departments in product design can ensure fewer problems during the process of production as well as after products are delivered to customers (Juran and Gryna, 1991).

Before production, new product design should be thoroughly reviewed in order to avoid problems during production. Design review is documented, comprehensive and systematic examination of a design to evaluate its capability to fulfil the requirements for quality, identify problems, if any, and propose the development of solutions (ISO 8402, 1994).

Price is still an important factor affecting competitive capability of products in the marketplace (Meredith and Shafer, 1999). Therefore, cost should be paid sufficient attention during the process of product design. It is possible that reducing production cost does not sacrifice product performance. Value engineering is a technique for evaluating the design of a product to assure that the essential functions are provided at minimal overall cost (Juran and Gryna, 1993).

For traditional products, product design process is not complex and can be achieved by experienced design engineers without using any special techniques. For modern products, certain special techniques or methods should be used to achieve successful product design (Juran and Gryna, 1993). According to the author's previous research (Zhang, 1998b, 1998d), experimental design is a widely used tool in product design. Its application has significantly reduced the time and expense needed to develop the new product, greatly improved the performance of the new product, and led to the success of new product design.

Quality function deployment is also an important and effective method in product design (Daetz et al., 1995). It is primarily concerned with the relationship between customer needs and new product attributes, which can support the establishment of a market advantage (Daetz et al., 1995; Reed et al. 1996; Slack et al., 1995). This technique consists of a series of interlocking matrixes that translates customer needs into product and process characteristics (Juran and Gryna, 1993).

Quality System Improvement

Quality system is defined as the organizational structure, procedures, processes and resources needed to implement quality management (ISO 8402, 1994). In 1987, the International Standardization Organization published the ISO 9000 standards series on quality management and quality assurance. Implementing ISO 9000 is a way in pursuing quality system improvement in a firm. In this study, quality system improvement means to establish a quality system according to the requirements of ISO 9000. Through the implementation of ISO 9000, a quality manual, quality system procedures, and work instructions are established. In the end, a firm may apply to be registered as having an ISO 9001 (9002 or 9003) quality certificate (Randall, 1995; Mirams and McElheron, 1995).

A quality manual is a document stating the quality policy and describing the quality system of an organization (ISO 8402, 1994), and should cover all the applicable elements of the quality system standard required for an organization. Guidelines for developing quality manuals (ISO 10013, 1995) can be used for drawing up a quality manual.

A procedure is a specified way to perform an activity. A written procedure contains the purposes and scope of an activity; what shall be done and by whom; when, where and how it should be done; what materials, equipment and documents shall be used; and how it shall be controlled and recorded. Documented quality system documents describe the activities of individual functional units needed to implement the quality system elements (ISO 8402, 1994; ISO 10013, 1995)

Work instructions consist of detailed work documents, which can guide people in conducting specific work. It should be noted that drawing up various work instructions should be based on the existing documents and characteristics of the firm, and should be presented to different people for extensive review. Thus, these work instructions can be effectively implemented in practice (Randall, 1995; Mirams and McElheron, 1995).

With an ISO 9000 quality system in place, a firm may consider becoming ISO 9000 certified. Please note that a quality system should be continuously improved. Quality system documents should be continuously modified with the change of quality activities within the firm. Of course, it is essential to maintain the quality system's conformance with the ISO 9000 requirements (Randall, 1995).

Employee Participation

Employee participation can be defined as the degree to which employees in a firm engage in various quality management activities. By personally participating in quality management activities, employees acquire new knowledge, see the benefits of the quality disciplines, and obtain a sense of accomplishment by solving quality problems. Participation is decisive in inspiring action on quality management (Juran and Gryna, 1993). Employee participation is exemplified by things such as teamwork, employee suggestions, and employee commitment.

A remarkable characteristic of employee participation is teamwork (e.g., cross-functional teams and within-functional teams). The aim of a team is to improve the input and output of

any stage. A team may well be composed of people from different staff areas, everyone having a chance to contribute ideas, plans, and figures. Teamwork is sorely needed throughout the firm; it can compensate one's strength for another's weakness (Deming, 1986). Group work and group decision-making offer several advantages over individual effort. If several knowledgeable people are brought into the decision-making process, a number of worthwhile possibilities may be uncovered, making synergy a possible benefit. Group members often evaluate each other's thinking, thus the team is likely to avoid major errors (DuBrin, 1995). Cross-functional quality teams and task forces are among the most common features of TQM firms (Hackman and Wageman, 1995). Teamwork can be characterized as collaboration between managers and non-managers, between different functions (Dean and Bowen, 1994). Teamwork practices include identifying the needs of all groups and firms involved in decision-making, trying to find solutions that will benefit everyone involved, and sharing responsibility and credit. Such practices are often implemented by forming teams. Hackman and Wageman (1995) stated that the single most commonly used TQM implementation practice is formation of short-term problem-solving teams. Problem-solving teams work on a wide variety of tasks, ranging from cross-functional involvement in tackling quality problems related to many functional departments to solving within-functional quality problems. Anderson et al. (1994a) suggested that internal cooperation among employees enables higher individual performance by creating mutually beneficial situations among organizational members and between organizational members, and the firm as a whole.

A quality control (QC) circle is a group of workforce-level people, usually from within one department, who volunteer to meet weekly to address quality problems that occur within their department (Juran and Gryna, 1993). QC circles have been successfully implemented in Japan, contributing a great deal to the Japanese economy (Lillrank and Kano, 1989).

Hackman and Wageman (1995) stated that 65% TQM firms create employee suggestion systems. Production workers should regularly participate in operating decisions such as planning, goal setting, and monitoring of performance. They are encouraged to make suggestions and take a relatively high degree of responsibility for overall performance (Deming, 1986). To have effective employee participation, employee contributions and ideas must receive serious consideration and be placed into operation whenever the recommendations are sound and relevant. Among the motivational programs that have received major attention are employee suggestion programs (Feigenbaum, 1991). Deming (1986) and Ishikawa (1985) identified one source of human motivation at work as task motivation, the good feeling that comes from accomplishing things and seeing them actually work.

For achieving effective employee participation, employees should be committed to their jobs. Job commitment can be defined in terms of one's loyalty, identification, and involvement with the firm (Mitchell, 1979). If employees are committed to their jobs, they will be motivated to spend more energy on providing high process, product, and service quality to satisfy the firm's customers (Lam, 1995).

In order to have effective employee participation, employees should be encouraged to report their own working problems as well as problems they find in other areas of the firm. Employees should be encouraged to inform top managers or supervisors concerning

conditions that need correction (e.g., inherited defects, machines not maintained, and poor tools). More importantly, employees should be encouraged to fix their own working problems (Deming, 1986).

Recognition and Reward

Recognition is defined as the public acknowledgment of superior performance of specific activities. Reward is defined as benefits, such as increased salary, bonuses and promotion, which are conferred for generally superior performance with respect to goals (Juran and Gryna, 1993). Public recognition is an important source of human motivation (Deming, 1986). It almost goes without saying that an important feature of any quality improvement program is the showing of due recognition for improved performance by any individual, section, department or division within the firm (Dale and Plunkett, 1990). To effectively support their quality effort, firms must implement an employee compensation system that strongly links quality and customer satisfaction with pay (Brown et al., 1994). Deming (1986) and Ishikawa (1985) identified one source of human motivation at work as social motivation, the energy that comes from cooperation with others on a shared task and the incentive provided by recognition from others. A large majority of firms implementing TQM modify their performance measurement and reward systems so that achievement of specific quality goals can be assessed and rewarded (Hackman and Wageman, 1995). TQM implementation relies increasingly on performance measurement and performance-contingent rewards to motivate and control employees. According to the review results by Hackman and Wageman (1995), 85% of TQM firms have developed programs to reward individuals and teams for quality achievements.

DuBrin (1995) stated that punishment is a behavior modification strategy. Punishment is the presentation of an undesirable consequence or the removal of a desirable consequence because of unacceptable behavior, and is regarded as negative motivator. DuBrin (1995) further proposed that a reward and recognition system should be equitable. Workers who achieve the same level of performance should receive comparable rewards. Similarly, workers who fail to obtain certain levels of performance should receive comparable punishment. In this regard, punishment is a special recognition and “reward” for employees who do not perform well. It is important to note that employees’ recognition and rewards should be based on equity. Effective recognition and reward activities can stimulate employee commitment to the firm.

A firm’s TQM initiative must be supported with a recognition and reward system that encourages and motivates employees to achieve the desired performance. Firms that are serious about achieving quality and customer satisfaction must integrate these aspects into their recognition and reward system. Ishikawa (1985) suggested that firm-wide gain-sharing or profit-sharing programs can appropriately be used to recognize and reward collective excellence. Excellent employee suggestions should be financially rewarded in order to encourage employee participation. The forms of recognition can be a praise letter, an oral praise, award ceremony, moral award, publicly presenting successful working experiences (Zhang, 2000a). Mann and Kehoe (1994) suggested that working condition improvement be used to recognize employee quality improvement efforts. Cherrington (1995) stated that the forms of reward can be merit pay, piece-rate incentives, team and group incentives, skill-

based pay and pay-for-knowledge, suggestion system, profit sharing, salary increase, and bonus scheme.

Education and Training

Training refers to the acquisition of specific skills or knowledge. Training programs attempt to teach employees how to perform particular activities or a specific job. Education, on the other hand, is much more general, and attempts to provide employees with general knowledge that can be applied in many different settings (Cherrington, 1995). Cherrington suggested that education and training require a systematic approach. The development of a sound education and training program requires systematically gathering data about the employees' or the firm's needs. A good assessment includes an analysis of: How well the firm is achieving its goals; the skills needed by the workforce to accomplish these goals; and the strengths and weaknesses of the current workforce. A careful analysis of these items provides valuable information to design effective training activities. Investment in education and training is vitally important for ensuring the success of education and training programs. According to Hackman and Wageman (1995), training is the second most commonly used TQM implementation practice in the United States. Firms that implement TQM invest heavily in training for employees at different levels. Deming (1986) spoke often of the importance of properly training workers in performing their work. Otherwise, it is difficult to improve their work.

The cross-functional quality teams among the characteristics of TQM firms stack the cards in favor of learning by the simple fact that they are cross-functional; individual members are exposed to more, and more diverse, points of view than would be the case if they worked mostly by themselves or in within-functional teams (Hackman and Wageman, 1995). Learning is the ability and willingness of the firm to engage in learning or knowledge-seeking activities at the individual, group or team, and organizational levels (Anderson et al., 1994a). In order to have effective learning activities, a firm should continually encourage employees to accept education and training.

The TQM aspiration of continuous improvement in meeting customer requirements is supported by a thorough learning orientation, including substantial investments in training and the widespread use of statistical and interpersonal techniques designed to promote individual and team learning (Hackman and Wageman, 1995). According to Deming (1986), Japanese firms obviously regard their employees as their most significant competitive assets and provide good general orientation as well as training in specific skills. Note that investment in employee education and training is to pursue long-term overall business excellence. In fact, employees are valuable resources worthy of receiving education and training throughout their career development.

Ishikawa (1985) advocated that employees accept training for the seven QC tools. According to Feigenbaum (1991), a brief and general course for first-line supervision is modern methods of planning and controlling quality, concentrating essentially upon the physical elements affecting product quality. In order to use various quality tools or methods effectively, employees should be trained in these methods. More training should be given to

employees such as quality inspectors, supervisors, and production operators. It is important to provide training to employees just at the time they need it; namely, just-in-time training.

In order to perform their work well, employees at different levels should accept specific work-skills training. Such training can improve employees' skills. In addition, employees should accept quality consciousness education in order to improve their commitment to quality. Newly recruited employees should accept more education on quality awareness. Newsletter, poster slogan, and quality day are commonly used for educating and/or training employees (Zhang, 2000a). Education and training have failed if they do not result in a change of behavior (Juran and Gryna, 1993).

Customer Focus

Customer focus can be defined as the degree to which a firm continuously satisfies customer needs and expectations. A successful firm recognizes the need to put the customer first in every decision made (Philips Quality, 1995). The key to quality management is maintaining a close relationship with the customer in order to fully determine the customer's needs, as well as to receive feedback on the extent to which those needs are being met. The customer should be closely involved in the product design and development process, with input at every stage, so that there is less likelihood of quality problems once full production begins (Flynn et al., 1994). Deming (1986) suggested that the customer is the most important part of the production line; product should be aimed at the needs of the customer.

Obtaining customer complaint information is to seek opportunities to improve product and service quality. Quality complaints have different problems that require different actions. Based on customer complaint information, it is important to identify the "vital few" serious complaints that demand in-depth study in order to discover the basic causes and to remedy those causes (Juran and Gryna, 1993). To improve customer focus efforts, customer complaints should therefore be treated with top priority. Records and analyses of customer complaint reports from the field furnish useful product-control information. Such information reflects the effectiveness of control programs and highlights those nonconformities upon which more aggressive corrective action must be initiated (Feigenbaum, 1991).

Obtaining customer satisfaction information is essential for pursuing customer focus efforts. Intensive examination of finished products from the viewpoint of the customer can be a useful predictor of customer satisfaction. Such information includes data on field failures and service-call rates, and analysis and reporting of customer attitude trends regarding product quality. Such information is valuable for new product development (Feigenbaum, 1991). The results of customer satisfaction surveys can be used to take immediate action on customer complaints, identify problems requiring generic corrective action, and provide a quantitative measurement of customer satisfaction (Juran and Gryna, 1993). Customer satisfaction may very well predict the future success or failure of a firm

(Kanji and Asher, 1993). Thus, it is very important to find customer satisfaction and perception of quality. The insights gained can clearly help the firm improve quality.

In-depth marketing research can identify suddenly arising customer needs. The attainment of quality requires the performance of a wide variety of identification activities of quality tasks such as the study of customers' quality needs, design review, and field complaint analysis (Juran and Gryna, 1993). To achieve quality, it is essential to know what customers need and provide products that meet their requirements (Ishikawa, 1985). According to the review results from Hackman and Wageman (1995), obtaining data about customers is one of the most commonly used TQM implementation practices. Deming (1986) suggested that firms understand what the customer needs and wishes now and in the future, so that products and services can be designed to satisfy those needs and wishes.

In order to pursue customer focus, firms should always provide warranties on their products sold to customers. Thus, customers will reduce their risk in buying products. In addition, firms should pay sufficient attention to customer services. In a word, pursuing customer focus efforts should be a long-term business strategy; it is never ending (Juran and Gryna, 1993).

2.6 Summary

This chapter began with reviewing TQM concept from quality gurus Deming, Juran, Crosby, Feigenbaum, and Ishikawa. Then, three quality award models were reviewed. These three awards are: The Deming Prize in Japan, the European Model for Total Quality Management in Europe, and the Malcolm Baldrige National Quality Award in the United States of America. In addition, some TQM literature from other researchers was studied. Based on the results of the literature review, the concept of TQM was defined. In this study, TQM consists of 11 constructs; implementing TQM is merely to implement these 11 constructs. Implementing each construct is through a set of TQM practices. The detailed explanations of these constructs and the set of practices that support their implementation were also described.

