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Document Version
Publisher's PDF, also known as Version of record

Publication date:
1997

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):
Zhang, Z. (1997). *Developing a TQM quality management method model.* s.n.

Developing a TQM
Quality Management Method Model

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Abstract

From an extensive review of total quality management literature, the external and internal environment affecting an organization's quality performance and the eleven primary elements of TQM are identified. Based on the primary TQM elements, a TQM quality management method model is developed. This model describes the primary quality management methods which may be used to assess an organization's present strengths and weaknesses with regard to its use of quality management methods. This model can also assist an organization to decide which quality management method to implement.

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[1] The author would like to express the gratitude to his promoters Prof. ir. A.C. Waszink and Prof. Dr. J. Wijngaard for their valuable comments. The author would also like to thank his colleague Drs. J. de Vries for giving some suggestions.

1. Introduction

The level of awareness of total quality management (TQM) has increased considerably over the last few years. There are many discussions on the subject of TQM. However, the contents of these papers differ to a considerable degree. Some focus on, for example, the importance of top management commitment and empowerment, while others focus on customer satisfaction and supplier involvement. There is a widespread consensus that TQM is a way of managing an organization to improve its overall effectiveness. There is less agreement as to what the primary elements of TQM are, what the overall concept of TQM is, and how many quality management methods actually exist.

This paper is based on an extensive review of literature concerning the primary elements of TQM. The reviewed literature includes concepts from quality gurus, quality award models, and some basic papers on the concept of quality management. The literature provides a perception of the historical development of quality management and enables an understanding of the primary elements of which TQM consists.

The purpose of this paper is to develop the TQM quality management method model. This model describes the primary quality management methods which may be used to assess an organization's present strengths and weaknesses with regard to its use of quality management methods. This model can also assist an organization to decide which quality management method to implement for improving organizational performance.

Section 2 presents the historical development of quality management. Subsequently, in Section 3, the TQM concepts from quality gurus are presented. In Section 4, a detailed review on three quality award models is undertaken. Section 5 presents the external and internal environment affecting an organization's quality performance. The eleven TQM elements are identified in Section 6. Section 7 describes the TQM quality management method model. In Section 8, the future research questions are proposed. Section 9 provides a number of conclusions of this paper.

2. Historical Development of Quality Management

The development of quality management can be defined in four stages (Dale and Plunkett, 1990).

(1)   Quality inspection stage;

(2)   Quality control stage;

(3)   Quality assurance stage;

(4)   Total quality management stage.

2.1 Quality Inspection stage

Quality management started with simple inspection-based systems. Under such a system, one or more characteristics of a product are examined, measured or tested and compared with specified requirements to assess its conformity (Kanji and Asher, 1993). This system is used to appraise incoming products, manufactured components and assemblies at appropriate points in the production process. It is undertaken mainly by staff employed specifically for this purpose. Products which do not conform to specification may be scrapped, reworked or sold as lower quality items. In some cases, inspection is used to grade the finished products. The system is an after-the-fact screening process with no prevention content other than, perhaps, the identification of suppliers, operations or workers manufacturing non-conforming products. Simple inspection-based systems are usually wholly in-house and do not directly involve suppliers or customers.

2.2 Quality Control Stage

Under a system of quality control, product testing and documentation control became the ways to ensure greater process control and reduced non-conformance. Typical characteristics of such systems were performance-data collection, feedback to earlier stages in the process, and self-inspection. While screening inspection was again the main mechanism for preventing products which were outside the

specification from being shipped to customers, quality control measures led to greater process control and a lower incidence of non-conformance.

2.3 Quality Assurance Stage

The quality assurance stage came with the change away from product quality towards system quality. In this stage, an organization sets up a system for controlling what is being done and the system is audited to ensure that it is adequate both in design and use. A major part of this change is the use of both second-party and third-party audits to assess the efficiency of the system. The major characteristics of this stage are the use of quality manuals, procedures, work instructions, quality planning, quality audits, etc. The fundamental difference is that quality assurance is prevention-based while quality control is inspection-based.

2.4 Total Quality Management Stage

Total quality management stage is the highest level, involving the application of quality management principles to all aspects of the business. Total quality management requires that the principles of quality management be applied in every branch and at every level in an organization. Typical of an organization going through a total quality process would be a clear and unambiguous vision, few interdepartmental barriers, time spent on training, excellent supplier and customer relations and the realization that quality is not just product quality but also the quality of the whole organization, including sales, finance, personnel and other non-manufacturing functions.

3. Concepts from Quality Gurus

An extensive review of literature was carried out to identify the primary elements necessary for the successful implementation of TQM. Over the past few decades, writers such as Deming, Crosby, Juran, Feigenbaum, Ishikawa, Taguchi and others

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have developed certain propositions in the area of quality management. Their insights into quality management provide a good understanding of quality management principles. An example of one such proposition is: quality is a responsibility of the whole organization, rather than of the quality department. There are many such propositions covering different aspects of quality management practices. The following sections present the main ideas proposed by these quality gurus.

3.1 Deming's Quality Management Approach

Deming is widely regarded as the master who developed Japan's "road map" to quality. The road map is basic, simple, consists of readily available technology, and relies on common sense. Deming defines quality as "satisfying the customer, not merely to meet his expectations, but to exceed them". Deming's philosophy thus starts and finishes with the customer.

The means to improve quality lie in the ability to control and manage systems and processes properly, and the role of management responsibilities in achieving this. Deming is associated with statistical process control and other problem-solving methods which aim to improve processes and reduce the inevitable variation which 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 stresses the responsibilities of top management to take the lead in changing processes and systems. Top management is responsible for most quality problems. Management should give employees clear standards for what is considered acceptable work, and provide the methods to achieve it. These methods include the appropriate working environment and climate for work - free of faultfinding, blame or fear. Deming also strongly promotes employee participation. These are set out in his 14 points or guidelines for managers (Deming, 1986). The 14 points put forward by Deming are listed below.

(1)   Create a constancy of purpose to improve products and services - take a longer   term view, and innovate;

(2)   Adopt the new philosophy - accept the management style which promotes constant improvement;

(3)   Cease dependence on mass inspection - concentrate on improving processes;

(4)   End the practice of awarding business on the basis of price tag alone, building up relationships with fewer suppliers to understand jointly specifications of and uses for materials and other inputs;

(5)   Constantly and forever improve the system - search continually for problems in all processes. It is management's job to work on the system;

(6)   Institute modern methods of training on the job - for all, to make the best use of every employee;

(7)   Institute modern methods of supervision - managers to focus on quality not numbers;

(8)   Drive out fear - so that people work more effectively;

(9)   Break down barriers between departments - teamworking to tackle problems;

(10)   Eliminate numerical goals for the workforce - eliminate slogans and exhortation, make reasonable requests of the workforce;

(11)   Eliminate work standards and numerical quotas - focus on quality and provide support;

(12)   Remove barriers that rob workers of pride in their work - for example, defective materials, poor tools, lack of management support;

(13)   Institute a vigorous program of education and training - for continual updating and improvement;

(14)   Create a top management structure to push every day on the above 13 points. Top management commitment is where it begins and ends.

3.2 Crosby's Quality Management Approach

Crosby defines quality as conformance to requirements. The requirements of a product need to be defined and specified clearly so that they are properly

understood. His maxim is that higher quality reduces costs and raises profits. Quality cost is used as a tool to help achieve that goal. Quality is measured by the quality cost. His categories of quality costs are similar to those of Juran - prevention, appraisal and failure. The aim is zero defects, of getting it right first time. This requires an emphasis on prevention rather than after-the-fact inspection. Crosby also presents the quality management maturity grid which may be used by organizations to assess their quality management maturity. The five stages are uncertainty, awakening, enlightenment, wisdom, and certainty. These can be used to assess progress on a number of "measurement categories", such as management understanding and attitude, the status of quality in the organization, problem handling, cost of quality as a percentage of sales, quality improvement actions. The quality management maturity grid and the cost of quality measures are the two main tools for managers to assess the seriousness of their quality problems. Crosby provides 14 steps to quality improvement (Crosby, 1979, 1984). The 14 steps are listed below.

(1)   Management commitment - to make clear where management stands on quality;

(2)   Quality improvement team - to set up a high-level, cross-functional team to run the quality improvement program;

(3)   Quality measurement - to provide a display/report of current and potential non-conformance problems in an objective manner;

(4)   The 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 for quality felt by all employees;

(6)   Corrective action - to provide a systematic method for resolving problems identified;

(7)   Zero defects (ZD) action - preparatory activities for ZD program-launching;

(8)   Employee education - define the type and extent of supervisor training;

(9)   ZD day - popularize ZD philosophy and raise quality consciousness;

(10)   Goal setting - goals and commitments are set by employees for themselves and their groups;

(11)   Error-cause removal - develop a method for employees to communicate with the management regarding error-cause removal;

(12)   Recognition of good work in the quality process - to appreciate employees with superior performance.

(13)   Quality councils - brings together the professional quality staff for a planned communication on a regular basis;

(14)   Do it over again - emphasize that quality improvement never ends and is a constant effort.

Crosby (1984) claims "Mistakes are caused by two factors: 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.

3.3 Juran's Quality Management Approach

Juran considers quality management as three basic processes (Juran Trilogy): quality planning, quality control, and quality improvement (Juran and Gryna, 1993). Juran defines quality as "Quality is customer satisfaction" or "Fitness for use". In his view, the approach to managing for quality consists of :

(1)   The sporadic problem is detected and acted upon by the process of *quality control*;

(2)   The chronic problem requires a different process, namely, *quality improvement*;

(3)   Such chronic problems are traceable to an inadequate *quality planning* process.

Like Deming, Juran believes most quality problems are due to management, not employees. He also states that the distinction between chronic and sporadic problems is essential because there are two different approaches to handling the

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problems. Chronic problems require the principle of "breakthrough", while sporadic problems require the principle of "control" (Juran and Gryna, 1970).

He further elaborates the sequence of activities required for "breakthrough" and "control". These are respectively as follows:

"Breakthrough" activities (quality improvement) (Juran and Gryna, 1970) include:

(1)   Breakthrough in attitudes - convincing those responsible that a change in quality level is desirable and feasible;

(2)   Discovery of the vital few projects - determining which quality problem areas are important;

(3)   Organizing for breakthrough in knowledge - defining the organizational mechanism for obtaining the knowledge for achieving a breakthrough;

(4)   Creation of a steering arm - defining and staffing a mechanism for directing the investigation for quality improvement;

(5)   Creation of a diagnostic arm - defining and staffing a mechanism for executing the technical investigation;

(6)   Diagnosis - collecting and analyzing the facts required and recommending the action needed;

(7)   Breakthrough in cultural pattern - determining the effect of a proposed change on the people involved and finding ways to overcome resistance to change;

(8)   Breakthrough in performance - obtaining agreement to take action;

(9)   Transition to the new level - implement the change.

"Control" activities (Juran and Gryna, 1993) include:

(1)   Choosing the control subject: i.e., choosing what we intend to regulate;

(2)   Choosing a unit of measure;

(3)   Setting a goal for the control subject;

(4)   Creating a sensor which can measure the control subject in terms of the unit of measure;

(5)   Measuring actual performance;

(6)   Interpreting the difference between actual performance and the goal;

(7)   Taking action (if any) on the difference.

"Planning" activities (Juran and Gryna, 1993) include:

(1)   Establish the quality goal;

(2)   Identify customers;

(3)   Discover customer needs;

(4)   Develop product features;

(5)   Develop process features;

(6)   Establish process controls and transfer to operations.

3.4 Feigenbaum's Quality Management Approach

Feigenbaum defines quality as the "total composite product and service characteristics of marketing, engineering, manufacture and maintenance through which the product and service in use will meet the expectations of the customer" (Feigenbaum, 1986). He states that total quality management covers the full scope of the product and service "life cycle" from product conception through production and customer service. The quality chain, he argues, 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, engineering, purchasing, manufacturing, inspection, shipping, accounting, installation, and service, etc., are involved in and influence the attainment of quality. Effective total quality control requires, therefore, a high degree of functional integration. Furthermore, it guides the coordinated actions of people, machines and information to achieve quality goals. He stresses a system approach to quality. The total quality control consists, he claims, of four main stages. They are described as follows.

(1)   Setting quality standards;

(2)   Appraising conformance to these standards;

(3)   Acting when standards are not met;

(4)   Planning for improvement in these standards.

The emphasis is on the prevention of poor quality rather than detecting it after the event. He argues that quality is an integral part of the day-to-day work of the line, staff and operatives of an organization. It cannot be effectively separated from other activities undertaken by employees and any attempt to do so more would than likely result in substandard quality. He, like most other gurus, considers effective staff training and education to be an essential component of TQM. He states that education and training should address the three vital areas of quality attitudes, quality knowledge, and quality skills.

3.5 Ishikawa's Quality Management Approach

Ishikawa defines quality as the "development, design, production and service of a product that is most economical, most useful, and always satisfactory to the consumer". He argues that quality control extends beyond the product and encompasses after-sales service, the quality of management, the quality of individuals and the company itself. He advocates employee participation as the key to the successful implementation of TQM. Quality circles, he believes, are an important vehicle to achieve this. In his work, like all other gurus, he emphasizes the importance of education. He states that quality begins and ends with education. He has been associated with the development and advocacy of universal education in the seven QC tools (Ishikawa, 1985). These tools are listed below:

(1)   Process flow chart;
(2)   Check sheet;
(3)   Histogram;
(4)   Pareto chart;
(5)   Cause - effect diagram (Ishikawa diagram);
(6)   Scatter diagram;
(7)   Control chart.

Ishikawa's concept of total quality control contains six fundamental principles:

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(1)   Quality first - not short-term profits first;

(2)   Customer orientation - not producer orientation;

(3)   The next step is your customer - breaking down the barrier of
        sectionalism;

(4)   Using facts and data to make presentations - utilization of statistical
        methods;

(5)   Respect for humanity as a management philosophy, full participatory
        management;

(6)   Cross - functional management.

3.6 Taguchi's Quality Management Approach

Taguchi emphasizes an engineering approach to quality. Taguchi defines quality as the "loss imparted to the society from the time a product is shipped". Examples of loss include: failure to reach ideal performance, failure to meet the customer's requirements, breakdowns, and harmful side-effects caused by products (Taguchi, 1986). Thus, the smaller the loss, the more desirable the product. The key elements of Taguchi's quality concepts are briefly stated below.

(1)   Quality improvement should concentrate on reducing the variation of the
        product's key performance characteristics with regard to their target
        values;

(2)   The loss suffered by a customer due to a product's performance variation is
often approximately proportional to the square of the deviation of the
        performance characteristics from its target value;

(3)   The final quality and cost of manufactured products are determined to a
        large extent by the engineering design of the product and the
        manufacturing process;

(4)   A product's or process's performance variation can be reduced by
        exploiting the non-linear effects of the product or process parameters on
        the performance characteristics;

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(5)   Statistically planned experiments can be used to identify the settings of product/process parameters that reduce performance variation.

3.7 Conclusions from Quality Gurus

Although each of the quality gurus on quality management has his own distinctive approach, there are some common points which are discussed below.

(1)   Top management is responsible for quality and not the employees. It is management's responsibility to provide commitment, leadership, and the appropriate support to technical and human processes. It is imperative that management has a clear understanding of the process.

(2)   Top management determines the climate and framework of operations within an organization. It is imperative that management fosters the participation of the employees in quality improvement, and develops a quality culture by changing perception and attitudes towards quality.

(3)   The importance of education and training is emphasized in changing employees' beliefs, behavior and attitudes and enhancing their competencies in carrying out their duties.

(4)   It is very important to control the process and not the product. The emphasis is on prevention of product defects, not inspection after the event, and on the reduction of the costs of quality to improve competitiveness.

(5)   There is a broad agreement that all aspects of activities should be looked   at for quality improvement, as these all contribute towards quality.   Functional integration is considered to be an important ingredient of TQM.   Quality   is   a company-wide activity.

The quality management approaches proposed by the quality gurus also have some shortcomings and limitations. Some researchers have commented on various gaps in these suggestions about quality management. These include the lack of a conceptual framework and of a sound instructional methodology to help organizations of different types examine quality management, in particular, to identify which aspects

of quality management matter, how much is needed, and how to establish customers' needs satisfactorily. Although these gurus have been strong on what is broadly needed, including detailed techniques, they offer little guidance on the immediate and direct value or relevance to organizations. It is difficult to connect the general quality concepts and ideas to these specific circumstances of an organization - to its markets, management practices, and human resource management. It is important that organizations do not rigidly apply the methods proposed by the gurus. Organizations need to examine the suggestions and match them to the specific requirements (Ghobadian and Speller, 1994; Garvin, 1987; Chase and Aquilano, 1989).

4. Review of Quality Award Models

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

(1)   Increase awareness of the importance of quality management because of
         its important contribution to superior competitiveness;
(2)   Encourage systematic self-assessment against established criteria and
         market awareness simultaneously;
(3)   Stimulate sharing and dissemination of information on successfully
         deployed quality strategies and on benefits derived from implementing
         these strategies;
(4)   Promote understanding of the requirements for the attainment of quality
         excellence and successful deployment of quality management;
(5)   Stimulate organizations to introduce a quality management improvement
         process.

Each award is based on a perceived model of total quality management. They 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 which influence the quality of the final offerings. They provide a useful audit framework against which organizations can evaluate their quality management methods, the deployment of these methods, and the end results.

4.1 The Deming Application Prize

The Deming Prize was established by the Board of Directors of the Japanese Union of Scientists and Engineers in 1951. Its primary purpose was to spread the quality gospel by recognizing performance improvements issuing from the successful implementation of company-wide or total quality control based on statistical quality control techniques (Ghobadian and Woo, 1996). The Deming Prize proved to be an effective instrument for spreading quality management methods throughout the Japanese industries.

There are ten primary elements in the Deming Application Prize (Ghobadian and Woo, 1996). There is also a checklist which 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. Also, the checklist provides the 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. The detailed criteria are listed in the Appendix.

(1)   Policies
(2)   The organization and its operations
(3)   Education and   dissemination
(4)   Information gathering, communication and its utilization
(5)   Analysis
(6)   Standardization
(7)   Control/management
(8)   Quality assurance

(9)   Effects

(10)   Future plans

The primary elements in the checklist used to evaluate the performance of senior executives are as follows:

(1)   Understanding and enthusiasm

(2)   Policies, objectives and targets

(3)   The organization, systems and human resources

(4)   Education, dissemination and thorough implementation

(5)   Implementation

(6)   Future policies, plans and measures

4.2 The European Quality Award

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 total quality management by European companies. 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 which are the measure of the level of output attained by the organization. The model consists of nine primary elements which are further divided into a number of secondary elements (EFQM, 1994). The primary and secondary elements are shown 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;

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- 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 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.

4.3 The Malcom 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 USA. The aim of the award is to stimulate American organizations to improve quality, satisfy customers, and improve overall company performance and capabilities. The model framework may be used to assess an organization's current quality management practices, benchmark performance against key competitors and world-class standards, improve relations with suppliers and customers. The model framework (CPE, 1997) is listed as follows:

(1)   Leadership
        - Leadership system;
        - Company responsibility and citizenship.
(2)   Strategic planning
        - Strategy development process;
        - Company strategy.
(3)   Customer and market focus
        - Customer and market knowledge;
        - Customer satisfaction and relationship enhancement.
(4)   Information and analysis
        - Selection and use of information and data;
        - Selection and use of comparative information and data;
        - Analysis and review of company performance.
(5)   Human resource development and management
        - Work systems;

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- Employee education, training, and development;

- Employee well-being and satisfaction.

(6)   Process management

- Management of product and service processes;

- Management of support processes;

- Management of supplier and partnering processes.

(7)   Business results

- Customer satisfaction results;

- Financial and market results;

- Human resource results;

- Supplier and partner results;

- Company-specific results.

4.4 Results of the Review of Quality Awards

The three models of quality awards provide a universal framework for evaluating aspects of quality management practices in an organization. They also provide a framework for identifying a range of intangible and tangible processes which influence the organization's total quality management and the end results. Although each award has its own unique categories and emphasis, there are some common areas which are listed below.

(1)   Leadership;
(2)   People management;
(3)   Processes;
(4)   Policy and strategy;
(5)   Supplier relations;
(6)   Customer focus;
(7)   Education and training;
(8)   Employee participation.

The three quality award models provide the organizations 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 practices and business results. However, the award models do not seek to assess the overall management excellence; they are concerned with factors which affect total quality management; they provide "what to do" and do not provide "how to do" to reach the targets; they do not address a specific organization's characteristics which may affect the implementation of TQM; they do not provide detailed guidelines for the organizations to use in improving quality management practices; they do not provide all kinds of quality management methods to be used for overcoming the weaknesses of the organizations. Thus, there remain some difficulties for the organizations in applying the quality award models effectively to improve their quality management practices. In addition, it is also unclear what kinds of quality management methods can be used to improve an organization's quality performance.

5. Environment Affecting TQM Implementation

The implementation of total quality management in an organization will be affected by external and internal environment. Figure 1 shows the internal environment and external environment which should be taken into account when an organization implements TQM.

The Adam et al. (1981) model is embedded in the basic elements of a business environment represented by a set of factors called environmental characteristics and constraints. The set is composed of four subsets:

(1)   Social environment - personal value system, ethical consideration, social
        responsibility, taste and behavior patterns, immediate community influence,
and greater community influence;
(2)   Legal-political environment - regulatory agencies, national laws, local
        ordinances, restrictions, international considerations, tax considerations,
        consumer legislation, union agreement;

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(3)   Technological environment - basic and applied research results, engineering knowledge, management knowledge, material-equipment innovation, process innovation, product innovation;

(4)   Economic environment - general economic conditions, labor market conditions, vendor market conditions, customer (international competitive) market conditions, inflation.

On the basis of the review of literature, the internal environment factors which affect the implementation of total quality management are identified and listed below. The detailed descriptions of the internal environment are in Section 6.

(1)   Leadership;
(2)   People;
(3)   Strategy and Policy;
(4)   Processes;
(5)   Suppliers;
(6)   Customers.
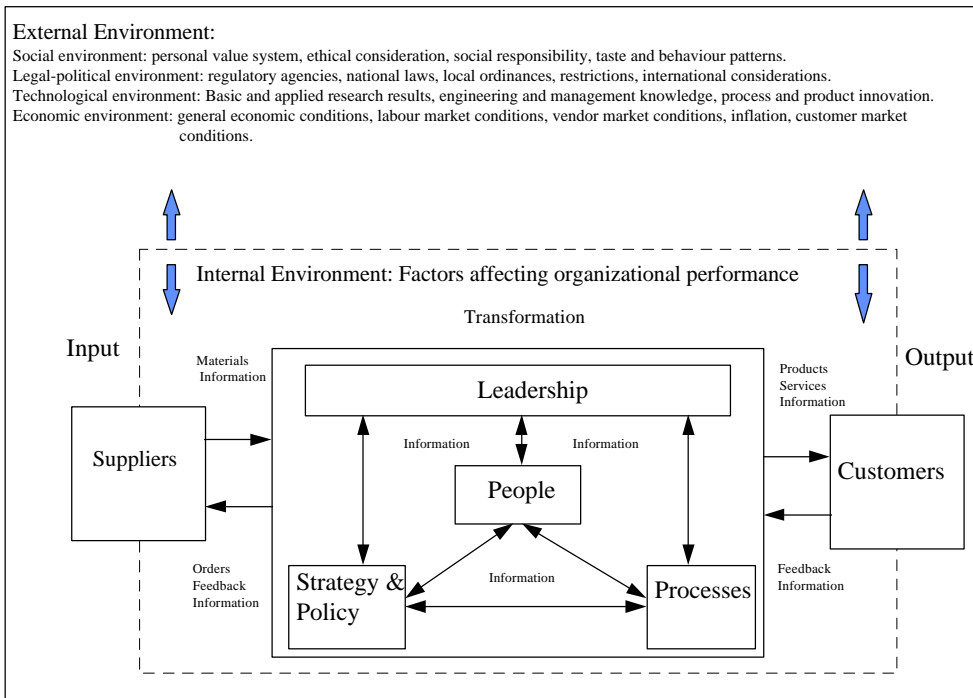
Figure 1. An Organization with Its Internal and External Environment

6. TQM Elements

Most quality practitioners divide TQM into a number of elements. Flynn et al. (1994) propose a model which is "Top management support creates an environment in which quality management activities are rewarded. These activities are related to quality information systems, process management, product design, work force management, supplier involvement and customer involvement". Mann and Kehoe (1994) divide 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, external customer focus. Saraph et al. (1989) propose eight critical factors of quality management, which are the role of management leadership and quality policy, the role of the quality department, training, product/service design, supplier quality management, process management, quality data and reporting, employee relations.

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After a comprehensive review of quality gurus, quality award models, and other existing literature, the six internal factors in Figure 1 may be divided into the following eleven elements which are identified as the most primary TQM elements. These elements can be distinguished as:

(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.

Although the number of elements often varies, as do the terms used to describe them, the actual constituents of these elements remain more or less similar. These eleven primary TQM elements are discussed below.

6.1 Leadership

The European Quality Award and the Malcolm Baldrige Quality Award recognize the crucial role of top management leadership in creating the goals, values and systems that guide the pursuit of continuous performance improvement. Recognition of the critical role of top management and its responsibility in pursuit of quality improvement echoes the arguments put forward by gurus of quality such as Deming, Juran, and Crosby. A predominant theme in quality management literature is that strong commitment from top management is vital. By definition, commitment is an intellectual characteristic, a personal attribute that, like honesty, can't be mandated or imposed from outside. To implement TQM in the organization successfully, top management has to believe in it - be committed to it. That is the first step. The

second and equally important step is to demonstrate the belief - the commitment to it. The foundation of an effective total quality management effort is commitment. Lack of management commitment is one of the reasons for the failure of TQM efforts (Brown et al., 1994). Garvin (1986) reports 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.

6.2 Supplier Quality Management

The supplier quality management is an important element of quality management in an organization because materials and purchased parts are often a major source of quality problems (Flynn et al., 1994). The Malcolm Baldrige Quality Award also recognizes the importance of supplier quality. Garvin (1983) found that organizations which manufactured the highest quality products had purchasing departments which ranked quality, rather than cost minimization, as their primary objective. Conversely, in organizations with the lowest quality performance, he found that the primary objective of the purchasing department was to obtain the lowest price for technically acceptable components. The poor quality of supplier items results in extra costs for the purchaser; e.g., for one appliance manufacturer, 75 percent of all warranty claims were traced to purchased components for the appliances (Juran and Gryna, 1993). In modern industrial production, the supplier becomes an extension of the buyer's organization to a certain extent.

6.3 Vision and Plan Statement

The process of introducing TQM can be explained by the "Quality Sweating Theory" proposed by Kano (1989). The theory consists of two alternative approaches: Crisis Consciousness and Leadership make people Sweat for Quality and Vision and Leadership encourage people to Sweat for Quality. A vision statement describes how a company wants to be seen in its chosen business. As such, it describes standards, values and beliefs. Above all, a vision is the

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advertisement of the intention to change. As such, it propels the company 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 which can be used to drive a process of change forwards (Kanji and Asher, 1993). Vision statement is usually cascaded down to mission statements which detail short-term site aims or departmental aims. In order to realize the vision statement, an organization has to make plan statements which support the realization of the vision. These plans may be a detailed business plan, quality policy, quality goal, and quality planning. Vision and plan statements are very important elements for an organization to implement an effective total quality management.

6.4 Evaluation

Evaluating the situation in an organization's quality management practices provides an important source for the organization to improve these quality management practices. Juran and Gryna (1993) state that a formal evaluation of quality provides a starting point by providing an understanding of the size of the quality issue and the areas demanding attention. Benchmarking is a powerful tool to use as a continuous process of evaluating an organization's products, services, and processes against those of its toughest competitors or those of organizations renowned as world-class or industry leaders. Evaluation activities comprise strategic evaluation, costs of quality, quality audit, diagnostic survey, department/function evaluation, employee performance evaluation, employee satisfaction evaluation, and team/project evaluation.

6.5 Process Control and Process Improvement

A key part of any total quality strategy is the management of processes (Porter and Parker, 1993). Process refers to some unique combination of machine, tools, methods, materials, and people engaged in production (Juran and Gryna, 1993). Process management focuses on managing the manufacturing process so that it operates as expected, without breakdowns, missing materials, fixtures, tools, etc., and despite work-force variability. One aspect of process management is equipment

maintenance, which ensures that variation is kept within acceptable bounds, keeping the manufacturing process running smoothly. Good process management also involves precisely defining and documenting process management procedures, with instructions for machine operation and set-up posted at each work station, in order to minimize the likelihood of operator error. Documentation increases the flexibility of workers to perform a variety of operations, keeping the manufacturing process running smoothly, despite job rotation (Flynn et al., 1994). Problem solving methods, statistical process control, failure mode effects analysis, foolproofing, sampling, and inspection are effective methods for process control and process improvement.

6.6 Product Design

Product design is an important dimension of quality management. For complex products, errors during product development cause about 50 percent of fitness-for-use problems (Juran and Gryna, 1993). Sound product design meets or exceeds the needs and desires of customers better than that of the competitors, leading to an increased market share (Flynn, 1994) . In fact, product design may be related to all of Garvin's (1987) critical dimensions of quality performance: performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality. There are several important components of product design for quality, such as concurrent engineering, reliability engineering, and designing for manufacturability. Taguchi methods and quality function deployment are two powerful methods used for product design.

6.7 Quality System Improvement

A documented quality system, as part of a total quality management strategy, contributes to this by managing the organizations' processes in a consistent manner. A quality system is defined as the organizational structure, procedures, processes and resources needed to implement quality management (ISO 8402, 1994). In 1987, ISO published the ISO 9000 standards series on quality management and quality assurance. Implementing the ISO 9000 is a way to improve organizational quality

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systems. There are many benefits to be derived from implementing ISO 9000 standards, such as reduced wastage, increased customer satisfaction, employee morale, more efficient and responsive organization, better position in the market place, and bigger profits (Mirams and McElheron, 1995). Through the implementation of the ISO 9000, a quality manual, quality procedures, and work instructions will be established. In the end, an organization may apply to be registered as having an ISO 9001 (9002 or 9003) quality certificate.

6.8 Employee Participation

It is tempting to believe that, to inspire action on quality, the first step is to change the people's attitudes. A change in attitudes should then lead to a change in behavior. In reality, the opposite is true. If people's behavior is changed first, their attitudes subsequently change. An age-old principle that helps to change behavior is the concept of participation. By personally participating in quality improvement activities, employees acquire new knowledge, see the benefits of the quality disciplines, and obtain a sense of accomplishment by solving quality problems. The participation leads to lasting changes in behavior. Participation is decisive in inspiring action on quality improvement (Juran and Gryna, 1993). Participation may enable the employees to improve their personal capabilities, increase the employees' self-respect, help them change certain personality traits. Participation may increase the management's and supervisors' respect for the employees, and increase the employees' understanding of the difficulties faced by management and supervisors. Participation may also change some employees' negative attitudes, reduce conflict stemming from the working environment, and instill in the employees a better understanding of the importance of product quality. Participation may contribute to the establishment of a company-wide quality culture.

6.9 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). 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 company or organization (Dale and Plunkett, 1990). To effectively support their quality effort, organizations need to implement an employee compensation system that strongly links quality and customer satisfaction with pay (Brown et al., 1994). An organization's total quality management initiative must be supported with a recognition and reward system that encourages and motivates employees to achieve the desired performance. Organizations that are serious about achieving quality and customer satisfaction must integrate these aspects of TQM into their recognition and reward system.

6.10 Education and Training

Education and training forms a vital part of TQM. Education and training are one of the key elements of total quality in which many people are involved, so the success of the implementation depends directly on how well they have been done (Kanji and Asher, 1993). Many research results reveal that education and training are one of the most important elements in a successful implementation of total quality management. The research confirms what most organizations already realize, namely, that education and training are an integral and essential part of the TQM initiative. Investment in education and training is vitally important for TQM success. In an organization, all of the management, supervisors, and employees should accept quality education and training. Quality education and training include quality awareness education and basic quality management methods, such as statistical process control, problem solving methods, basic tools and techniques. Education and training are a failure if they do not result in a change in behavior (Juran and Gryna, 1993).

6.11 Customer Focus

A successful organization recognizes the need to put the customer first in every decision made (Philips, 1995). The key to quality management is maintaining a close

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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 of the process, so that there is less likelihood of quality problems once full production begins (Flynn et al., 1994). The ultimate measure of company performance is customer satisfaction, which may very well predict the future success or failure of an organization (Kanji and Asher, 1993). Thus, it is very important to find customer satisfaction and customer perception of quality. The insights gained can clearly help the organization improve quality.

7. Forming a TQM Quality Management Method Model

The primary elements of TQM have been identified. The next question is how the eleven primary elements can be made operational for practical use within an organization.

There are some books and articles dealing with quality management methods. Kanji and Asher (1996) list 100 methods for total quality management. Each quality management method is described although how to integrate the 100 quality management methods is not discussed in the book.

The paper by Mann and Kehoe (1994) provides a TQM quality activity model. This quality activity model provides general guidelines detailing the effects of sixty-five quality activities on operational business performance. The model shows that the quality activities are classified by the operational business performance elements they primarily aim to improve.

Our paper builds on the Mann and Kehoe paper. However, this paper has some differences with the model established by Mann and Kehoe in several respects.

Firstly, this paper uses a different category of elements to those mentioned above. In the Mann and Kehoe model, TQM is divided into ten elements which 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.

Secondly, in this paper, a term "quality management method" is used. This is a generic term which describes a distinguishable tool or technique used for quality management. These quality management methods range from a basic tool, such as control charts, statistical quality control, to ISO 9000, and to total quality management. TQM is considered to be a quality management method which is composed of many quality management methods. In the Mann and Kehoe model, the term "quality activity" is used.

Thirdly, the quality management methods in this paper are different from those in the Mann and Kehoe quality activity model. There are some important quality management methods, such as empowerment, equipment maintenance, concurrent engineering, reliability engineering, designing for manufacturability, value engineering, computer-aided design, seven new tools, fault tree analysis, quality control circle, warranty of quality, which are not included in the Mann and Kehoe quality activity model.

An examination of each of these eleven elements enables the identification of a list of quality management methods. These quality management methods are then categorized by the elements they primarily aim to improve. Figure 2 is the TQM quality management method model. There are eighty-three kinds of quality management methods which may be used to improve leadership, supplier relations, processes, strategy and policy, people, and customer focus.

The purpose of this TQM quality management method model is to enable the optimal execution and harmonization of the various activities within an organization, in the most effective and efficient way, in order to make the final products exceed the customer's expectations. The TQM quality management method model provides an important guide to the expected effects of quality management methods on business performance. It can be used to assess an organization's present strengths and weaknesses with regard to the use of quality management methods. This TQM quality management model can assist in choosing which quality management methods to implement in an organization. The model can also be used as a tool for evaluating the quality management maturity in an organization.

At this point a few remarks should be made. An organization is a dynamic system consisting of many activities. Some quality management methods may be used in different areas in an organization. For example, the seven new tools may not only be used for improving processes but also be used for improving product design, planning, etc. Some quality management methods should be integrated for use in practice. Some quality management methods are discussed under different names in different literature. It is outside the scope of this paper to address further detailed concepts, definitions, or explanations of the eighty-three kinds of quality management methods shown in Figure 2. In addition, neither the relative importance nor the relationships between the quality management methods are indicated. Furthermore, how to use these quality management methods has also not been discussed in this paper.

8. Future Research Questions

As discussed in Section 5, the implementation of total quality management in an organization will be affected by the external and internal environment. Figure 1 shows the internal and external environment. The environment should be taken into account when an organization implements total quality management.

What kind of external environment should be formed in order to encourage an organization to implement total quality management?

In this paper, the TQM quality management method model is developed. Which kinds of quality management methods are commonly used by an organization? Which kinds of quality management methods are more important than others in terms of improving organizational quality performance?

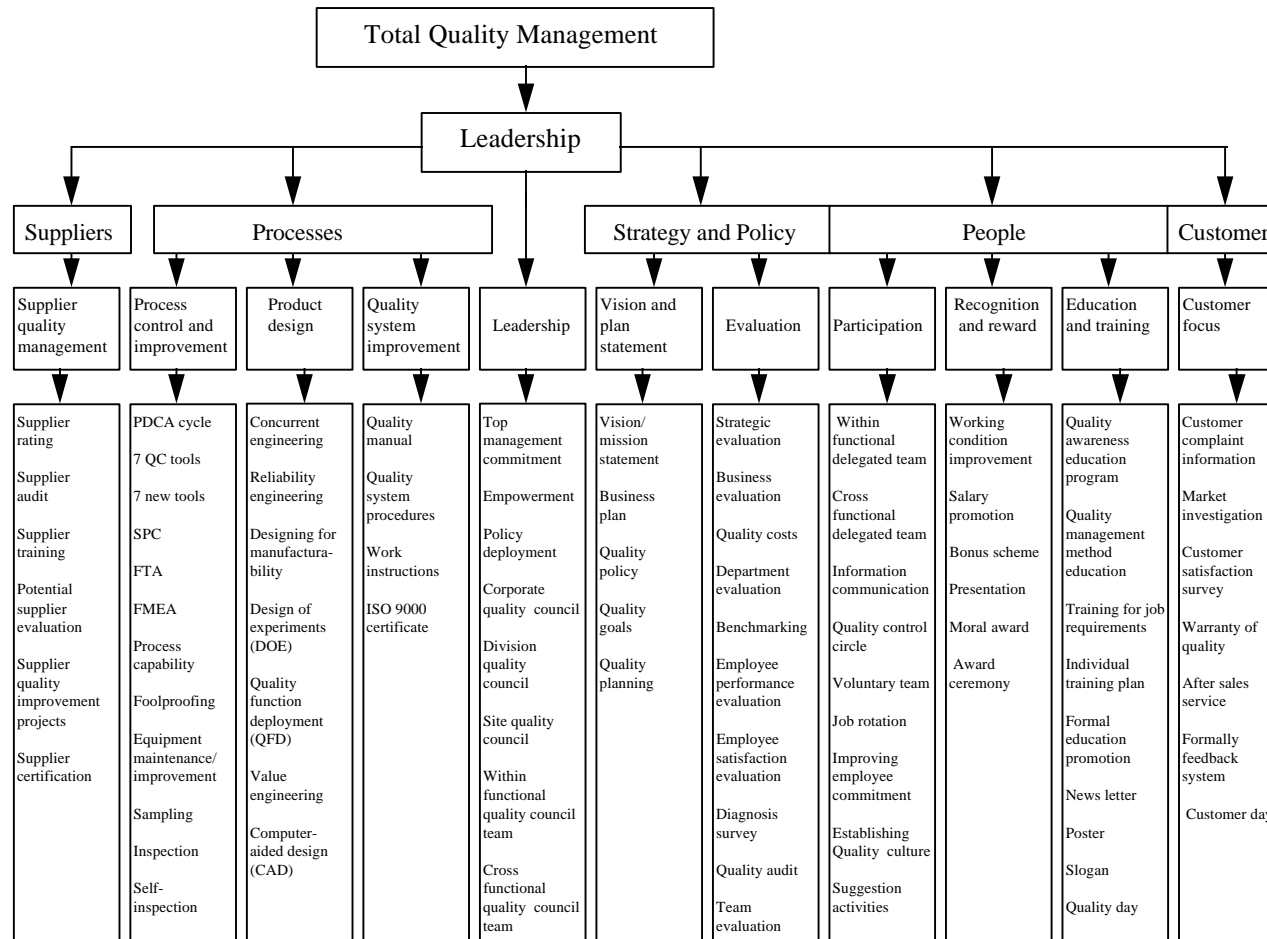The questions raised in this Section are the subjects of future research.

Total Quality Management
→ Leadership

Leadership branches to: Suppliers · Processes · Strategy and Policy · People · Customers

Supplier quality management	Process control and improvement	Product design	Quality system improvement	Leadership	Vision and plan statement	Evaluation	Participation	Recognition and reward	Education and training	Customer focus
Supplier rating	PDCA cycle	Concurrent engineering	Quality manual	Top management commitment	Vision/mission statement	Strategic evaluation	Within functional delegated team	Working condition improvement	Quality awareness education program	Customer complaint information
Supplier audit	7 QC tools	Reliability engineering	Quality system procedures	Empowerment	Business plan	Business evaluation	Cross functional delegated team	Salary promotion	Quality management method education	Market investigation
Supplier training	7 new tools	Designing for manufactura-bility	Work instructions	Policy deployment	Quality policy	Quality costs	Information communication	Bonus scheme	Training for job requirements	Customer satisfaction survey
Potential supplier evaluation	SPC	Design of experiments (DOE)	ISO 9000 certificate	Corporate quality council	Quality goals	Department evaluation	Quality control circle	Presentation	Individual training plan	Warranty of quality
Supplier quality improvement projects	FTA	Quality function deployment (QFD)		Division quality council	Quality planning	Benchmarking	Voluntary team	Moral award	Formal education promotion	After sales service
Supplier certification	FMEA	Value engineering		Site quality council		Employee performance evaluation	Job rotation	Award ceremony	News letter	Formally feedback system
	Process capability	Computer-aided design (CAD)		Within functional quality council team		Employee satisfaction evaluation	Improving employee commitment		Poster	Customer day
	Foolproofing			Cross functional quality council team		Diagnosis survey	Establishing Quality culture		Slogan	
	Equipment maintenance/improvement					Quality audit	Suggestion activities		Quality day	
	Sampling					Team evaluation				
	Inspection									
	Self-inspection									

Figure 2 TQM Quality Management Method Model

9. Conclusions

Total quality management appears to be a concept which is difficult to summarize in a short definition. From an extensive review of total quality management literature from quality gurus, quality award models, and other quality management research results, a description employing eleven primary elements appears to be a workable solution. Based on the primary TQM elements, a TQM quality management method model has been developed. This model describes the primary quality management methods which may be used to assess an organization's present strengths and weaknesses with regard to its use of quality management methods. This model can assist an organization to decide which quality management methods to implement in order to improve organizational performance. The model can also be used as a tool for evaluating the quality management maturity in an organization. It is hoped that the research presented in this paper will not only assist an organization in understanding and implementing total quality management but will also provide a solid foundation for future research.

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Appendix: Criteria of Deming Application Award

(1)   Policies

- Management, quality and quality control/management policies;

- Methods for establishing policies;

- Appropriateness and consistency of policies;

- Utilization of statistical methods;

- Communication and dissemination of policies;

- Checks on policies and status of their achievement;

- Their relationship to long- and short-term plans.

(2)   The organization and its operations

- Clarity of authority and responsibility;

- Appropriateness of the delegation of authority;

- Inter-departmental co-ordination;

- Committee activities;
- Utilization of staff;
- Utilization of QC activities;
- Quality control/management diagnosis.

(3)   Education and dissemination
- Educational plans and results;
- Consciousness of quality and how it is managed, and understanding of quality control/management;
- Education on statistical concepts and methods and the degree to which they are disseminated;
- Grasp of effects;
- Education of associated companies (especially group companies, vendors, contractors and distributors);
- QC circle activities;
- The system of improvement suggestions and its status.

(4)   Information gathering, communication and its utilization
- Collection of external information;
- Inter-departmental communication;
- Speed of communication (utilization of computers);
- Information processing (statistical) analysis and utilization of information.

(5)   Analysis
- Selection of important issues and improvement themes;
- Appropriateness of analytical methods;
- Utilization of statistical methods;
- Linkage with industry-intrinsic technology;
- Utilization of analysis results;
- Action taken on improvement suggestions.

(6)   Standardization
- System of standards;
- Methods of establishing, revising and abolishing standards;
- Actual performance in establishing, revising and abolishing standards;
- Contents of the standards;

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- Utilization of statistical methods;
- Accumulation of technology;
- Utilization of standards.

(7)   Control/management
- Management systems for quality and other related elements, such as cost and delivery (quantity);
- Control points and control items;
- Utilization of statistical methods and concepts, such as control charts;
- Contribution of QC circle activities;
- Status of control/management activities;
- In-control situation.

(8)   Quality assurance
- New products and service development methods (quality deployment and analysis, reliability testing and design review);
- Preventive activities for safety and product liability;
- Degree of customer satisfaction;
- Process design, process analysis and process control and improvement;
- Process capabilities;
- Instrumentation and inspection;
- Management of facilities, vendors, procurement and services;
- Quality assurance system and its diagnosis;
- Utilization of statistical methods;
- Quality evaluation and audit;
- Status of quality assurance.

(9)   Effects
- Measurement of effects;
- Tangible effects such as quality, service, delivery, cost, profit, safety and environment;
- Intangible effects;
- Conformity of actual performance to planned effects.

(10)   Future plans
- Concrete understanding of current situation;
- Measures for solving defect problems;

- Future promotion plans;
- future plans and long-term plans.

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

(1)   Understanding and enthusiasm
       - How well do senior executives understand the concepts of quality,
         quality assurance, reliability, etc.?
       - How knowledgeable and enthusiastic are they in managing quality?
       - Do they understand and utilize statistical concepts?
       - Is there overall co-ordination between QC and other management
         systems?
       - How knowledgeable and enthusiastic are they in scientific management
(management consciousness and responsibility)?
       - How do they understand, respect and pursue scientific logic (statistical
         concepts)? Are they enthusiastic?
       - How knowledgeable and enthusiastic are they about QC activities?
(2)   Policies, objectives and targets
       - Have policies for management and QC been established?
       - Have policies and objectives for quality and quality assurance been
         established?
       - How (on what basis) have these policies been established?
       - How are they deployed?
       - How are the implementation measures developed and promoted?
       - How is the evaluation (check) of results and effects planned and
designed?
       - Are appropriate actions being taken? How are changes in objectives and
plans managed?
       - What are their annual and long-term plans?
(3)   The organization, systems and human resources
       - How are the organizations for managing QC and other issues
         established?
       - What are the senior executives' roles in QC management?

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- How are human resources for such organizations allocated?

- How is the job authority and responsibility established and allocated?

- How are the organizational structures and human resources management reviewed and improved?

- How are external activities (with associated companies and other organizations) managed for co-ordination, co-operation, support, guidance and advertisement?

- How well is organizational education and training coordinated?

(4)   Education, dissemination and thorough implementation

- What are the educational policies for QC management, QC circle activities, necessary scientific technology, managerial techniques and statistical methods? How knowledgeable and enthusiastic are senior executives about these policies?

- What are the promotional measures for education, dissemination and thorough implementation?

- How are the educational programs reviewed and evaluated, and how are necessary improvement actions taken?

- What educational programs are offered to associated companies (especially group companies, vendors, contractors and distributors)?

(5)   Implementation

- How is the budget for QC management, quality assurance, etc. established?

- How are the necessary facilities maintained?

- Are implementation measures properly carried out? How are the necessary elements and conditions for control/management identified? Is proper guidance and research conducted for the above?

- Is the quality of the company's own products and services, as well as QC management practices, reviewed and evaluated?

- Is the statistical way of thinking used for analyzing and implementing improvement measures?

- How are the different management systems coordinated?

- Are the management activities in different departments well balanced and practiced?

- Are the contributions of improvement activities to business performance studied and reviewed?

    - How are the measures for associated companies implemented?

    - How does the company fulfill its social responsibilities?

    - How is the new product development system managed?

(6)   Future policies, plans and measures

    - What are the future policies, plans and measures for managing quality and other related issues?

    - What are the future policies, plans and measures for quality, price and demand in response to economic growth?

    - Does the company have future policies, plans and measures for new products?

    - What are the future policies, plans and measures for quality, product lines, production methods, management methods, equipment and new product development in response to the progress of science and technology?

    - What are the sales plans and sales expansion plans?

    - What are the future policies, plans and measures for the business scope, finance and human resources?

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