Implementation of Total Quality Management

An Empirical Study of Chinese Manufacturing Firms

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RIJKSUNIVERSITEIT GRONINGEN

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Chapter 7 Development of A TQM Implementation Model

Chapter 1 Introduction[1]

1.1 Confusion about TQM

1.1.1 TQM Concept

Over the past few decades, quality gurus such as Deming (1986), Juran (Juran and Gryna, 1993), Crosby (1979), Feigenbaum (1991), and Ishikawa (1985), the primary authorities of total quality management (TQM), have developed certain propositions in the field of TQM, which have gained significant acceptance throughout the world. Their insights provide a good understanding of the TQM philosophy, principles, and practices. After careful study of their work, it has been found that these quality gurus have different views about TQM, although some similarities can be found. Worldwide, there are several Quality Awards such as the Deming Prize (1996) in Japan, the European Quality Award (1994) in Europe, and the Malcolm Baldrige National Quality Award (1999) in the United States of America. Each award model is based on a perceived model of TQM. However, the three award models are different from each other and each has its own characteristics. In the field of TQM implementation, much research has already been conducted, different researchers adopting different definitions of TQM. The concept is still a subject of debate (Easton and Jarrell, 1998), still a hazy and ambiguous concept (Dean and Bowen, 1994). So far, TQM has come to mean different things to different people (Hackman and Wageman, 1995).

1.1.2 Effects of TQM Implementation

TQM has been widely implemented throughout the world. Many firms have arrived at the conclusion that effective TQM implementation can improve their competitive abilities and provide strategic advantages in the marketplace (Anderson et al., 1994a). Several studies have shown that the adoption of TQM practices can allow firms to compete globally (e.g., Easton, 1993; Handfield, 1993; Hendricks and Singhal, 1996, 1997; Womack et al., 1990; American Quality Foundation and Ernst & Young, 1991). Several researchers also reported that TQM implementation has led to improvements in quality, productivity, and competitiveness in only 20-30% of the firms that have implemented it (Benson, 1993; Schonberger, 1992). A study conducted by Rategan (1992) indicated that a 90% improvement rate in employee relations, operating procedures, customer satisfaction, and financial performance is achieved due to TQM implementation. However, Burrows (1992) reported a 95% failure rate for initiated TQM implementation programs; Eskildson (1994) and Tornow and Wiley (1991) reported that TQM implementation has uncertain or even negative effects on performance. Longenecker and Scazzero (1993) indicated that achieving

[1] Parts of this chapter were drawn from the author's previous publications: Zhang (1997a, 1998a, 1998c, 1999a, 2000b). Concerning quality management related to China, please refer to these publications for details.

high product quality and pursuing successful TQM implementation are highly dependent on top management support. However, Motwani et al. (1994) reported that there is no association between top management support for quality and the level of product quality achieved. Many researchers suggested that effective product design can lead to the improvement of product quality (e.g., Gitlow et al., 1989; Juran and Gryna, 1993), whereas Motwani et al. (1994) reported that there is no relationship between systematic product design and the level of product achieved. Recently, Rungtusanatham et al. (1998) attempted to replicate, as closely as possible, empirical evaluation of a Deming-based theory of quality management conducted by Anderson et al. (1995). In their replication study, they used data obtained from three different Italian industries to compare with the reported results in Anderson et al. (1995), which used data from US-based firms. It was interesting to find that the research results between the two studies differed considerably. Thus, conflicting research findings have been reported surrounding the effects of TQM implementation on overall business performance.

These seemingly conflicting results were also found in Chinese manufacturing firms. TQM has been introduced in China from 1978 onwards. In order to encourage firms in implementing TQM, great efforts have been made by the Chinese government. As a result, an increasing number of firms implemented TQM; in a survey conducted by Yu et al. (1998), 96% of responding firms reported that they had done so. Therefore, it can be said that the rate of TQM implementation is very high in Chinese manufacturing firms. However, Yu et al. (1998) also stated that the effectiveness of the deployment of TQM in Chinese firms is still puzzling. As to how effective the implementation truly is, that may be another story. According to Zhao et al. (1995), China still lacks effective TQM systems and application at the firm level. Some basic quality principles and modern quality management methods have not been widely used by Chinese manufacturing firms. Based on the results of the state supervision and inspection of product quality, it can be concluded that China's product quality as a whole is still at a relatively low level. Table 1.1 lists the sample inspection results from 1986 to 1995.

What is TQM implementation really going on in Chinese manufacturing firms? The existing literature has shown that no large-scale empirical research has been systematically conducted dealing with TQM practices and their effects on overall business performance in Chinese manufacturing firms. In order to bridge this gap, an investigation into the effects of TQM implementation in Chinese manufacturing firms is truly needed. Such a study can explore the degree of the impact of TQM implementation on overall business performance in firms and help in identifying problem areas and possible remedies.

Table 1.1 The Average Sample Conformity Rates From 1986 to 1995

Year	Average conformity rates	Large-sized firms	Medium & small-sized firms	Township firms
1986	71.2%	88.1%	76.7%	63.0%
1987	77.9%	86.9%	73.4%	69.6%
1988	76.6%	85.5%	74.2%	64.7%
1989	75.3%	83.1%	75.2%	61.2%
1990	76.9%	84.1%	77.9%	56.2%
1991	80.0%	91.1%	78.4%	67.2%
1992	70.1%	88.0%	69.3%	51.8%
1993	70.4%	84.1%	70.7%	58.2%
1994	69.8%	85.0%	66.2%	67.6%
1995	75.4%	88.6%	73.4%	67.2%
Total average	73.6%	86.3%	72.3%	60.8%

1.2 TQM Implementation in China

Based on the author's thorough literature review, the TQM implementation in China has been identified. This section presents the brief review results. In 1978, the Beijing Internal Combustion Engine Factory and the Qinghe Woollen Mill started to implement TQM through cooperating with their foreign partners. In the meantime, a number of experts and scholars began to disseminate the knowledge of TQM to firms. In September 1978, some firms began to introduce QC circle activities. On 24 August 1979, the excellent QC circles' reports were presented in Beijing. On 31 August 1979, the China Quality Control Association was established. One of its duties was to cooperate with relevant governmental agencies to promote TQM in the country. Because of the significant effects of TQM implementation in the Beijing Internal Combustion Engine Factory, it was concluded that TQM could be effectively implemented in China. Thus, the experiences of TQM implementation were then popularized and disseminated to other firms. In order to encourage firms in implementing TQM, the State Economic Commission issued the Provisional Regulations on TQM Implementation in Industrial Firms in March 1980. The provisional regulations, which integrated TQM theory with Chinese national specific conditions, stipulated the significance, role, and implementation method of TQM. In order to help firms implement TQM, a large number of training courses and seminars were organized by the quality control associations at various levels[2]. The statistical data in 1985 showed that 38,000 firms implemented TQM while 500,000 QC circles were established in various firms. Today, there are tens of thousands of firms that have implemented TQM, which has been implemented not only in state-owned firms but also in collective and township firms, not only in industrial firms but also in service firms.

[2] China has different levels of quality control associations such as state, ministry, province, municipality, and county.

In fact, TQM was not well defined in China, but was still an ambiguous concept. However, the major TQM implementation practices in Chinese manufacturing firms could be summarized as: Using various kinds of quality management tools such as the QC seven tools and statistical process control in practice; implementing QC circles activities; analyzing and identifying quality-related costs; emphasizing quality inspection; establishing quality bodies (e.g., TQM implementation offices) in manufacturing firms; conducting quality audits; strengthening process control and improvement, product design, and after sales services. In the meantime, many people working in firms accepted education and training on TQM.

Over the past several years, China has become a focus of interest for Western organizations and management researchers, along with the awareness of the important role it has played in the global economy. Accordingly, more and more researchers have been involved in conducting research projects in relation to China in various fields, such as culture (e.g., Adler et al., 1989), organizational studies (e.g., Shenkar and von Glinow, 1994), technology transfer (e.g., Tackaberry, 1998), and marketing (e.g., Fock and Woo, 1998). Research on China's TQM domain, however, has not attracted much attention. As a result, little research has been conducted in this field, especially on TQM implementation at the firm level. Table 1.2 lists main articles published in international journals before 1996, dealing with general China's quality management.

Table 1.2 Articles Concerning China's Quality Management Appeared in International Journals Before 1996

- Stephens, K.S. (1989), China's emerging quality emphasis, Quality Progress, December, pp. 56-61.
- Liu, D.X. and Willborn, W. (1990), Quality improvement in China, International Journal of Quality & Reliability Management, Vol. 7 No. 5, pp. 27-33.
- Chou, Y., Chang, P.L. and Tuan, C. (1993), Total quality control Chinese style and its management implications - Taiwan versus China, Total Quality Management, Vol. 4, No. 3, pp. 283-303.
- Liu, Y.Z. (1994), TQM in the socialist market economy of China, Asia Pacific Journal of Quality Management, Vol. 3 No. 3, pp. 36-44.
- Barad, M. (1995), Some cultural/geographical styles in quality strategies and quality costs (P.R. China versus Australia), International Journal of Production Economics, Vol. 41, pp. 81-92.
- Zhao, X.D., Young, S.T. and Zhang, J.C. (1995), A survey of quality issues among Chinese executives and workers, Production and Inventory Management Journal, Vol. 36 No. 1, pp. 44-48.
- Tang, C.L. and Tummala, V.M.R. (1996), The PCB industry in Hong Kong and China: A 14-step implementation strategy for ISO 9002 certification, International Journal of Quality & Reliability Management, Vol. 13 No. 2, pp. 99-113.

The existing Chinese literature[3] related to the TQM showed that there are three main streams of published Chinese articles. First, a number of articles were published dealing with institutional policies. Such articles mainly discussed what kinds of governmental quality policies should be drawn up in order to encourage Chinese firms to emphasize quality management, implement TQM, and improve product quality. Second, some articles reported the specific experiences of implementing TQM in firms. These articles generally discussed the benefits, importance, and methods of implementing TQM in firms. These writers adopted case study research methodologies in their studies. Third, a few articles addressed how to use specific quality tools (e.g., the seven QC tools, statistical process control, experimental design, and quality function deployment) in practice.

Although many Chinese manufacturing firms began to implement TQM in the late 1970's and early 1980's, to date no large-scale empirical survey has been conducted to study the effects of TQM implementation on overall business performance in Chinese manufacturing firms. In addition, no research has been conducted about the confusion of TQM concept and TQM effects. Furthermore, no research has been conducted for developing a TQM implementation model that can be used by Chinese manufacturing firms to improve their TQM implementation efforts. The lack of sufficient guidelines to assist firms' TQM implementation has contributed to a number of unsuccessful TQM implementations in China.

1.3 Research Objectives

Based on the current TQM implementation in Chinese manufacturing firms, this research aims at achieving the following research objectives:

- To obtain the effects of TQM implementation on overall business performance in Chinese manufacturing firms;
- To obtain a TQM implementation model for Chinese manufacturing firms.

Thus, new knowledge related to TQM implementation in Chinese manufacturing firms can be derived. In this research, new knowledge is generated from existing TQM knowledge integrated with specific characteristics of Chinese manufacturing firms. After reviewing the existing TQM literature, it has become very clear that this research project is the only one that systematically examines the effects of TQM implementation in Chinese manufacturing firms. In addition, this research attempts to develop a TQM implementation model that can be used by Chinese manufacturing firms.

[3] The reviewed literature was mainly from the Journal of Quality Management, which is an authorized journal in the field of quality management in China. The Journal of Quality Management is organized by the China Quality Control Association. In June 1996, the journal was renamed the Journal of China Quality. Part of the reviewed literature was from the Journal of China Conformity Assessment, which was initiated in 1994.

1.4 Research Questions

Based on the research objectives, the extensive literature review, brainstorming sessions with the author's promoters, and informal talks with quality practitioners, five research questions have been proposed. They are listed as follows:

Question 1: *What is TQM?*

Question 2: *What is overall business performance within TQM?*

Question 3: *What are the effects of TQM implementation on overall business performance in Chinese manufacturing firms?*

Question 4: *What kind of TQM implementation model should be developed in order to guide Chinese manufacturing firms in implementing TQM?*

Question 5: *How can this TQM implementation model be demonstrated in practice?*

1.5 Structure of the Thesis

Chapter 1 gives a brief description of the research.

Chapter 2 describes the concept of TQM based on the literature from the five quality gurus (Deming, Juran, Crosby, Feigenbaum, and Ishikawa), the three quality award models (the Deming Prize, the European Quality Award, and the American Quality Award), and others conducting research in the field of TQM. Thus, the concept of TQM is defined and the research question "What is TQM?" is answered.

Chapter 3 identifies the four constructs of overall business performance. Thus, the research question "What is overall business performance within TQM?" is answered. Based on the literature review, two theoretical models linking TQM implementation and overall business performance are developed. One is the model of TQM implementation and overall business performance, which has nine hypotheses. The other is the model of TQM implementation constructs and overall business performance, which has 17 hypotheses. Finally, this chapter describes how to operationalize these theoretical constructs.

Chapter 4 presents the methodological perspectives of this research. The strategies adopted in this research are discussed in greater detail. The issues of how to develop the research questionnaire and structured interviews, how to conduct the questionnaire survey and structured interviews, and how to conduct the case study are described in this chapter.

Chapter 5 presents the evaluation of measurement instruments. In the questionnaire survey, there are two instruments used for obtaining information from Chinese manufacturing firms, one to measure TQM implementation and the other to measure overall business performance. The instruments for measuring TQM implementation and overall business

performance are empirically evaluated for their reliability and validity using data from Chinese manufacturing firms.

Chapter 6 describes the method used for testing the two theoretical models hypothesized in this study, the results of the model testing using data from Chinese manufacturing firms, and the interpretations of the model testing results. Ten structured interviews conducted in Chinese manufacturing firms are used to help the author interpret the questionnaire findings.

Chapter 7 presents the development of a TQM implementation model. This model is developed based on existing TQM knowledge, the results of the questionnaire survey and the structured interviews in Chinese manufacturing firms, and the specific characteristics of Chinese manufacturing firms. The use of this model in practice is also addressed in this TQM implementation model.

Chapter 8 provides an example of using this TQM implementation in practice. This is realized through conducting a case study in a Chinese state-owned manufacturing firm.

Chapter 9 presents a brief summary of the research and the main conclusions with respect to the new knowledge derived from this research. The limitations of the research and issues requiring further study are also addressed.

Chapter 2 Concept of Total Quality Management[4]

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 TQM[5] 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

Ishikawa[6] (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.

(l0) 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:

(l) 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 TQM[7].

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:

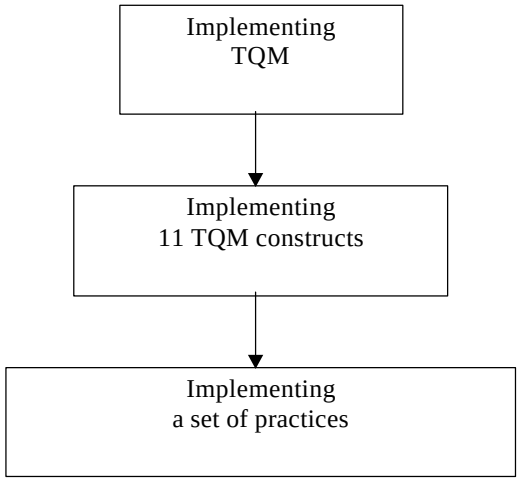
A management philosophy for continuously improving overall business performance based on leadership, supplier quality management, vision and plan statement, evaluation, process control and improvement, product design, quality system improvement, employee participation, recognition and reward, education 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 author[8].

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 improvement[9] 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.

Chapter 3 Impact of TQM on Overall Business Performance[10]

3.1 Introduction

This chapter presents the identification of overall business performance, the development of two theoretical models of TQM implementation on overall business performance, and the operationalization of theoretical constructs. Section 3.2 presents the identification and the explanations of overall business performance. The development of the model of TQM implementation and overall business performance is described in Section 3.3. Section 3.4 involves the development of the model of TQM implementation constructs and overall business performance. Section 3.5 discusses the operationalization of the theoretical constructs. Finally, Section 3.6 summaries this chapter.

3.2 Overall Business Performance

An objective of this study is to obtain the effects of TQM implementation on overall business performance in Chinese manufacturing firms. One of the research questions is to identify what overall business performance within TQM is. Based on this identification, the research question "What are the effects of TQM implementation on overall business performance in Chinese manufacturing firms?" can be answered. The literature review indicated that different researchers adopted different indicators for measuring overall business performance. To date, no uniform measures have existed. Therefore, the constructs of overall business performance had to first be identified so that this research could be conducted.

3.2.1 Identification of Overall Business Performance

After various business performance measures had been evaluated, it was decided that four constructs of overall business performance would be adopted in this study: Employee satisfaction, product quality, customer satisfaction, and strategic business performance. In fact, these constructs were already implicitly addressed by Hackman and Wageman (1995). They stated "Deming, Ishikawa, and Juran share the view that an organization's primary purpose is to stay in business, so that it can promote the stability of the community, generate products and services that are useful to customers, and provide a setting for the satisfaction and growth of organization members. The focus is on the preservation and health of the organization, but there also are explicitly stated values about the organization's context and about the well-being of individual organization members". The importance of the four constructs of overall business performance is described below.

[10] Parts of this chapter were published in Zhang (2000c, 2000d, 2000e, 2000f) and Zhang et al. (2000).

Employee satisfaction

Employee satisfaction should be one of a firm's key performance measures (Naumann and Giel, 1995). Employee satisfaction is seen as an important factor in business effectiveness because employee satisfaction can lead to behaviors by employees that affect a firm's functioning (Spector, 1997). Employees' negative feelings can lead to behaviors that are detrimental to firms. Organizational practices that maximize employee satisfaction will likely see employees who are more cooperative and willing to help the firm be successful. Employee satisfaction is a topic of interest to both researchers who study it and practitioners who work in firms (Naumann and Giel, 1995). Thousands of employee satisfaction studies can be found in the journals of organizational behavior and related fields. An increasing number of organizations also conduct employee satisfaction surveys to learn how employees feel about their jobs (Spector, 1997). Employee satisfaction is also an important factor in the European Model for Total Quality Management (1994), the Deming Prize (1996), and the American Baldrige Quality Award (1999). Ted (1996) stated that employee satisfaction is as important as customer satisfaction, as Ishikawa (1985) stated that a firm whose members are not happy and cannot be happy does not deserve to exist.

Product Quality

Product quality is one of the most important factors for a manufacturing firm to be successful in the world market. It is argued that a quality image, once obtained, can improve a firm's ability to compete, as well as its long-term opportunity for success (Pfau, 1989). DuBrin (1995) stated that business strategy development must place a high priority on product quality, which is a crucial hinge for business success or failure in today's quality-performance-oriented markets. Product quality has become a major business strategy (Feigenbaum, 1991). Ahire et al. (1996a) suggested that improving product quality be the prime objective of a firm's quality management efforts, and product quality be used as a primary indicator of the firm's quality efforts. Increasingly, firms are recognizing the strategic importance of product quality (Anderson et al., 1994a). Product quality is increasingly viewed as a strategic asset to improve a firm's global competitiveness (Steingard and Fitzgibbons, 1993). The literature review by Anderson et al. (1995) showed that product quality has often been cited as the highest competitive priority, an issue of strategic importance and survival, and a means of competitive performance. The Japanese quality revolution opened the way for Japan to become an economic superpower (Juran, 1994).

Customer Satisfaction

Customer satisfaction has recently drawn much more attention than ever before. According to Fornell (1992), not only do many firms continually monitor customer satisfaction at the firm level, but some countries also make the effort to measure customer satisfaction on a nationwide basis (e.g., Sweden, US, Japan, Singapore, and EC countries). Customer satisfaction should be one of firms' key performance measures (Naumann and Giel, 1995). The attainment and maintenance of satisfactory levels of customer satisfaction is today fundamental determination for business health, growth, and economic viability

(Feigenbaum, 1991). The Malcolm Baldrige National Quality Award (1999), a case in point, considers customer-focused results the most important. For the European Quality Award (1994), customer satisfaction is the most important in terms of points assigned. According to Fornell et al. (1996), customer satisfaction is a new type of market-based performance measure for firms. It provides an important measure of the firm's past and current performance, as well as future financial health. Customer satisfaction represents a new means of evaluating performance for the modern firm and the modern economy. Marketing scholars and practitioners have long recognized that customer satisfaction is an important and central concept, as well as an important goal of all business activities. Dean and Bowen (1994) believed that customer satisfaction to be the most important requirement for long-term organizational success. In fact, a firm can exist because the firm has customers; it is very clear that no customer means no business.

Strategic Business Performance

Strategic business performance is the final result of running a manufacturing firm, which can reveal the effects of doing business, show the competitive capability of the firm in the marketplace and its financial health, and predict its future success or failure. Strategic business performance is a good indicator to test the effects of TQM implementation and of a firm's efforts in pursuing employee satisfaction, product quality, and customer satisfaction. According to Mann and Kehoe (1994), strategic business performance refers to those measures typically addressed by the firm's management board. The board is concerned with measuring a firm's performance in terms of its major goals such as profitability, sales growth, market share, annual sales, and exports. According to Naumann and Giel (1995), strategic business performance refers to market share, increased revenues, and/or profit. Lee et al. (1995) proposed a hierarchical structure for overall business performance in which a higher level performance includes market share and profitability. In this study, strategic business performance was identified as: Annual sales, sales growth, profits, market share, and exports. It is no doubt that the aim of any manufacturing firm is to stay in business and make profits in the marketplace. In essence, the five indicators of strategic business performance are highly related to market and profitability. In China, strategic business performance is not only emphasized by firms' top managers but also addressed by the governments.

3.2.2 Explanations of Overall Business Performance

Employee Satisfaction

Employee satisfaction[11] is defined as the degree to which employees like their jobs (Spector, 1997); it is simply how employees feel about their jobs and different aspects of their jobs. It is the extent to which employees like (satisfaction) or dislike (dissatisfaction) their jobs. Employee satisfaction is an attitudinal variable, and can be considered as a global feeling about the job or as a related constellation of attitudes about various aspects or facets of the job. The global approach is used when the overall or bottom line attitude is of interest; for example, if one wishes to determine the effects of people liking or disliking their jobs. Most of the research adopting the global approach was to study the relationships between global employee satisfaction and other variables of interest. The facet approach is used to identify which parts of the job produce satisfaction or dissatisfaction, and can provide a more complete picture of an employee's job satisfaction on different facets. This can be very useful to firms that wish to identify areas of dissatisfaction that they can improve upon. Sometimes, both approaches can be used in order to obtain a complete picture of employee job satisfaction (Spector, 1997).

Employee satisfaction is not a static state but is subject to influence and modification from forces within and outside an individual, which are his or her own personal characteristics and the immediate working environment (Baran, 1986; Lam, 1995). In one firm, some employees may be satisfied and others may not. Individuals differ in how they respond to work conditions. While some employees may be highly satisfied with a particular job, other employees may find the same conditions extremely dissatisfying (Cherrington, 1995). An important issue surrounding employee satisfaction is: Will employee satisfaction increase or decrease as a result of a better benefit package, a new training program, or some other change in human resource practices? Many factors may affect employee job satisfaction. Among them are, for example, working environment, relationships with supervisors and colleagues, promotion opportunities, pay, equality, job characteristics, compensation and reward systems, and job security (Lam, 1995; Spector, 1997). Smith et al. (1969) developed a job descriptive index to measure employee satisfaction, which has been used across a wide variety of demographic groups. Their instrument consists of 72 items for measuring five theoretical and practical dimensions of employee satisfaction: Satisfaction with work itself, pay, promotion, supervision, and coworkers.

Studies of employee satisfaction have determined that job attitudes are influenced most by the qualitative aspects of the job (Cherrington, 1995). Good pay policies generally create positive satisfaction with pay. Supervisors who are fair, considerate, and competent generally create positive feelings of satisfaction with supervision. However, employee satisfaction is also related to other variables not directly associated with the job, such as age, sex, and work values. Employees with a strong work ethic also report greater satisfaction than do those

[11] In essence, employee satisfaction is synonymous with job satisfaction. Therefore, the terms "employee satisfaction" and "job satisfaction" are interchangeable. Spector (1997) used the term "job satisfaction" in his 1997 book.

who reject the work ethic. Satisfaction with a job is apparently influenced by the values and expectations that employees bring with them to the job. Satisfaction on the job is also influenced by what has happened to employees off the job-just as work influences a person's satisfaction with life in general, so too does the quality of life away from work influence satisfaction with work. The frustrations and difficulties people face in their personal lives have contributed to the general decline in employee job satisfaction.

Product Quality

Many definitions of "quality" exist. Deming (1986) defined it as satisfying the customer, not merely to meet his expectations, but to exceed them. His philosophy thus starts and finishes with the customer. Juran and Gryna (1993) defined quality as customer satisfaction or fitness for use. Quality is judged by the customer or user, thus the aim is to satisfy the customer. Crosby (1979) defined quality as conformance to requirements, thus making quality tangible, manageable, and measurable. Feigenbaum (1991) defined 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. Terms such as reliability, serviceability, and maintainability make up the composite of product and service quality. He argued that quality is a multi-dimensional entity and there are balances between various individual quality characteristics. Quality is dynamic in nature because customers' expectations are subject to change. Ishikawa (1985) defined quality as the development, design, production and service of a product that is most economical, most useful, and always satisfactory to the consumer. Two components of quality (Juran and Gryna, 1993) are listed in Table 3.1.

Table 3.1 Two Components of Quality

Manufacturing industries	Service industries
Performance	Accuracy
Reliability	Timelines
Durability	Completeness
Ease of use	Friendliness and courtesy
Serviceability	Anticipating customer needs
Esthetics	Knowledge of server
Availability of options and expandability	Esthetics
Reputation	Reputation

Quality is a judgment by customers or users of a product or service; it is the extent to which the customers or users believe the product or service surpasses their needs and expectations (Gitlow et al., 1989). In the ISO 9000 series standards, quality is defined as totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs (ISO 8402, 1994). Reeves and Bednar (1994) compared various quality definitions in their paper. On the basis of their literature review, quality can be defined as excellence, value, conformance to specifications, fitness for use, loss avoidance, and meeting and/or exceeding customers' expectations. They also compared the strengths and weaknesses of these quality

definitions in their paper. Thus, based on the author's extensive literature review, quality is defined as conformance to specifications in this study. Thus, product quality is defined as *conformance to product specifications.*

The major strengths of this definition are that: It is relatively straightforward to use a conformance-to-specifications definition to measure quality. Firms can assess whether their quality conforms to the established specifications. As the world's economy becomes more internationalized, conformance to specifications is increasingly important. If customers' needs and expectations are governed by specific requirements or standards, conformance to specifications is the most appropriate and easily measured definition of quality. Thus, the more subjective definitions of excellence, value, and meeting and/or exceeding customers' satisfaction become unnecessary (Reeves and Bednar, 1994).

In fact, quality as conformance to specifications has been used extensively in China. Every quarter, the China State Bureau of Quality and Technical Supervision samples industrial products for inspection in order to supervise firms, with the aim of improving product quality. If sampled products do not conform to product specifications, they are judged as nonconforming products. Product specifications are the only standard used for such a judgement[12].

Customer Satisfaction

Customer[13] satisfaction is defined as the degree to which a firm's customers continually perceive that their needs are being met by the firm's products and services (Anderson et al., 1994). According to the literature review by Anderson et al. (1994), at least two different conceptualizations of customer satisfaction can be distinguished: Transaction-specific and cumulative. From a transaction-specific perspective, customer satisfaction is viewed as a post-choice evaluative judgment of a specific purchase occasion. By comparison, cumulative customer satisfaction is an overall evaluation based on the total purchase and consumption experience with a product or service over time. Thus, overall customer satisfaction is a more fundamental indicator of the firm' past, current, and future performance. Customer satisfaction is a customer's feelings of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) in relation to his or her expectations. Customer satisfaction is a function of perceived performance and expectations. If the performance falls short of the expectations, the customer is dissatisfied. If the performance matches the expectations, the customer is satisfied. If the performance exceeds the expectations, the customer is highly satisfied or delighted (Naumann and Giel, 1995).

Besides quality of products and services, customer satisfaction can also be influenced by price (Fornell et al., 1996; Naumann and Giel, 1995). If customers' perceptions of benefits match price exactly, customers will be satisfied. If the benefits are viewed to be less than the

[12] This paragraph was obtained from the author's previous publications: Zhang (1998a, 2000b).

[13] "Customer" is the recipient of a product provided by the supplier (ISO 8402, 1994). In this study, the term refers to external rather than internal customer.

price, then customers will feel they are not getting their money's worth and will indicate very low levels of satisfaction (Naumann and Giel, 1995).

In fact, customer satisfaction is not static, but continues to evolve in an upward spiral. The diversity of product offerings has conditioned customers to have higher and higher expectations (Naumann and Giel, 1995). The customer's opinions of products and services may change very rapidly, the change toward a negative direction occurring considerably faster and more easily than increasing customer satisfaction. A great deal of work must be done in order to increase customer satisfaction, but only one failure may cause dissatisfaction.

Strategic Business Performance

Strategic business performance consists of annual sales, sales growth, profits, market share, and exports. According to the China Statistical Yearbook (1998), annual sales refer to the total volume of industrial products sold in currency terms within one year, even though the sold products were made in a different year. Annual sales include the value of the sold finished products, sold semi-finished products, industrial services rendered to other firms, products provided for a firm's own construction or well-being department, self-made production equipment among other items. Annual sales growth refers to the ratio of annual sales difference between this year and the previous year, divided by the annual sales volume in the previous year. Profits refer to the total profits gained by the firm. Market share refers to the percentage of a firm's product output compared with the same kinds of product output produced by all firms located in China in the same industrial sector. Market share, in this study, refers to local market share. Exports include the value of various products and services sold in foreign countries. Note that the sale of products in Hong Kong, Macao, and Taiwan is considered exporting, although the three districts belong to China.

3.3 Model of TQM Implementation and Overall Business Performance

3.3.1 Hypotheses Between TQM Implementation and Overall Business Performance

TQM has been widely implemented in various firms around the world. TQM is now considered by virtually all leading firms and quality practitioners as the way forward, to gain a competitive edge (Goh and Ridgway, 1994). There are many discussions about the benefits of implementing TQM. Many firms have arrived at the conclusion that effective quality management can improve their competitive abilities and provide strategic advantages in the marketplace (Anderson et al., 1994a). In recent years, much research has been conducted on the effects of TQM implementation on overall business performance. Many researchers, in one way or other, have argued that it has positive effects on employee satisfaction, product quality, customer satisfaction, and strategic business performance (e.g., Adam, 1994; Knotts et al., 1994; American Quality Foundation and Ernst & Young, 1991; United States General Accounting Office, 1991).

TQM provides people with opportunities to learn and develop themselves through joint problem-solving efforts. Meeting clear and often challenging customer requirements and working to improve work processes continuously provide task challenges that should both test and stretch members' skills. Insistent emphasis on teamwork and cross-functional relationships provides many opportunities for social interaction and social reinforcement (Hackman and Wageman, 1995). A study conducted by Lam (1995) and Adam (1994) suggested that TQM implementation has positive effects on employee satisfaction. A comprehensive study jointly conducted by the American Quality Foundation and the accounting and consulting firm Ernst & Young (1991) studied the TQM efforts of more than 500 various firms in the US, Canada, Germany, and Japan. They found that process improvement methods, strategic plan deployment, and supplier certification programs have significant impact on quality, regardless of industrial sector and country. TQM has been widely recognized and successfully implemented in many firms, giving them the edge in both international and local competitiveness through the production of high quality products that not only meet customers' needs, but also delight them (Goh and Ridgway, 1994). Indeed many quality practitioners believe that implementing TQM is an effective means of improving product quality, removing waste. It is a way of managing to improve not only product quality, but also the effectiveness, flexibility, and competitiveness of a business as a whole. It has been shown that TQM implementation leads to quality conformance and customer satisfaction (Forza and Filippini, 1998). Choi and Eboch (1998) suggested that TQM implementation has an impact not only on customer satisfaction but also on product quality. The study conducted by Adam (1994) indicated that quality improvement practices have positive effects on customer satisfaction, profit, and sales growth, and Mann and Kehoe (1994) suggested that TQM implementation has positive effects on annual sales, market share, and export market. Zairi et al. (1994) suggested that it leads to improvement of bottom-line results such as profits. Therefore, it follows that TQM implementation will have a positive effect on the firm's market share and profits, although mediated through customer satisfaction. Dean and Bowen (1994) suggested that the goal of satisfying customers is fundamental to TQM. Easton and Jarrell (1998) found that firms' accounting variables and stock returns have improved due to adopting TQM. Most of the TQM programs claim to help a firm increase customer satisfaction, employee satisfaction, and productivity (Wollner, 1992). The US General Accounting Office (1991) reported that 1988 and 1989 Baldrige finalists and winners increased their employee satisfaction, product quality, customer satisfaction, market share, sales per employee, and return on sales. There have been many cases showing that firms attained great success through implementing TQM; the success of Japanese industry is due primarily to its TQM implementation (Ikezawa, 1993). Based on these empirical research findings, the following four hypotheses were proposed:

Hypothesis H1T: TQM implementation has a positive effect on employee satisfaction.
Hypothesis H2T: TQM implementation has a positive effect on product quality.
Hypothesis H3T: TQM implementation has a positive effect on customer satisfaction.
Hypothesis H4T: TQM implementation has a positive effect on strategic business performance.

3.3.2 Hypotheses Among Overall Business Performance Constructs

Research has been conducted on the relationships among employee satisfaction, product quality, customer satisfaction, and strategic business performance (annual sales, sales growth, profits, market share, and exports). Saha (1989) argued that Japanese employees possess superior motivation compared to their counterparts elsewhere in the industrialized world, with greater dedication and commitment to their work. These characteristics will absolutely contribute to product quality. It is more likely that satisfied employees will have higher dedication and commitment. It has been stated that, for the quality of any firm's products to improve, it must require, motivate, and reward change on the part of all parties concerned (Juran and Gryna, 1993). Anderson et al. (1995) suggested that employee satisfaction has a significant effect on customer satisfaction; it is the foundation for a firm in pursuing customer satisfaction. Feigenbaum (1991) suggested that employee motivation affects product quality. Further, it is needed to support customer satisfaction (Dean and Bowen, 1994). According to George (1992), understanding what is important to your customers is only one aspect of your relationship with them. A survey reported that 68% of customers switched because of the indifference of one of the supplier's employees. Total customer service contributes to total customer satisfaction. Tornow and Wiley (1991) found that employees' perceptions and attitudes are positively related to customer satisfaction. The research conducted by Anderson et al. (1995) suggested that satisfied employees have positive effects on customer satisfaction. In fact, within a firm, employees are the ones who can produce high quality products and deliver satisfaction to customers. It is obvious that satisfied employees will contribute to improving product quality and customer satisfaction through their commitment. Satisfied employees will also make the extra effort and contribute their best performance to ensure the success of their firms through improving product quality and customer satisfaction. Therefore, the following two hypotheses were proposed:

Hypothesis H1D: Employee satisfaction has a positive effect on product quality.
Hypothesis H2D: Employee satisfaction has a positive effect on customer satisfaction.

Much research has confirmed the strategic benefits of product quality. It has been shown to contribute to greater market shares and return on investments (Cole, 1992; US General Accounting Office, 1991), as well as lower manufacturing costs in the long run and improved productivity (Garvin, 1983). The manufacturing of top quality products is recognized as one of the most important strategic objectives of modern manufacturing firms. It is related to profits, market share, and economic survival in the international world of competition (Wacker and Sheu, 1994). The Boston Consulting Group and Harvard Business School faculty have developed the widely quoted Profit Impact of Marketing Strategy database. It has been cited as one source supporting market share as positively and strongly related to perceived quality of a firm's products (Buzzell and Wiersema, 1981; Craig and Douglas, 1982; Garvin, 1984; Phillips et al., 1983). Longenecker and Scazzero (1993) conducted a case study in a manufacturing firm that lost a number of key customers due to its product quality problems. Primrose and Leonard (1988) suggested that product quality has a direct effect on sales, and consequently profits, and Anderson et al. (1994) suggested that product quality has a positive impact on customer satisfaction, providing high quality products and high customer satisfaction is rewarded by economic returns. Deming (1986)

stated that improving product quality can reduce costs because of less rework, fewer mistakes, and better use of machine-time and materials. Thus, firms can capture the market with better product quality. Finally, firms will stay in business. Low product quality creates dissatisfied customers who will not only be more open to considering competitors' offerings but will also be likely to discuss their dissatisfaction with other potential customers. In short, improving product quality can improve firms' profits (Reed et al., 1996). Reeves and Bednar (1994) reported that customers are satisfied only when the firm provides superior product quality at reasonable prices; that is, when the value offered by products is superior to that of the competing products. Therefore, high quality products at reasonable prices will attract customers, thus improving the firm's strategic business performance. DuBrin (1995) stated that product quality can contribute to sales growth and market share. Juran and Gryna (1993) considered that the evidence of the importance of quality to retaining present customers is dramatic. Hackman and Wageman (1995), based on Deming's writing, stated that producing quality products is not merely less costly but, in fact, is absolutely essential to long-term organizational survival. According to Juran and Gryna (1993), the longer a firm keeps a customer, the larger the profit will be. The extensive literature review by Anderson et al. (1994a) suggested that a good way to satisfy customers is by delivering and improving product quality. Quality has a positive impact on customer satisfaction, profitability, and market share. Finally, the firm's competitive advantages in the market place will be enhanced. Therefore, the following two hypotheses were proposed:

Hypothesis H3D: Product quality has a positive effect on customer satisfaction.
Hypothesis H4D: Product quality has a positive effect on strategic business performance.

Numerous studies have shown that high level of customer satisfaction is strongly related to firms' profitability. Any firm with low customer satisfaction will experience a continual erosion of its customer base, resulting in declining market share (Naumann and Giel, 1995). Rust and Zahorik (1993) suggested that customer satisfaction has positive effects on customer retention and market share. They portrayed customer satisfaction as an important indicator of a firm's overall financial health, largely because it is perceived to be a key indicator of the firm's market share and profitability. Simply stated, satisfied customers will repeat their purchases of products, increasing the firm's market share and profits. According to George (1992), customer satisfaction is essential to retaining customers, which can give profits a critical boost. Retention of customers is important because it costs more to acquire a customer than to keep one. Deming (1986) asserted that dissatisfied customers are detrimental to a firm's further development. Zairi et al. (1994) suggested that customer satisfaction can lead to an increase in a firm's market share and profits. The research conducted by Cronin and Taylor (1992) suggested that customer satisfaction has a significant effect on purchase intentions. According to Fornell (1992), increases in customer satisfaction are generally believed to reduce marketing costs, lower transaction costs (e.g., contract negotiations, order processing, bargaining), reduce customer turnover, and enhance reputation (positive customer word of mouth). Anderson et al. (1994) reported that higher customer satisfaction should increase customer loyalty, insulate current market share from competitors, lower transaction costs, reduce failure costs and the costs of attracting new customers, and help to build a firm's reputation in the marketplace. The successful

experiences in Haier Group[14] suggested that customer satisfaction can lead to increased market share, profit, sales, and exports (Zhangruimin, 1998). Thus, an additional hypothesis was proposed as follows:

Hypothesis H5D: Customer satisfaction has a positive effect on strategic business Performance.

3.3.3 Model Formulation

Based on the above nine hypotheses, a theoretical model of TQM implementation and overall business performance was developed, and is displayed in Figure 3.1. The links between TQM implementation, employee satisfaction, product quality, customer satisfaction, and strategic business performance are incorporated in one single model.

In these nine hypotheses, TQM implementation is an independent variable and employee satisfaction, product quality, customer satisfaction, and strategic business performance are dependent variables. In the first four hypotheses (H1T-4T), the relationships between the independent variable (TQM implementation) and dependent variables are examined. In the last five hypotheses (H1D-5D), the relationships among the four dependent variables are studied. To the best of the author's knowledge, no researchers have empirically examined the relationships between TQM implementation and employee satisfaction, product quality, customer satisfaction, and strategic business performance in a single model.

[14] Haier Group is a Chinese manufacturing firm producing electrical appliances. This firm enjoyed a high reputation in terms of product quality, service quality, and customer focus.

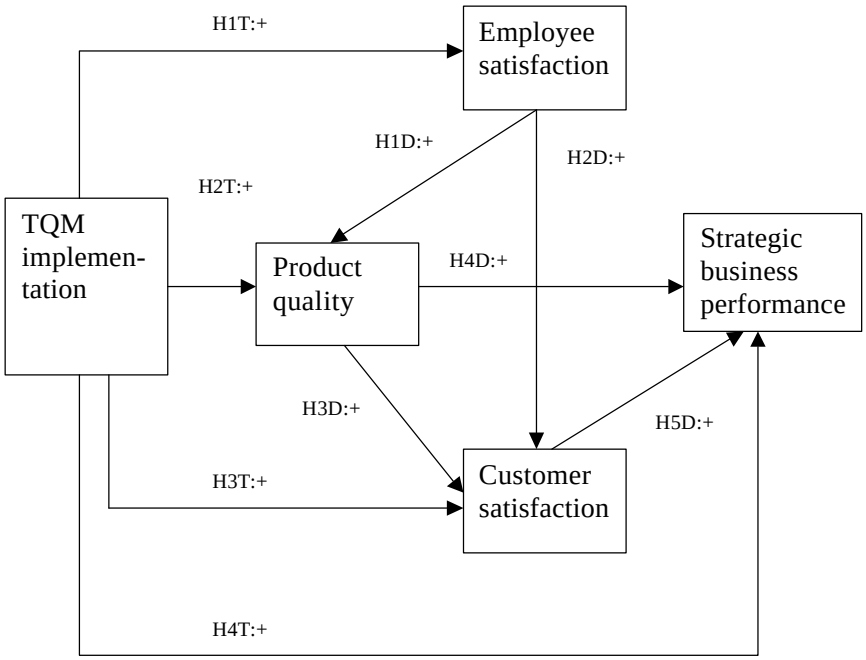


Figure 3.1 Theoretical Model of TQM Implementation and Overall Business Performance

3.4 Model of TQM Implementation Constructs and Overall Business Performance

In this research, TQM implementation is a large concept composed of 11 constructs. In order to understand whether different TQM implementation constructs have different effects on overall business performance, the individual effects of TQM implementation constructs are studied.

3.4.1 Hypotheses Between TQM Implementation Constructs and Overall Business Performance

Leadership

According to Deming (1986), it is the responsibility of leadership to institute programs of ongoing training and education since through these programs, organizational members embrace a continuous process of learning-about their work, as well as for the purposes of self-actualization and intellectual growth. The aim of leadership should be to improve the performance of people and machines, to improve quality, to increase output, and simultaneously to bring pride of workmanship to employees. Top management also has a responsibility to improve the system, i.e., to make it possible, on a continuous basis, for everyone to do a better job with greater satisfaction. Management must declare a policy for the future, to stay in business and provide jobs for their employees. According to DuBrin (1995), top management may have the authority to choose a technological strategy. Choosing the most appropriate strategy greatly influences the success of the firm. Leadership involves having a vision of what the organization can become. Without effective leadership, it is difficult to sustain profitability and productivity, and the firm cannot remain competitive. Positive management actions and attitudes toward quality will result in increased employee commitment to both the TQM program and the firm's strategy (Lau and Anderson, 1998). It is top management's responsibility to analyze organizational problems, review its vision and mission, and appropriately define the strategy needed to achieve organizational goals and objectives. Strong, positive, open-minded leadership will give rise to long-term and sustainable business success (Randell and Mannas, 1999). The empirical results suggest the importance of organizational leadership and its impact on creating an organizational form and instituting organizational practices to bolster the goal of organizational survival (Anderson et al., 1995). Some research evidence supports the widely accepted view that the leader affects organizational strategic business performance (DuBrin, 1995). Therefore, the following two hypotheses were proposed:

Hypothesis H1: Leadership has a positive effect on strategic business performance.
Hypothesis H2: Leadership has a positive effect on employee satisfaction.

Supplier Quality Management

According to Juran and Gryna (1993), poor quality of supplier products results in extra costs for the purchaser; for example, for one appliance manufacturer, 75% of all warranty claims were traced to purchased components for the appliances. Materials and purchased parts are often a major source of quality problems. Garvin (1983) found that firms that manufacture the highest quality products have purchasing departments that rank quality rather than cost minimization as their major objective. Conversely, in firms with the lowest quality performance, he found that the primary objective of the purchasing department is to obtain the lowest price for technically acceptable components. Newman (1988) suggested that a firm pursuing long-term relationships with suppliers can benefit from improved quality and process performance and continuous cost reductions. Flynn et al. (1995) stated that suppliers can contribute to quality performance in a number of ways. For example, selection of suppliers should be based on product quality rather than price, and suppliers can contribute

to the product design process through inclusion in the firm's product design teams, where the suppliers provide input about the capabilities of prospective materials and parts. Leonard and Sasser (1982) reported that purchased materials and parts are a dominant source of process variability. Therefore, improving supplier quality management will contribute to the improvement of the firm's product quality. Thus, the following hypothesis was proposed:

Hypothesis H3: Supplier quality management has a positive effect on product quality.

Vision and Plan Statement

Kano (1993) proposed that vision can encourage employees to work hard at improving quality. The research conducted by Bart and Baetz (1998) indicated that there is significant difference observed between firms with and without vision statements in terms of financial measures. Further, a vision statement can influence organizational members' behaviors and improve resource allocation. Quality policies contribute to firms improving product quality (Motwani et al., 1994). It is obvious that a targeted quality goal can help a firm maintain a constant quest for increasing quality levels (Aravindan et al., 1996). Goal-setting theory predicts that motivation is greatest when people focus their attention on achieving clear, specific, and challenging goals (Locke and Latham, 1990). Of course, a quality improvement plan, if implemented effectively, can contribute to improving product quality. Thus, the following hypothesis was proposed:

Hypothesis H4: Vision and plan statement has a positive effect on product quality.

Evaluation

Evaluating the situation in a firm's quality management practices provides an important base for the firm to improve its quality management practices. The availability of quality-related information can have positive effects on product quality (Motwani et al., 1994). Ishikawa (1985) also stated that the analysis of quality-related costs can be used to highlight cost savings that can be achieved by doing the work right the first time. Feigenbaum (1991) suggested that using modern information methods for collecting, storing, processing, and evaluating various pieces of information can greatly affect product quality. The new, improving methods of data processing have made available to management far more useful, accurate, timely, and predictive information upon which to base the decisions that guide the firm's future business. It is obvious that relevant quality information available can be used for quality improvement. Thus, the following hypothesis was proposed:

Hypothesis H5: Evaluation has a positive effect on product quality.

Process Control and Improvement

Process management focuses on managing the manufacturing process so that it operates as expected: Without breakdowns, missing materials, fixtures, tools, etc., and despite workforce variability (Flynn et al., 1994). Process control can make the process stable. Process improvement aims at managing and continually reducing variation. The reduction in process variation leads to benefits such as increasing output uniformity, continual reduction

of rework and mistakes and of machine time and materials (Deming, 1986). According to Juran and Gryna (1993), a major reason for quantifying process capability is to be able to compute the ability of the process to hold product tolerances. Thus, if process capability can ensure production requirements, various processing parts or components can be ensured automatically. Feigenbaum (1991) stated that machines and mechanization are a very important factor affecting product quality. Therefore, good equipment maintenance can contribute to product quality (Ollila and Malmipuro, 1999). The importance of quality tools, such as the seven QC tools, as aids in the work to improve quality has been stated by Gaafar and Keats (1992), Ginder (1990), Imai (1986), and Mizuno (1979). Mizuno (1979) wrote "These tools have been used as effective means of analysis and control, and they have contributed significantly to quality improvement." According to Juran and Gryna (1993) and Anderson et al. (1994a), statistical process control, when effectively implemented and practiced, brings about process improvements; first by eliminating special causes of variation and, second, by reducing common causes of variation. Much research has shown that good process management and using relevant quality tools have a positive effect on product quality (e.g., Adam, 1994; Mann and Kehoe, 1994). Thus, the following hypothesis was proposed:

Hypothesis H6: Process control and improvement has a positive effect on product quality.

Product Design

For complex products, errors during product development cause about 50% of fitness-for-use problems (Juran and Gryna, 1993). The author of this study has suggested that using experimental design and quality function deployment have positive effects on improving product quality (Zhang, 2000a). He also presented an example of using experimental design in new product design, which contributed greatly to product quality (Zhang, 1998b). Using reliability engineering can help to increase a product's failure resistance and tolerance of failures (Kanji and Asher, 1996). According to Gatenby et al. (1994), concurrent engineering can contribute to fast and high-quality product realization. Of course, product design quality will be improved if product designers have more shop floor and marketing experiences. Sound product design can contribute to the improvement of product quality ahead of competitors, increasing a firm's competitive advantage in the marketplace. Thus, the following hypothesis was proposed:

Hypothesis H7: Product design has a positive effect on product quality.

Quality System Improvement

A documented quality system helps employees understand exactly what they can do in their work areas. 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). Randall (1995) stated that adopting ISO 9000 can produce the following benefits: Improved efficiency of operations; improved utilization of time and materials; clearly defined responsibilities and authorities; improved accountability of individuals, departments, and systems; improved communication and quality of information;

formalized systems with consistent quality, punctual delivery, and a framework for future quality improvement; fewer rejects, less repeated work and warranty costs; less scrap, etc. Empirical study shows that firms with ISO 9000 certification reported significantly higher quality than those without (Voss and Blackmon, 1996). Many researchers indicated that having an ISO 9000 certificate can help firms improve product quality (e.g., Motwani et al., 1996). Thus, the following hypothesis was proposed:

Hypothesis H8: Quality system improvement has a positive effect on product quality.

Employee Participation

Over the past decade, numerous American firms have introduced employee participation programs such as job rotation, team-based work, and shop floor decision-making, with the expectation that these measures will lead to employee satisfaction (Finlay and Marin, 1995). Working in groups can enhance many members' job satisfaction. Being a member of a work group makes it possible to satisfy more needs than if one worked alone (DuBrin, 1995). Juran and Gryna (1993) stated that the most important benefit of QC circles is their effects on employees' attitudes and behavior. QC circles enable the individual to improve personal capabilities, increase the individual's self-respect, and help employees change certain personality characteristics. They increase the respect of the supervisor for the employees, increase employees' understanding of the difficulties faced by supervisors, and increase management's respect for employees. They change some employees' negative attitudes to the firm, reduce conflict stemming from the working environment, help employees better understand the reasons why many problems cannot be solved quickly, and instill in the employee a better understanding of the importance of product quality. According to Lillrank and Kano (1989), QC circles can improve employee morale and skill development of employees. Through participation, employees will make their jobs more enjoyable. Mann and Kehoe (1994) suggested that delegated teams and voluntary teams have positive effects on employee communication and morale. It is obvious that employees will be glad if their suggestions are implemented by the firm. As a result, employees may increase their satisfaction level. Therefore, the following hypothesis was proposed:

Hypothesis H9: Employee participation has a positive effect on employee satisfaction.

Recognition and Reward

One of the most important reasons people work is to earn money. Even those intrinsically motivated to work because of the satisfaction they derive from their jobs must earn sufficient money. If their jobs do not provide adequate income, people are forced to seek other jobs, no matter how satisfying they find their current ones (Cherrington, 1995). Therefore, to effectively support organizational quality efforts, firms need to implement an employee compensation system that strongly links quality and customer satisfaction with pay (Brown et al., 1994). Rewards for quality appear to have a positive relationship with employee morale (Kassicieh and Yourstone, 1998). Giving public visibility to quality efforts that identify and remedy problems sends a strong message that such efforts are a valued part of employees' contributions to the firm (Wruck and Jenson, 1994). According to Herzberg's (1966) hygiene/motivator theory, recognition is one of the four motivators, which can

contribute to employee satisfaction when it is present. According to the equity theory, people attempt to maintain conditions of equity. Pay and other organizational rewards must be balanced with effort, skill, experience, and other inputs for a state of equity to exist (Cherrington, 1995). Therefore, employees will be more satisfied if their efforts can be rewarded and recognized. The expectancy theory suggests that money can be a powerful motivator if the proper relationships between effort, performance, and rewards are perceived. The expectancy theory predicts a strong relationship between money and motivation (Schwab, 1973). Money can be a powerful motivator when pay is based on performance. Therefore, the expectancy theory implies that employees will be more satisfied if they are provided money incentives for their efforts (Cherrington, 1995). Besides monetary reward, today's employees require reinforcement of a sense of accomplishment in their jobs and the positive recognition that they are personally contributing to achievement of firm goals (Feigenbaum, 1991). Cherrington (1995) stated that career development can provide increased satisfaction for employees. Therefore, position promotion can have positive effects on employee satisfaction. Recognition and reward activities are valued by employees, and therefore provide motivation or incentives. Effective recognition and reward activities can make employees commit to their jobs and make their jobs more enjoyable. Thus, the following hypothesis was proposed:

Hypothesis H10: Recognition and reward has a positive effect on employee satisfaction.

Education and Training

Education and training can improve employees' knowledge and skills and have an important influence on their development. Thus, employees can generate innovative ideas for solving working problems. Training provides a forum for communication of new organizational strategy, values, and ways of performing work. Thus, employees' commitment and satisfaction may be enhanced. Deming (1986) stressed the importance of education and training for continual updating and improvement, identifying one source of human motivation at work as intrinsic motivation; more generally, growing, learning, and developing one's self. Employees inherently want to learn and develop. Cherrington (1995) stated that a successful training and education program will achieve the following benefits: Create more favorable attitudes, loyalty, and cooperation; and help employees in their personal development and advancement. Extensive literature review by Anderson et al. (1994a) suggested that an employee deserves to take pride in his or her work. Deming believed that this pride (as he often referred to it) comes from self-improvement, and that it is the firm's job to offer opportunities for continuous education. According to Cherrington (1995), most learning situations are intrinsically reinforcing because of the satisfaction associated with acquiring new knowledge or skills. Thus, the following hypothesis was proposed:

Hypothesis H11: Education and training has a positive effect on employee satisfaction.

Customer Focus

In today's turbulent market environment, it is very clear that a firm's survival depends on its ability to satisfy customers' needs and expectations and to compete effectively in global markets. A successful firm recognizes the need to put the customer first in every decision. Analyzing and responding to customer complaints on a product is essential to minimizing customer dissatisfaction; it is obvious that extensively analyzing and using customer complaint information can contribute to customer satisfaction. The information obtained from customer satisfaction surveys can also be used for further improving customer satisfaction. In fact, providing warranty on sold products is a commitment to a firm's own product quality. Such efforts can contribute to customer satisfaction (Juran and Gryna, 1993). It is no doubt that the aim of any customer focus effort is to pursue customer satisfaction. Thus, the following hypothesis was proposed:

Hypothesis H12: Customer focus has a positive effect on customer satisfaction.

3.4.2 Hypotheses Among Overall Business Performance Constructs

The five hypotheses among the four constructs of overall business performance were presented in Section 3.3.2. These five hypotheses are re-listed as follows:

Hypothesis H1D: Employee satisfaction has a positive effect on product quality.
Hypothesis H2D: Employee satisfaction has a positive effect on customer satisfaction.
Hypothesis H3D: Product quality has a positive effect on customer satisfaction.
Hypothesis H4D: Product quality has a positive effect on strategic business performance.
Hypothesis H5D: Customer satisfaction has a positive effect on strategic business performance.

3.4.3 Model Formulation

Based on the above 17 hypotheses a model of TQM implementation constructs and overall business performance was formulated, which is displayed in Figure 3.2. The 11 boxes at the

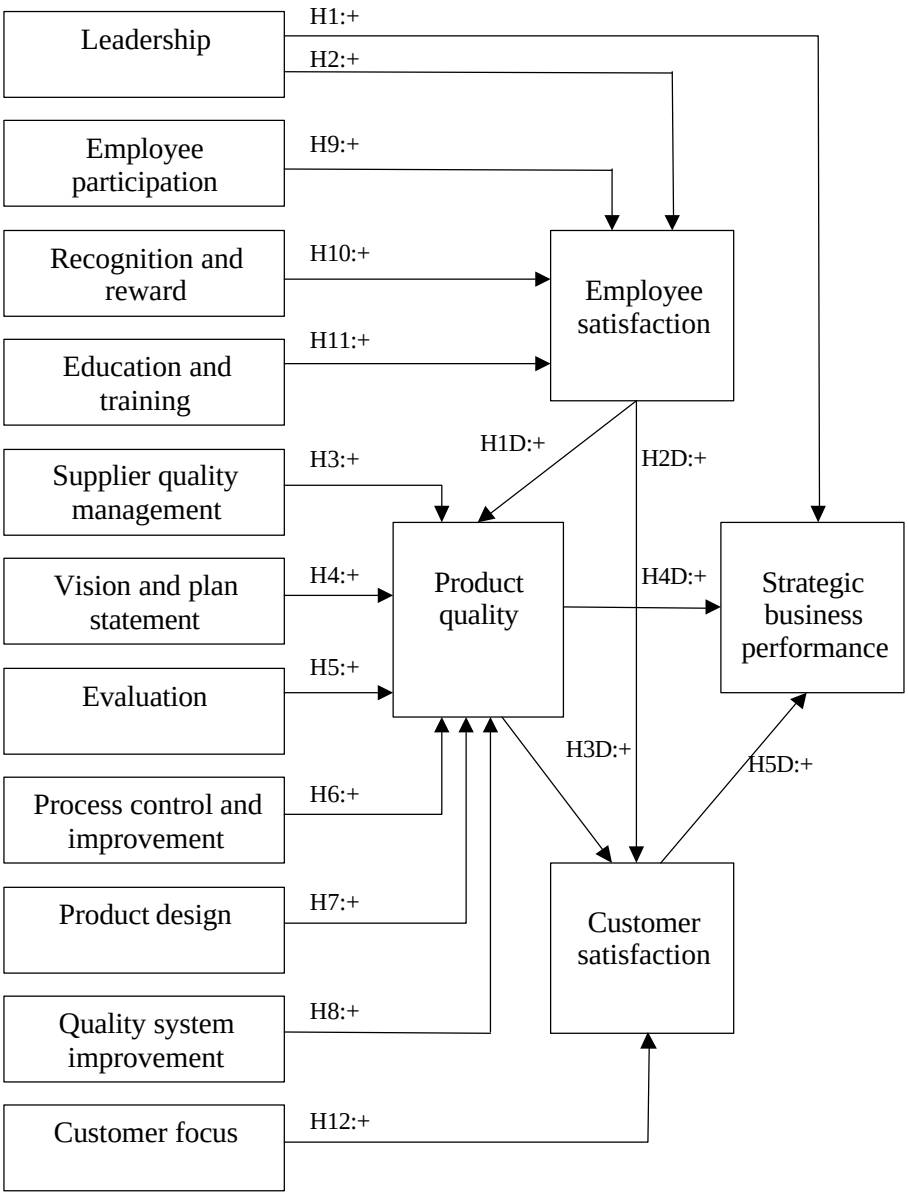


Figure 3.2 Theoretical Model of TQM Implementation Constructs and Overall Business Performance

left contain TQM implementation constructs. At the right are the four boxes representing the four constructs of overall business performance. In this model, all these TQM implementation constructs are regarded as independent variables. It should be noted that there might be some causal relationships among the 11 TQM implementation constructs. However, these relationships are beyond the scope of this study.

3.5 Construct Operationalization

In order to empirically test the theoretical models hypothesized in this study, it was first necessary to operationalize these theoretical constructs so that empirical investigation was possible. Therefore, a set of items for measuring the constructs of TQM implementation, employee satisfaction, product quality, customer satisfaction, and strategic business performance had to be adequately developed. Items should be chosen or developed in a careful manner to tap as comprehensively as possible the conceptual domain of the theoretical constructs. The following subsections present how to operationalize these constructs.

3.5.1 TQM Implementation

Several studies dealing with empirically validated scales for TQM implementation have been conducted (i.e., Ahire et al., 1996; Flynn et al., 1994; Saraph et al., 1989). The three instruments developed by the aforementioned researchers differ in terms of constructs and measurement items, each instrument having its own strengths and weaknesses (Their differences were addressed by Ahire et al. [1996]). However, these three instruments could not be adopted by this study since it adopted different TQM implementation constructs and targeted different samples. Therefore, a new set of items for measuring these constructs for Chinese manufacturing firms had to be developed. The existing instruments developed by these researchers did, however, give some insights into operationalizing the 11 TQM implementation constructs. In this study, based on the existing literature review, the definitions and explanations of the 11 constructs, the set of TQM implementation practices that support TQM implementation, and the special characteristics of Chinese manufacturing firms, 79 items were developed for measuring the 11 constructs of TQM implementation (see Table 3.2). A widely used 5-Likert scale was employed for scoring responses (1: strongly disagree; 2: disagree; 3: neutral; 4: agree; 5: strongly agree). Appendix 1 lists these 79 measurement items.

A comparison between this and other instruments was conducted in order to identify the characteristics of this instrument. In this study, only three instruments were selected for this comparison. They were developed by Saraph et al. (1989), Flynn et al. (1994), and Ahire et al. (1996), respectively. The instrument developed in this study has two unique characteristics, discussed in the following paragraphs.

The first is that this instrument covers a broader scope of TQM in comparison with the other researchers' instruments. This instrument has 11 scales that are broader than the scales in the other instruments. Chapter 2 discusses this comparison. In addition, this instrument has 78

measurement items in total (the original instrument had 79 items and one was deleted after factor analysis), which is more than the other measurement items. This instrument, therefore, covers a broader scope of TQM.

Secondly, specific characteristics of Chinese manufacturing firms were taken into account in developing this instrument. Since its aim was to measure TQM implementation for Chinese manufacturing firms, the instrument had to be suitable for use in China. Thus, specific characteristics of Chinese manufacturing firms had to be taken into account in its development. For example, most Chinese firms were weak in terms of their visions and plans. Thus, "Vision and plan statement" was therefore one scale in this instrument. Most Chinese firms were trying to implement ISO 9000 in order to improve their quality systems. This instrument thus included the scale of "Quality system improvement". Some Chinese top managers preferred to pursue short-term business success because of the nature of the country's institutional system. Item 8 (top management pursues long-term business success) in Scale 1 (Leadership) was therefore a very important item for measuring leadership. This item could not be found in the existing instruments. Most Chinese firms implemented reward and penalty measures to strengthen their management. The item "employees' rewards and penalties are clear" was therefore developed for Scale 9 (Recognition and reward). For details, please refer to Appendix 1, and note that it is beyond the scope of this thesis to address the characteristics of Chinese manufacturing firms.

Table 3.2 Operationalization of TQM Implementation

Scales	Item number
Leadership	8
Supplier quality management	6
Vision and plan statement	8
Evaluation	10
Process control and improvement	8
Product design	8
Quality system improvement	5
Employee participation	6
Recognition and reward	6
Education and training	6
Customer focus	6

3.5.2 Employee Satisfaction

According to Cherrington (1995), the best way to measure employee satisfaction is to either interview employees or ask them to complete a questionnaire. A questionnaire survey is the most popular method of measuring employee satisfaction since it is relatively short and can be administered to large numbers of employees simultaneously; interviews are more expensive and time consuming to conduct. According to Spector (1997), perhaps the easiest way to assess employee satisfaction is to use one of the existing scales, as their reliability and validity have been established. Several widely used facet employee satisfaction scales

are, for example, The Job Satisfaction Survey (JSS) by Spector (1985), The Job Descriptive Index (JDI) by Smith et al. (1969), The Minnesota Satisfaction Questionnaire (MSQ) by Weiss et al. (1967), and The Job Diagnostic Survey (JDS) by Hackman and Oldham (1975). There are another two global satisfaction scales, which are The Job in General Scale (JIG) by Ironson et al. (1989) and The Michigan Organization Assessment Questionnaire Subscale (MOAQ) by Cammann et al. (1979). In fact, The Job Diagnostic Survey includes a facet measure since it covers several areas of job satisfaction, specifically growth, pay, security, social, and supervision, as well as global satisfaction (Spector, 1997).

According to Cherrington (1995), absenteeism and turnover are frequently used as indirect measures of employee satisfaction. However, two types of absenteeism and turnover should be distinguished: Voluntary and involuntary. Voluntary absenteeism and turnover occur when employees have a choice of working or not working, and when they intentionally decide to miss work or quit. Involuntary absenteeism and turnover occur when employees miss work or are terminated for reasons beyond their control. It is not easy to identify whether an absence is truly involuntary or not; therefore, it is difficult to measure absenteeism. For employee turnover, employee dissatisfaction and economic conditions are the significantly related variables. Employees may leave their jobs when alternative jobs that better satisfy their needs become available. Research findings show that improved pay and promotion policies reduced the turnover level. Turnover rates are strongly influenced by economic conditions; when the economy is depressed and unemployment levels go up, turnover in most firms goes down. Therefore, it was very difficult to use absenteeism and turnover to measure employee satisfaction.

According to Spector (1997), the JIG and the MOAQ may be a good choice for the assessment of overall employee satisfaction when this, rather than facets, is of interest. Facet scales are often used to assess overall satisfaction by summing all of the individual facet scores. This can be justified by the fact that facets often correlate well with overall employee satisfaction. For example, Ironson et al. (1989) identified a 0.78 correlation of the JIG with the JDI and a 0.53 correlation of the JSS with the MOAQ. However, they also argued that overall employee satisfaction is not the same as the sum of individual facets. The summing of subscale scores assumes that all facets in the scale make equal contributions to overall satisfaction. In fact, it is unlikely that each facet has the same importance to every individual. Thus, the sum of facets is an approximation of overall employee satisfaction, but may not precisely match the overall satisfaction of individuals.

Spector (1997) stated that most research adopting the global approach studied the relationships between global employee satisfaction and other variables of interest. In this study, the relationships between employee satisfaction and TQM implementation, some TQM implementation constructs (e.g., leadership, education and training, recognition and reward, employee participation), product quality, and customer satisfaction were examined. Thus, the global approach was adopted.

In this study, there were some difficulties in measuring employee satisfaction in a reasonably precise way. First, each sampled firm received only one questionnaire; it was impossible to obtain employee satisfaction data from employees directly. Therefore, alternative procedures had to be adopted. However, it could not concluded that the alternative sources were equivalent to asking the individuals directly about their job satisfaction. Second, most

Chinese manufacturing firms did not evaluate employee satisfaction. Thus, overall employee satisfaction remained to some extent unclear. Third, most respondents were quality managers, for whom it was difficult to precisely assess employee satisfaction in their respective firms. Fourth, respondents' overall satisfaction would affect their assessment of employee satisfaction. In this regard, employee satisfaction could not be precisely measured through respondents.

According to Spector (1997), there have been a number of attempts to use alternative procedures to assess employee satisfaction. Spector, Dwyer, and Jex (1988) asked supervisors to estimate the employee satisfaction of their subordinates. The correlation was 0.54 between subordinates and supervisors, suggesting that supervisors have better feelings about their employee job satisfaction. Glick et al. (1986) reported that observers estimate employees' job satisfaction after watching them work for approximately two hours. Again, there was moderate agreement between the two sources. Since most respondents had worked in their respective organizations for a long time (on average 16.26 years), it was assumed that they had a general perception about overall employee satisfaction. Thus, it was suitable to ask respondents to assess employee overall satisfaction instead of asking employees directly.

The Michigan Organization Assessment Questionnaire is a global satisfaction scale containing a three-item overall satisfaction subscale (Cammann et al., 1979), which is listed in Table 3.3. The scale is simple and short, which makes it ideal for use in questionnaires that contain many scales. For each item there are seven response choices: Strongly disagree, disagree, slightly disagree, neither agree nor disagree, slightly agree, agree, and strongly agree. Item scores are summed in order to yield an overall employee satisfaction score.

Table 3.3 Items from the Michigan Organizational Assessment Questionnaire Satisfaction Subscale

1.	All in all I am satisfied with my job
2.	In general, I do not like my job
3.	In general, I like working here

However, the MOAQ could not be adopted directly in this study. First, each sampled firm received only one questionnaire. If this scale had been utilized, it would have measured respondents' overall satisfaction, rather than overall employee satisfaction in the firm. Thus, the research findings might have been biased. Second, after the three items in the MOAQ scales were carefully examined, it became very evident that the contents of the three items are very similar even though their wording is different. Thus, it was not surprising that subsequent studies using this scale found higher reliability (e.g., 0.87) (Spector, 1997). In fact, the three items can be combined to form only one: I am satisfied with my job. Based on this, it was decided that only one item would be used to measure overall employee satisfaction in this study: "What is overall employee satisfaction in your firm?". The respondents were asked to choose a number between 0 and 10 to 1 decimal place. The number 0 meant that employees were extremely unsatisfied, and 10 indicated that they were

extremely satisfied. The advantage of using such a scale to measure overall employee satisfaction was that respondents had to think about it before they chose an exact number. Thus, more reliable information could be obtained.

3.5.3 Product Quality

The operationalization of product quality should be based on the definition of quality: Conformance to specifications. Thus, product quality can be measured by conformance to product specifications and other indicators that are the results of nonconformance to product specifications. According to current quality management practices in China, the finished product conformity rate is the most important index for the Chinese government to supervise manufacturing firms' product quality. If the firm's product cannot meet the requirements of product specifications, that product will be judged as a nonconforming product. Thus, the product manufacturer will be penalized by the Chinese government. In fact, one product consists of many components. Every component also has its specifications (e.g., material contents, size, weight, and hardness) according to design requirements. If a component does not conform to its specifications, the component will be judged as defective. Defective parts cannot be used for the final product. Therefore, internal defective rate is also a very important index for measuring product quality level. Due to nonconformance to specifications, internal failure costs (found prior to transfer of the product to the customer) will be caused. These costs include scrap, rework, failure analysis, and downgrade among others. If a product is found to be nonconforming after it is delivered to the customer, the firm will experience losses; namely, external failure costs. These costs would disappear if there were no defects. External failure costs include those such as warranty charges, complaint adjustment, returned materials, and allowances (Juran and Gryna, 1993). In fact, product specifications have no meaning if they are not related to customer needs and expectations. Thus, product performance, reliability, and durability are also very important indices for measuring product quality.

Ahire et al. (1996) used performance, reliability, and durability as part of indicators to measure product quality. These are also included in the eight dimensions of product quality identified by Garvin. Performance refers to a product's primary operating characteristics (Garvin, 1987). Increased complexity of products has emphasized the importance of product reliability (Feigenbaum, 1991), which reflects the probability of a product malfunctioning or failing within a specified time period. Durability is actually a measure of product life, the amount of use before a product deteriorates (Garvin, 1987).

Based on the literature related to the various measures of product quality, the quality definition adopted in this study, and the current measures for measuring product quality in Chinese manufacturing firms, seven items were used to measure product quality in this study: Performance, conformity rates, reliability, durability, internal defect rates, internal failure costs, and external failure costs. Five categories (1: worst in the industry; 2: below average; 3: average; 4: above average; 5: best in the industry) were used for scoring responses compared with the other firms within the same industry in China. Please see Appendix 2 for details.

3.5.4 Customer Satisfaction

After the literature on customer satisfaction was reviewed, it became evident that there is no consensus on how to measure customer satisfaction. According to Fornell (1992), The American Customer Satisfaction Index (ACSI) is a national index for providing a standardized measure across industries that can be used for comparative purposes. The ACSI measures the quality of the products and services as experienced by customers who consume them. An individual firm's ACSI represents its served market's (its customers') overall evaluation of total purchase and consumption experience. Hence, the ACSI represents a cumulative evaluation of a firm's market offering, rather than a person's evaluation of a specific transaction. The Customer Satisfaction Barometer (CSB) is a customer satisfaction index based on annual survey data from customers of about 100 leading firms in some 30 industries in Sweden. The CSB can measure a firm's quality of output as experienced by customers. Naumann and Giel (1995) also developed a customer satisfaction measurement for measuring customer satisfaction. However, these instruments for measuring customer satisfaction could not be adopted directly. In this study, each firm received only one questionnaire. Therefore, customer satisfaction information was from different respondents rather than from firms' customers. Therefore, this study only measured overall customer satisfaction based on respondents' perceptions. Thus, a new scale for measuring customer satisfaction had to be developed so that this study could be conducted.

According to Fornell (1992) and Hauser et al. (1994), customer satisfaction is an overall postpurchase evaluation of all experiences including transactions, product use, and service received. Deming (1986) suggested that the goal of firms should be to constantly improve their services and products for the customers. Customer satisfaction is dependent on a comparative judgement against some standard related to the lack of confirmation of expectations. Thus, dissatisfaction may be due to inherently poor services or products, or perhaps to the continuation of a once-acceptable level of services or products that no longer meet customer expectations, due to competitive marketing of improved standards or changing customer tastes (Rust and Zahorik, 1993). Anderson et al. (1994) suggested that the measurement of customer satisfaction has often been based on a customer's perception of the quality of products and services. The payoff for excellent customer service, along with high-quality products and services, is a high level of customer satisfaction (George, 1992). Based on the literature, there are two major factors affecting customer satisfaction; namely, product quality and service quality. Therefore, these were the two indicators used for measuring customer satisfaction in this study. It should be noted that product quality and service quality are related but not equivalent to customer satisfaction, which results from the comparison of expectations with actual performance (Cronin and Taylor, 1992).

Thus, overall customer satisfaction was operationalized through respondents' perceptions about customer satisfaction on quality of products and services provided by the firm. In fact, many Chinese manufacturing firms regularly conducted customer satisfaction surveys in order to improve customer satisfaction. Different firms used different means of obtaining customer satisfaction with their products and services. Therefore, the firms understood their customer satisfaction levels quite well. Thus, it was assumed that respondents (e.g., quality managers) could perceive their customer satisfaction. In fact, it would be very difficult to

obtain direct feedback from the customers of hundreds of sampled firms. For any study, there is a trade-off between the sample size and obtainment of objective performance results. The author balanced trade-off by using respondents (e.g., quality managers) because they would be the most familiar with customer satisfaction. Similarly, five categories (1: extremely unsatisfied; 2: unsatisfied; 3: average; 4: satisfied; 5: extremely satisfied) were used for scoring customer satisfaction levels.

In the field of quality management, some researchers have used alternative sources to measure customer satisfaction. For example, Anderson et al. (1995) used four items: Customer relations, product conformance, product performance, and customer satisfaction with product quality over the past three years. The responses were from respondents rather than customers. To the best of the author's knowledge, no empirical research has reported that the alternative sources (customer satisfaction data from respondents) are equivalent to customer satisfaction data obtained directly from customers.

3.5.5 Strategic Business Performance

In order to allow respondents to easily provide information, five categories were used to measure annual sales, sales growth, profits, market share, and exports. For annual sales, objective measure was used to score responses. These categories were formulated on the basis of annual sales volume of total potentially sampled manufacturing firms. Perceptual measure (decreased a great deal, decreased slightly, stayed almost the same, increased slightly, and increased a great deal) was used to measure sales growth. Profits were measured by perceptual measure. Respondents were asked: "Do you think your firm was losing money badly, losing money slightly, breaking even, making some profits, or very profitable?" There were difficulties in measuring market share. Many Chinese firms did not precisely know their absolute market share in the domestic market. However, they did know which firm was the largest in terms of market share in the same industrial sector in the country. Thus, a relative market share was used in this study, calculated by the firm's annual product output divided by the annual product output in the largest firm in the same industrial sector in the country in the same year. Exports were measured by the value of exporting products divided by total annual sales within the same year. Please see Appendix 2 for details.

3.6 Summary

First, the four constructs of overall business performance within TQM were identified as important for Chinese manufacturing firms: Employee satisfaction, product quality, customer satisfaction, and strategic business performance. These constructs were also explained in greater details. Second, a model of TQM implementation and overall business performance was developed, consisting of nine hypotheses. Third, a model of TQM implementation constructs and overall business performance was developed, consisting of

17 hypotheses. The aim of this model was to examine the effects of different TQM implementation constructs on different constructs of overall business performance. Finally, the 11 constructs of TQM implementation and the four constructs of overall business performance were operationalized. Thus, it was possible to empirically test the two theoretical models hypothesized in this study.

Chapter 4 Research Methodology

4.1 Introduction

This chapter presents an overview of the methodological perspective of the research. Section 4.2 describes the research design based on the research questions and theoretical models hypothesized in this study. Section 4.3 presents the research strategy of a questionnaire survey. The research strategy of structured interviews is described in Section 4.4. Section 4.5 discusses the strategy of a case study. Finally, Section 4.6 summarizes this chapter.

4.2 Research Design

The role of research design is to connect the questions to data. Design sits between the two, showing how the research questions will be connected to the data, and the tools and procedures to use in answering them. Research design must follow from the questions and fit them with data. The design is the basic plan for a piece of empirical research, and includes main ideas such as strategy, sample, and the tools and procedures to be used for collecting and analyzing empirical data (Punch, 2000). In this section, only the research strategies and general research sample are described. Other aspects such as tools and procedures used for collecting data, detailed sample determination for the questionnaire survey, the structured interviews, and the case study are presented in Sections 4.3, 4.4, and 4.5, respectively.

4.2.1 Research Strategies

For conducting empirical research, there are two methods of data collection: Qualitative and quantitative. These two methods have their strengths and weaknesses. The qualitative method permits researchers to study selected issues in depth and detail. Approaching fieldwork without being constrained by predetermined categories of analysis contributes to the depth, openness, and detail of qualitative inquiry. The quantitative method, on the other hand, requires the use of standardized instruments so that the varying perspectives and experiences of people can fit a limited number of predetermined response categories, to which numbers are assigned. The advantage of a quantitative method is that it is possible to measure the reactions of a great many people to a limited set of questions, thus facilitating comparison and statistical aggregation of the data. This gives a broad, generalizable set of findings presented succinctly and parsimoniously. By contrast, a qualitative method typically produces a wealth of detailed information about a much smaller number of people and cases. This increases understanding of the cases and situations studied but reduces generalization (Patton, 1990).

In order to avoid their respective disadvantages, one important way to strengthen a research design is to use both qualitative and quantitative methods. A number of research strategies are available for conducting social sciences: Experiments, surveys, histories, case studies, and the analysis of archival information. The kinds of research strategies adopted in a study

should be dependent on three conditions: The type of research questions, the control an investigator has over actual behavioral events, and the focus on contemporary, as opposed to historical, phenomena. However, the first and most important condition for differentiating among the various research strategies is to identify the type of research questions being asked (Yin, 1989). Based on the five research questions proposed in this study, the research strategies of a literature review, a questionnaire survey, structured interviews, and a case study were adopted in this research. The explanations for adopting such research strategies are presented in the following subsections.

Literature Review

The first and the second research questions-"What is TQM?" and "What is overall business performance within TQM?"-are descriptive in nature. According to Punch (2000), a descriptive study sets out to collect, organize, and summarize information about the matter being studied; it is concerned with making complicated things understandable. For answering these two research questions, a literature review approach was the best strategy. The literature review on all aspects of TQM helped to provide a detailed understanding of the state of TQM today in terms of its research and its application within industries. The literature review identified what the concept of TQM is. Thus the first research question, "What is TQM?", was answered. Similarly, the literature review on all aspects of overall business performance identified what is important for measuring organizational overall business performance. Thus, the second research question, "What is overall business performance within TQM?", was answered.

Questionnaire Survey

The third research question-"What are the effects of TQM implementation on overall business performance in Chinese manufacturing firms?"-is to examine the effects of TQM implementation on overall business performance. Based on the existing theories, two theoretical models were derived. In essence, to answer this research question is to verify a theory. According to Punch (2000), a theory verification study aims to test a theory or, more accurately, to test hypotheses derived from the existing theory. It is a common practice in social science areas that have traditionally emphasized quantitative research. Such a study starts with a theory, deduces hypotheses from it, and proceeds to test these hypotheses. Thus, a questionnaire survey was the most appropriate strategy to answer this research question. The greatest advantage of a questionnaire survey is its lower cost compared to other methods. Mail questionnaires also have sample-related advantages: Geographic coverage, larger samples, and wider coverage within a sample population. A questionnaire survey can be used only when the objective of the study is clear and not complex (Bourque and Fielder, 1995). In the area of TQM implementation, much research has been conducted using questionnaire surveys to collect information (e.g., Anderson et al., 1995; Choi and Eboch, 1998; Forza and Filippini, 1998). These researchers tested the effects of TQM implementation on overall business performance using questionnaire surveys. Generally, questionnaires were used to obtain a large database of TQM information with a low level of details. In this study, the questionnaire survey was used to obtain information about TQM implementation and overall business performance from a wide range of Chinese

manufacturing firms. Such data could be used to examine the effects of TQM implementation on these firms' overall business performance.

Structured Interviews

The fourth research question is "What kind of TQM implementation model should be developed in order to guide Chinese manufacturing firms in implementing TQM?". This question is exploratory in nature. In order to make the TQM implementation model applicable in practice, current practices of TQM implementation, successful experiences of TQM implementation, problems and difficulties of TQM implementation, and effects of TQM implementation in Chinese manufacturing firms should be studied. Thus, the dynamics of firms' TQM implementation can be obtained. In order to meet such a research requirement and answer this question, it was decided that the strategy of structured interviews would be used to obtain information on the areas identified for the research. It was obvious that structured interviews could obtain more dynamic, detailed information on TQM implementation and overall business performance from a number of firms within a relatively short time period. Such information obtained from structured interviews was used to develop the TQM implementation model and make it more robust. Generally, structured interviews can obtain more detailed information compared with questionnaire surveys; some information that cannot be obtained through questionnaire surveys can be obtained through structured interviews. In fact, in the research area of TQM implementation, some researchers used structured interviews to develop their TQM implementation frameworks (e.g., Mann, 1992). In addition, the results obtained from structured interviews could be used to explain the results obtained from the questionnaire survey findings. Furthermore, the results obtained from the structured interviews were used to give the author a better understanding of TQM implementation in Chinese manufacturing firms.

Case Study

The fifth research question is "How can this TQM implementation model be demonstrated in practice?". In fact, the model was developed on the basis of existing TQM knowledge and the structured interviews in Chinese manufacturing firms. In order to understand how to use this model in practice, a case study would be conducted in a Chinese manufacturing firm. According to Yin (1989), case studies are the preferred strategy when "how" or "why" questions are being posed. Therefore, it was suitable to conduct a case study to answer this research question. Although the case study approach has a number of drawbacks, it also has a number of unique advantages. Among the drawbacks are the lack of statistical evidence from research findings and the possibility of the research influencing the phenomenon under study. The case study strategy is, however, the only way to provide an in-depth insight into the processes going on within complex organizations. The case study method has its strength in its ability to deal with a full variety of evidence such as documents, artifacts, interviews, and observations (Yin, 1989). Through conducting a case study, the way to use this TQM implementation model could be obtained. The case study can provide practical assistance to Chinese manufacturing firms in implementing this TQM model in practice, and can also provide a better understanding of the model.

Summary

In summary, the literature review was conducted to identify what TQM is and what overall business performance is. A questionnaire survey was used to obtain data from Chinese manufacturing firms to study the effects of TQM implementation on overall business performance. Structured interviews were used for two purposes: To obtain information used for developing the TQM implementation model and to use the results of structured interviews to explain the findings from the questionnaire survey. A case study was used to provide a practical example of using this model in practice. In a word, the research strategies adopted in this study can be characterized as approaches of quantitative (a questionnaire survey) and qualitative investigations (a literature review, structured interviews, and a case study).

4.2.2 Research Sample

Manufacturing firms in Liaoning province were selected for investigation due to the province's position as one of the most important industrial centers in China, as well as for reasons of practicality and convenience perceived by the author. Several years ago, the author worked in a provincial governmental agency and had good contact with people who worked in the field of quality management in other governmental agencies. It was relatively easy for the author to obtain sufficient information to be used for this study. The details about the sample frame for conducting the questionnaire survey, structured interviews, and case study are described in Sections 4.3, 4.4, and 4.5, respectively.

4.3 Questionnaire Survey

Questionnaire Development

In the field of quality management, a number of researchers have used questionnaire surveys. These included, for example, Flynn et al. (1994), Saraph. (1989), Mann (1992), Blauw (1990), and Blauw and During (1987, 1990). All of these researchers developed their questionnaires for data collection, based on their own research purposes, thus, their questionnaires differed from each other. After the questionnaires were examined, it was determined that none fully met the requirements of this research. Therefore, it was necessary to develop a new research questionnaire. However, the questionnaires developed by these researchers did give some insights into developing the questionnaire required for this research purpose. In fact, the design of the research questionnaire was highly dependent on the concepts of theoretical constructs and the operationalization of the theoretical constructs. The major issue of designing the questionnaire was to determine measurement questions, which respondents would be asked to answer. During the process of designing a research questionnaire, the following six issues should always be kept in mind. Following these principles might ensure the successful design of the questionnaire.

- Why is this question asked?
- What is the aim of asking this question?

- Is the question of proper scope?
- Can the respondents answer adequately?
- Will the respondents answer willingly?
- Are scales clear?

It should be noted that the questionnaire survey was used to study the effects of TQM implementation on overall business performance. Therefore, the questionnaire should cover the scopes of these two areas. The items developed for measuring TQM implementation should be based on the concept of TQM and the 11 TQM implementation constructs. More importantly, item development should cover the TQM implementation practices presented in Chapter 2. The items developed for measuring overall business performance should be based on the concepts of the four constructs: Employee satisfaction, product quality, customer satisfaction, and strategic business performance. Chapter 3 discusses how to operationalize the 11 constructs of TQM implementation and the four constructs of overall business performance. In addition, question wording should be given sufficient attention when building up the measurement items:

- Is the question wording stated in terms of a shared vocabulary?
- Is the question wording precise and unambiguous?
- Are there unstated or misleading assumptions?
- Is there biased wording?

Questionnaire Modification

In this research most of the TQM literature reviewed was in English, thus the questionnaire was first developed in English. However, it was actually used for collecting information in China. Therefore, the English version had to be translated into Chinese. This translation might have biased the original design of the questionnaire. A number of quality management terms, such as benchmarking, could not be precisely translated into Chinese terms. Various measures were taken in order to minimize these potential problems. The English version was translated into Chinese by the author himself, who had previously worked in the field of quality management in China and was therefore assumed to have enough knowledge of quality management in both English and Chinese. Some English terms were translated into Chinese by providing additional explanations so that respondents could better understand them.

After translation, the Chinese version of the questionnaire was mailed to three quality managers from the Netherlands who worked in different Chinese manufacturing firms. They were asked whether: (1) The items were stated in a shared vocabulary, (2) The items were precise and unambiguous, (3) There were biased wordings, (4) They could answer these questions. They returned the questionnaires with their comments, and some alterations were made according to their suggestions. During the author's research visit to China, the Chinese version of the questionnaire was formally pre-tested on various people (i.e., governmental officials, consultants, researchers, practitioners, and quality managers). The author interviewed these people and asked them to provide feedback on ease of comprehension, clarity of the specific items, suggestions for possible change, and suggestions for additional items, etc. Their suggestions were then carefully evaluated by the author and the Chinese

version of the questionnaire was further modified. After this step, the author was confident that the questionnaire could be used for the large-scale survey. The final Chinese version of the questionnaire consisted of 79 items to measure TQM implementation and 15 items to measure overall business performance. Appendices 1 and 2 list the two instruments that the author retranslated back into English from the final Chinese version. These two instruments were used to measure TQM implementation and overall business performance, respectively. If readers request a Chinese version of the questionnaire, the author will provide it.

Contacting Relevant Persons

Between July and October 1998, the author conducted data collection in China. Before leaving for China, he had asked the Education Section of the Chinese Embassy in the Netherlands to write an introduction letter for him. The major content of that letter follows:

Zhihai Zhang is working at the Faculty of Management and Organization of the University of Groningen in the Netherlands. He is also the Chairman of the Chinese Student Association in Groningen. Currently, he is doing research in the field of TQM implementation. The major aim of the research is to study TQM implementation in Chinese manufacturing firms. Through this study, a TQM implementation model will be developed, which can provide some suggestions and methods for improving quality management and product quality in Chinese manufacturing firms. In order to make the TQM implementation model applicable and reliable, Zhihai Zhang is going to investigate quality management issues in Chinese manufacturing firms starting from July 1st 1998. On basis of this situation, it is appreciated that relevant Chinese organizations could cooperate with him.

After arriving in China, the author first interviewed a number of people who were considered potential contributors in helping to send questionnaires to manufacturing firms. These people worked at the Liaoning Provincial Economy Commission, the Liaoning Provincial Bureau for Technical Supervision, the Liaoning Provincial Statistics Bureau, the Liaoning Provincial Machinery-Building Bureau, the Liaoning Provincial Electronics Bureau, the Liaoning Provincial Chemicals Bureau, the Liaoning Provincial Quality Control Association, the Liaoning Provincial Township Enterprises Management Institute, and the Northeast Quality System Audit Center. The major aims for contacting these people were as follows:

- Discussing the possibilities of sending research questionnaires through these above mentioned organizations;
- Providing insights into modifying the questionnaire.

The author first visited the Liaoning Provincial Economy Commission to discuss the possibility of sending questionnaires to Liaoning manufacturing firms. Unfortunately, the directors of the quality management department at the commission refused the author's request due to various reasons. However, they promised that it was possible for the Liaoning Provincial Quality Control Association (the two departmental directors were in charge of the Association) to send the questionnaires. The major disadvantage to this was that the Liaoning Provincial Quality Control Association was a non-profit organization rather than a

governmental agency; if the Association sent questionnaires to firms, the response rate might be low. In order to improve the response rate, the author contacted other governmental organizations, asking them to send questionnaires. These organizations were the Liaoning Provincial Machinery-Building Bureau, the Liaoning Provincial Electronics Bureau, and the Liaoning Provincial Chemicals Bureau, in charge of administrative management for the three sectors of machinery building, electronics, and chemicals. These were also three large industrial sectors in Liaoning province. Fortunately, these three organizations agreed to help the author send questionnaires to firms in the Liaoning region.

Survey Samples

The type of samples and the number of firms were determined on the basis of meeting the information requirements for the research. In this research, all of the investigated firms were from Liaoning province, where there were more than 1,000 large or medium-sized manufacturing firms. Almost all these firms implemented TQM or, more specifically, part of TQM. Thus the samples from Liaoning Province were enough for this research purpose. Although the selected samples were limited to firms in the Liaoning region, it was assumed that the samples from Liaoning Province might represent the whole situation of manufacturing firms in China. Therefore, the research results might be generalized to all firms in China. However, strictly speaking, this generalization is limited. In this research, only Chinese manufacturing firms with annual sales revenues of more than RMB 10 million were randomly selected for investigating their TQM implementation and overall business performance. The reason for this was that such relatively large firms could have more experiences of implementing TQM, have more qualified respondents to fill in questionnaires, and take the questionnaires seriously.

The Liaoning Provincial Statistics Bureau provided the author with a firm name list. In Liaoning Province, there were 2,929 manufacturing firms with annual sales volumes of more than RMB 10 million. The data were based on the year 1997, and a sample of 900 manufacturing firms was randomly selected from the list with the help of a computer. The sample size was decided after considering the expected response rate, requirements for performing statistical analyses, and survey cost. After the 900 firms were randomly selected, they were divided into four groups according to their industrial sectors-301 for machinery building, 180 for chemicals, 97 for electronics, and 322 for other industrial sectors. The Liaoning Provincial Machinery-Building Bureau, the Liaoning Provincial Chemicals Bureau, the Liaoning Provincial Electronics Bureau, and the Liaoning Provincial Quality Control Association respectively sent 301, 180, 97, and 322 questionnaires to their targeted groups along with their respective official documents. These documents (namely, cover letters, drafted by the author), which described the aim of the questionnaire surveys, were issued by the four organizations. The questionnaires were sent by mail directly to quality management departments in these sampled manufacturing firms. Finally, 212 questionnaires were returned. The response rate was 23.6%, normal for such research. The Liaoning Provincial Machinery-Building Bureau, the Liaoning Provincial Chemicals Bureau, the Liaoning Provincial Electronics Bureau, and the Liaoning Provincial Quality Control Association received 97, 44, 21, and 50 questionnaires back, respectively; response rates were 32.23, 24.44, 21.65, and 15.53%, respectively.

Additional Issues of the Survey in China

A number of additional issues with regard to the questionnaire survey in China are presented here. In order to make it easy for firms to fill in these questionnaires, the names of the author and the Faculty of Management and Organization of the University of Groningen were not mentioned. The firms did not know the Faculty of Management and Organization of the University of Groningen conducted this research project. An official document (cover letter) was presented after the translation from Chinese into English. This document was from the Liaoning Provincial Machinery-Building Bureau, and read as follows:

In order to further strengthen quality management in provincial machinery building sector, the provincial bureau will organize relevant quality management experts to study the suggestions and measures for improving quality management and enhancing product quality. In order to accomplish this task better, please seriously fill in the quality management questionnaires according to your firm's actual situations. Please send the finished questionnaires to the Quality Management Department of the Liaoning Provincial Machinery-Building Bureau.

Contact person:	*Zhang Xiaofeng*
Telephone:	*(024) 23862112*
Address:	*No. 28, Nan Si Ma Lu, Heping District, Shenyang*
Postcode:	*110001*

The research questionnaires were sent to quality management departments in the sampled firms, not all of which had independent quality management departments. However, every firm did have a specific department that was in charge of quality management. The four organizations sending questionnaires were not entirely clear whether firms had quality management departments. Within the sampled firms, procedures for dealing with these questionnaires were different. Some registered questionnaires and presented them to their administrative departments, which then presented them to top managers in charge of quality management. If top managers agreed, they signed their names and arranged for quality management departments to answer questionnaires. Under such a situation, most quality management departments would do so. In a number of firms, quality management departments had the right to deal with such documents themselves. Whether to respond to these questionnaires was highly dependent on their perceptions about the questionnaires' importance. In these cases, it was not necessary to present the questionnaires to their respective top managers.

Before the questionnaires were sent, discussions with relevant personnel in the four organizations sending them caused the author to expect a response rate of at least 50%, especially for the questionnaires being sent by the three governmental agencies. However, in reality, the final response rate was only 23.6%, much lower than expected. There were many reasons for the low response rate. First, in 1998, China had many economic problems; for example, the whole Asian economic environment was bad due to the financial crisis in Asia. Many employees in Chinese firms were laid off and relatively fewer employees were working in firms. At the same time their working loads remained unchanged; under such a circumstance, people in charge of quality management were very busy with their daily work.

They did not have much time to fill in these questionnaires. Second, it was common for quality management departments to receive a great deal of official documents from relevant governmental agencies or various associations. How to deal with these documents was highly dependent on whether firms could obtain benefits from doing so. Of course, they could not obtain direct benefits from filling in questionnaires, and were therefore not motivated to fill them in. Third, the Chinese government was giving firms management autonomy and financial responsibility. The governmental agencies, especially provincial governmental ones could not influence firms as they could some years ago. Firms were more independent. More importantly, provincial governmental agencies did not have the right to appoint and dismiss top managers. Therefore, firms did not pay much attention to such documents issued by provincial governmental agencies . This factor would negatively affect firms' inclination to fill in questionnaires.

Although Chinese firms had more rights to make their own decisions and provincial governmental agencies did not directly intervene in their internal affairs, the Chinese provincial government still had some influential power. Therefore, at least currently in China, to conduct research like a large-scale questionnaire survey, the best way to achieve a high response rate was to send questionnaires through governmental agencies. The four response rates in this research provide a good argument for this suggestion. The average response rate obtained through the three governmental agencies was 28.03% while that obtained through the Association was only 15.53%, exhibiting a large difference between the two groups.

Because the questionnaires were sent through four different organizations, it was impossible to maximize a good response rate by using follow-up mailing. Due to the limitation of financial budget, telephone calls were not used to improve a response rate.

A Brief Description of the Respondent Firms

Respondents

Among the 212 respondents ages ranged from 24 to 68 years old, and the average age was 42.78. The employment length of these respondents ranged from 2 to 49 years, and average employment length was 21.26 years. Among them, 135 were male and 77 female. The respondents' education level is listed in Table 4.1. The respondents had been working in their respective firms from 1 to 38 years, with an average length of 16.26. Table 4.2 lists the different departments where the respondents worked. These respondents had been working in their current jobs from 1 to 30 years, with an average length of 6.42 years. Table 4.3 lists the respondents' job titles.

Table 4.1 Respondents' Education Level

Final education	Frequency	Percentage (%)
University	81	38.2
Polytechnic college	79	37.3
Technical secondary school	37	17.5
High school	15	7.1

Table 4.2 Respondents' Departments

Departments	Frequency	Percentage (%)
Quality management department	83	39.2
Product inspection department	34	16.0
Technology department	23	10.8
Chief engineer office	14	6.6
Management department	13	6.1
Technology and quality department	12	5.7
Production department	10	4.7
Administrative office	8	3.8
Top management team	7	3.3
Quality assurance department	6	2.8
Technology supervision department	1	0.5
Quality and environment protection department	1	0.5

Table 4.3 Respondents' Job Titles

Titles	Frequency	Percentage (%)
Departmental manager	128	60.4
Quality controller	25	11.8
Managerial personnel	22	10.4
Engineer	15	7.1
Chief engineer	6	2.8
Statistician	6	2.8
Deputy general manager	6	2.8
Assistant general manager	3	1.4
Quality inspector	1	0.5

Respondent Firms

Of the 212 manufacturing firms, 82 were large-sized, 70 medium-sized, and 60 small-sized. They were from different industrial sectors. For details, please refer to Table 4.4. Table 4.5 lists the ownership of these respondent firms, and their establishment time is listed in Table 4.6. The current number of employees working in these sampled firms ranged from 75 to 26,809. On average, each firm employed 2,006 employees. Approximately, half the firms exported products to foreign countries. The annual sales of the firms ranged from RMB 10 to 3,500 million. On average, annual sales were RMB 154 million. Of the firms that responded, 70 were losing money, 18 were breaking even, and 124 were making a profit. In the 79 money-losing firms, a total of RMB 195 million had been lost. On average, each firm lost RMB 2.8 million .

Table 4.4 Industrial Sectors of Respondent Firms

Industrial Sectors	Frequency	Percentage (%)
Machinery	97	45.8
Chemical	44	20.8
Electronics	21	9.9
Building material	11	5.2
Textile	11	5.2
Light industry	10	4.7
Food industry	7	3.3
Metallurgical industry	7	3.3
Medicine industry	4	1.9

Table 4.5 Ownership of Respondent Firms

Ownership	Frequency	Percentage (%)
State-owned firm	137	64.6
Collective firm	19	9.0
Township firm	19	9.0
Joint venture	13	6.1
Others	24	11.3

Table 4.6 Establishment Time of Respondent Firms

Established year	Frequency	Percentage (%)
Before 1949	34	16.0
1950 – 1966	84	39.6
1967 – 1978	48	22.6
1979 – 1990	31	14.6
1991 – 1997	15	7.1

Data Analysis

For testing the two theoretical models hypothesized in this study, the measurement instruments should be reliable and valid. Thus, they should be evaluated for reliability and validity. In evaluating measurement instruments, reliability analysis, item analysis, and factor analysis should be conducted in order to understand whether measurement instruments were reliable and valid. The SPSS program was used in evaluation. To test the two theoretical models, structural equation modeling (LISREL) technique was used. LISREL can provide the appropriate and most efficient estimation technique for a series of separate multiple regression equations estimated simultaneously (Hair et al., 1992). There were two reasons for employing LISREL in this study. First, LISREL estimates a series of separate, but interdependent, multiple regression equations simultaneously by specifying the structural model used by the statistical program. LISREL is powerful in studying the relationships

among independent and dependent variables, even when a dependent variable becomes an independent variable in other relationships. Second, the sample size was 212 in this study, which is proposed as the critical sample size for employing LISREL analysis.

4.4 Structured Interviews

Design of Structured Interviews

The design of the structured interviews was based mainly on the research objectives, the research questions, the extensive TQM literature review, the theoretical models, guidance from the author's two promoters, input from colleagues, and previous research conducted by other researchers (e.g., Mann, 1992; Mann and Kehoe, 1994, 1995). Before the structured interviews began, their content was pre-tested with management consultants, practitioners, and academic experts. Minor alterations were made as a result of this pretest. A pilot study was conducted in a Chinese manufacturing firm in order to modify its contents, after which the interview questions were altered for the better. Seven broad categories of questions were asked during each interview: General information about respondents, organizational characteristics, overall business performance, the effects of TQM implementation on overall business performance, TQM implementation process, organizational characteristics affecting TQM implementation, and TQM implementation practices used.

Sample Determination

To conduct structured interviews, it was first necessary to decide the sample of firms, the interviewees in the firms to be interviewed, and the number of firms for interviews. The criteria for selecting interviewed firms are described as follows:

- Quality management maturity. Firms are required to have been implementing TQM for at least five years. These firms have experience with regard to TQM implementation and its effects on overall business performance. These firms may also experience the difficulties of implementing TQM.
- Organizational characteristics. A large diversity between each firm's organizational characteristics is required. This can assist in the investigation of which organizational characteristics influence the effectiveness of TQM implementation.
- Enthusiasm toward the research. If interviewees are willing to participate in the research, it is much easier to obtain much information required for the research.
- Level of seniority. Interviewees with a high level of seniority are more likely to know much more information for the research requirements.
- ISO 9000 certification. A firm with ISO 9000 certification may have more experience in how to implement the ISO 9000 standards. They may also experience the difficulties of establishing their quality management systems.

After the criteria for structured interviews were determined, the next step was to decide how many firms would be selected for structured interviews. The number of interviews was decided by considering the information required against the cost and time of conducting

structured interviews. Finally, ten structured interviews were regarded as sufficient for this study.

Access to Firms

All of the ten interviewed firms were recommended and introduced by the head of the Quality Management Department of the Liaoning Provincial Economy Commission and the director of the Northeast Quality System Audit Center (an ISO 9000 registration body). Both of these organizations had a better understanding of quality management situations in Liaoning province, as well as which kinds of firms were suitable for conducting interviews, and both had good contacts with manufacturing firms in Liaoning Province. After the author explained the research objectives in greater details, they provided many potential firms in Liaoning Province that might be suitable for conducting the interviews. On the basis of their suggestions and recommendations, ten manufacturing firms were chosen from a wide range of choices. Interviewee information such as names, job titles, telephone numbers, and addresses was provided by the two introducers. The author then made a telephone call to each interviewee and explained the aim of the interview. As a result, they all agreed to cooperate with the author and were willing to participate in this research. At the same time, appointments were made. The author naturally mentioned the names of the two introducers-due to their good personal relationships with these ten interviewees, it was relatively easy to access these firms.

Process for Structured Interviews

The ten structured interviews were conducted between July and October 1998. The interview questions were given to the interviewees in advance so that they could prepare the interview. It was an effective and efficient way of obtaining sufficient information within a short time period. During the process of the interview, the interviewees were encouraged to give the major points of the quality management issues in their respective firms. In addition, all interviewees provided documents about their TQM implementation practices to the author. Thus, more insights into TQM implementation were obtained. Each interview was approximately 4-8 hours long, and in most cases was preceded or followed by firm tours. In most cases, the interviews could not be finished within one day. Sometimes, several visits were required. Relevant archival documents were also provided by these interviewees for the author's reference. All interviewees were quality managers and had worked in quality management area for a long time. Therefore, they had deep insights into TQM implementation.

Description of Interviewed Firms

The ten interviewed firms were large- or medium-sized, state-owned manufacturing firms in the machinery-building and chemical industries. The number of employees in the firms ranged from 404 to 4,300. All of them had obtained ISO 9000 certification, nine for ISO 9001 and one for ISO 9002. Approximately, they had implemented TQM for more than ten years. Therefore, they had good experience in implementing TQM. The characteristics of the interviewed firms are presented in Table 4.7.

Table 4.7 Characteristics of Interviewed Firms (Data from the end of the year 1997)

Firms	Employee number	Annual sales (RMB million)	Pre-tax profits (RMB million)	Loss-making	Fixed assets (RMB million)
C1	1,100	78	7.33	No	180
C2	1,200	100	8	No	118.95
C3	4,000	240	18.47	No	300
C4	404	15.58	1.59	No	35
C5	800	80	4.5	No	300
C6	3,350	200	10	No	260
C7	3,000	210.06	12.42	No	115.72
C8	1,560	77.41	0.19	Yes	129
C9	4,300	678.51	138.65	No	488.13
C10	3,400	180	13	No	90

Notes: These interviewed firms are state-owned.
C1-C8 are for machinery building; C9-C10 for chemicals.

4.5 Case Study

According to Yin (1989), a case study design is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions. Colloquially, a case study design is an action plan for getting from here to there, where "here" may be defined as the initial set of questions to be answered, and "there" is some set of conclusions (answers) about these questions. Between "here" and "there" may be found a number of major steps, including the collection and analysis of relevant data. Another way of thinking about a case design is as a "blueprint" of research, dealing with issues such as study questions, study aims, and data collection. The design of a case study is very important in overcoming the traditional criticisms of the case study method.

Case Study Questions

In this study, a TQM implementation model has been developed on the basis of existing quality management knowledge, questionnaire surveys, and structured interviews in Chinese manufacturing firms. How can this TQM implementation model be used in firms? Thus, the major aim of the case study is to provide a practical example of using this model in practice. It should be mentioned that only one firm was selected to conduct this case study and this firm was not asked to practically implement this TQM implementation model, which was used as a template with which to compare the firm's TQM implementation practices. Thus, the strengths and weaknesses of TQM implementation and overall business performance in the firm would be identified. The weak areas could be used as improvement possibilities, and based on these possibilities an improvement plan could be formulated. More importantly, this plan should be accepted by the top management in the firm; otherwise, the formulated improvement plan was nothing. Thus, three case questions should be answered through conducting this case study, which are listed as follows:

Case Question 1: What are the strengths of the firm's current TQM implementation and overall business performance?

This is a descriptive question dealing with the strengths of the firm's current TQM implementation and overall business performance, compared with the practices presented in the TQM implementation model. After the comparison, the strengths of the firm's TQM implementation could be identified.

Case Question 2: What are the weaknesses of the firm's current TQM implementation and overall business performance?

The firm's current TQM implementation practices and overall business performance were compared with the TQM implementation model. Thus, the weak areas could be identified. The weaknesses could be used by the firm as opportunities to seek improvement actions and develop an improvement plan.

Case Question 3: What kind of improvement plan can be formulated in order to improve the firm's TQM implementation?

Based on the potential improvement possibilities and the firm's current situations (e.g., resources, employees' skills, and market competition), an improvement plan would be formulated. In order to ensure this plan's practical implementation, all the improvement possibilities identified should be examined and analyzed carefully. Thus, top management was asked: Which improvement possibilities could be structurally impossible to implement at this moment? Which improvement possibilities could be ineffective? Which improvement possibilities could be implemented in the future? Which improvement possibilities could be implemented at this moment? Thus, based on identified feasible improvement possibilities, the firm's available resources, and the firm's targeted improvement areas of overall business performance, an improvement plan was developed.

Case Selection

Several factors should be considered in selecting a case. First, the case firm should have been implementing TQM for a long time. Thus, the firm would have more experience with TQM implementation. Second, the firm should implement ISO 9000 and should have ISO 9000 certification. Third, the firm should have relatively high quality management maturity. Fourth, the firm should be willing to cooperate fully (making it easier to obtain relevant information). Fifth, a Chinese manufacturing firm with fully Chinese management would be selected for conducting the case study. Finally, there were many types of manufacturing firms in terms of ownership-state-owned, collective-owned, township, joint venture, private-owned, and wholly foreign-owned, etc. Since China's state-owned firms played a major role in the country's economy, the case study would be conducted in such a firm. Details about the case firm are presented in Chapter 8.

Data Collection

In order to conduct the case study, evidence was mainly from four sources: Documents, archival records, interviews, and observations. The different data sources offered a more comprehensive insight into the subject matter than the use of only a single data source. Interviews were conducted with top managers, functional departmental managers and workshop managers, supervisors, inspectors, and operators. Appendix 6 presents a list of interviewees working in different departments (workshops) in the firm.

Case Study Process

The author conducted the case study in a machinery-building firm in Shenyang, Liaoning Province, in March 2000. First, the author presented the aim of conducting the case study to the top managers. At the same time, the top managers were asked to arrange a research coordinator to help the author to conduct the study in the firm. Second, the manager of the production department was asked to give a general introduction of the production process, production activities, organizational structure (structural chart), etc. Third, the author took a firm tour in order to understand the production activities, inventory, equipment, and working environments. Fourth, the author began to collect relevant information from relevant departments, with the help of the coordinator. This information included, for example, general history of the firm, current TQM implementation, overall business performance over the past several years, and the firm's yearly working reports. Fifth, the author made an interview plan in order to determine the interviewees, the aims of interviewing these people, and interview questions. Sixth, interviews began according to the interview plan. Interviewees were asked to provide more evidence to support their viewpoints. Seventh, after all interviews were conducted, the strengths and weaknesses of the firm's current TQM implementation and overall business performance were identified. Eighth, based on the weak parts of the firm's TQM implementation and overall business performance, an improvement plan was formulated. This improvement plan consisted of a set of improvement programs. In order to make the improvement plan more practical and applicable, a top manager in the firm was asked to be involved in its development. Finally, based on the result obtained from the firm, the author made a final case study report, which is presented in Chapter 8. The report was unbiased, honest, and fact-based.

4.6 Summary

This chapter first presented the research strategies adopted in this study: A literature review, a questionnaire survey, structured interviews, and a case study. Therefore, the research strategies adopted in this study can be characterized as the combination of qualitative and quantitative strategies. Second, the detailed processes and the methods of conducting the questionnaire survey, structured interviews, and case study were described. Finally, it must be admitted that the author's previous practical experience working in a provincial governmental agency contributed a great deal to conducting this research. If the author lacked this experience and had not had good personal contacts with many people working in the area of quality management, the author would not have successfully collected data used in this research.

Chapter 5 Measurement Evaluation[15]

5.1 Introduction

In this study, a research questionnaire was developed and used to obtain empirical data from Chinese manufacturing firms in order to test the theoretical models hypothesized in this study. In the questionnaire, there were two measurement instruments used to measure TQM implementation and overall business performance, respectively. Each instrument had some measurement scales (see Appendices 1 and 2). Before testing the theoretical models, it was necessary to first evaluate the reliability and validity of the instruments; it is only on the basis of reliable and valid measurement scales that hypothesis testing can be conducted. Section 5.2 provides methods for empirically testing and validating the reliability and validity of the measurement scales. Section 5.3 presents the results of testing and validating the reliability and validity of the TQM implementation instrument. Section 5.4 involves the evaluation of measurement instrument of overall business performance. Finally, a number of conclusions are presented in Section 5.5.

5.2 Methodology

5.2.1 Reliability

Reliability refers to whether you get the same answer by using an instrument to measure something more than once (Bernard, 2000). Reliability concerns the extent to which an experiment, test, or any measuring procedure yields the same results in repeated trials (Carmines and Zeller, 1979); it is a statistical measure of how reproducible the survey instrument's data are (Litwin, 1995). There are four methods commonly used for assessing reliability, namely, (1) the test-retest method, (2) the alternate-form method, (3) the split-halves method, and (4) the internal consistency method (Nunnally, 1967).

Test-retest reliability is measured by having the same set of respondents complete a survey at two different times to see how stable the responses are. It is a measure of how reproducible a set of results is. Correlation coefficients are then calculated to compare the two sets of responses. These correlation coefficients are collectively referred to as the survey instrument's test-retest reliability. In general, if correlation coefficients equal or exceed 0.70, it is considered that the test-retest reliability is good (Litwin, 1995).

Alternate-form reliability is a method of evaluating the reliability of a survey instrument. It involves employing differently worded items to measure the same attribute. Questions and responses are reworded, or their order changed, to produce two items that are similar but not identical. Items are only different in their wording. Items or scales are administered to the

[15] Parts of this chapter were published in Zhang (1999b) and Zhang et al. (2000).

same population at different time points. In the same way, correlation coefficients are calculated. If they are high, the survey instrument is considered to have good alternate-form reliability (Litwin, 1995).

The split-halves method is a way to evaluate the reliability of the survey instrument. To use the split-halves method, the sample should be large enough to be divided in half and each alternate form administered to half of the group. Results from the two halves are then compared. When the split-halves method is used, the half-samples should be randomly selected. To do so, it can be ensured that no group differences exist (Litwin, 1995).

Internal consistency reliability is a commonly used psychometric measure in assessing survey instruments and scales. Internal consistency is an indicator of how well the different items measure the same concept. This is important because a group of items that purports to measure one variable should indeed be clearly focused on that variable. Internal consistency is measured by calculating a statistic known as Crobach's coefficient alpha (Cronbach, 1951; Nunnally, 1967). Coefficient alpha measures internal consistency reliability among a group of items combined to form a single scale. It is a statistic that reflects the homogeneity of the scale. Generally, reliability coefficients of 0.70 or more are considered good (Nunnally, 1967).

Among the four methods mentioned above, it is clear that the first three have some limitations, particularly for field studies. These limitations include, for example, requiring two independent administrations of the instrument on the same group of people and requiring two alternate forms of the measuring instrument. In contrast, the internal consistency method does not require either the splitting or repeating of items. Instead, it requires only a single test administration and provides a unique estimation of reliability for the given test administration. It is the most general form of reliability estimation (Nunnally, 1967). Therefore, the internal consistency method was used in evaluating the reliability of the survey instruments in this research.

5.2.2 Item Analysis

Nunnally (1967) developed a method of evaluating the assignment of items to scales that considers the correlation of each item with each scale. Specifically, the item-score to scale-score correlations are used to determine whether an item belongs to the scale as assigned, to some other scales, or should be eliminated. The scale-score is obtained by computing the arithmetic average of the scores of the items that comprise that scale. The values of item to scale correlations should be greater than 0.50; those lower than 0.50 do not share enough variance with the rest of the items in that scale. Therefore, it is assumed that the items are not measuring the same construct and it should be deleted from the scale (Kemp, 1999). Saraph et al. (1989) used this method to evaluate the assignment of items to scales in developing their instrument for measuring the critical factors of quality management. It was judged that item analysis should be performed in order to understand whether items were assigned appropriately.

5.2.3 Validity

Validity is defined as the extent to which any instrument measures what it is intended to measure. The three most popular methods of evaluating the validity of a measurement instrument are content validity, criterion-related validity, and construct validity (Carmines and Zeller, 1979). However, due to limitations of some instruments that are known to be valid, many researchers did not evaluate the criterion-related validity of their instruments (e.g., De Jong, 1999; Kemp, 1999). In this study, only content validity and construct validity were conducted in order to evaluate the measurement instruments.

Content Validity

Content validity depends on the extent to which an empirical measurement reflects a specific domain of content. It cannot be evaluated numerically-it is a subjective measure of how appropriate the items seem to various reviewers with some knowledge of the subject matter. The evaluation of content validity typically involves an organized review of the survey's contents to ensure that it includes everything it should, and does not include anything it should not. Strictly speaking, content validity is not a highly scientific measure of a survey instrument's accuracy. Nevertheless, it provides a solid foundation on which to build a methodologically rigorous assessment of a survey instrument's validity. In this research, however, it was argued that the 11 scales for measuring TQM implementation constructs and the four scales for measuring overall business performance had content validity since the development of these measurement items was based mainly on an extensive review of the literature and detailed evaluations by academicians and practitioners. The references list the literature reviewed by the author during the period of conducting this research, and the research methodology section addresses the detailed process of developing the research questionnaire.

Construct Validity

Construct validity measures the extent to which the items in a scale all measure the same construct (Flynn et al., 1994), and can be evaluated by the use of factor analysis. Factor analysis addresses the issue of analyzing the interrelationships among a large number of items[16] and then explaining these items in terms of their common underlying dimensions (factors). In fact, the general purpose of factor analysis is to find a way of condensing or summarizing the information into a smaller set of new composite dimensions (factors) with a minimum loss of information (Hair et. al., 1992). There are two forms of factor analysis, namely, exploratory factor analysis and confirmatory factor analysis. According to Hair et al. (1992), there is continued debate concerning the appropriate role of factor analysis. Many researchers consider it only exploratory, useful in searching for structure among a set of variables, or as a data reduction method. In this study, two instruments were developed in order to measure TQM implementation and overall business performance, respectively. These instruments had never been used before. Therefore, factor analysis in this context was

[16] In some literature, the term "variable" is often used. In this context, the term "item" is the same as "variable".

exploratory in nature rather than confirmatory; thus, exploratory factor analysis was adopted in this study.

According to Hair et al. (1992), there are two methods of exploratory factor analysis: Principal component analysis and common factor analysis. Principal component analysis is appropriate when researchers are primarily concerned about the minimum number of factors needed to account for the maximum portion of the variance represented in the original set of items. In contrast, common factor analysis is appropriate when the primary objective is to identify the latent dimensions or constructs represented in the original items. According to the aim of conducting factor analysis in this study, principal component analysis was selected as it can determine how and to what extent items are linked to their underlying factors (Byrne, 1998). Principal component analysis can help to identify whether selected items cluster on one or more than one factor. Particularly, three or more items are selected for measuring a latent construct. Factor loadings are used to present these relations. Factor loadings greater than 0.30 are considered significant; loadings of 0.40 are considered more important; if the loadings are 0.50 or greater, they are considered very significant (Hair et. al, 1992). In this study, a factor loading of 0.50 was used as the usual cut-off point.

According to Hair et al. (1992), the most commonly used method of determining whether items are loading on one factor is the latent root criterion. Only the factors having latent (eigenvalues) greater than 1 are considered significant; those with eigenvalues less than 1 are considered insignificant and are disregarded.

5.3 TQM Implementation Instrument

5.3.1 Reliability

There were 11 scales for measuring the 11 TQM implementation constructs for Chinese manufacturing firms. For each scale, there were a number of items to measure it (see Appendix 1). Appendix 3 lists the relative frequency distributions and means of respondents' responses to items that measure TQM implementation constructs. After all data were entered into a computer, the SPSS 7.5.2 reliability program was performed separately for the items of each scale. Table 5.1 lists Cronbach's alpha for different TQM implementation scales. This table shows that the reliability coefficients ranged from 0.838 to 0.925, indicating that some scales were more reliable than others. Accordingly, the instrument developed for measuring TQM implementation constructs was judged to be reliable.

Table 5.1 Internal Consistency Analysis

Scales	Number of items	Cronbach's alpha
1. Leadership	8	0.892
2. Supplier quality management	6	0.838
3. Vision and plan statement	8	0.914
4. Evaluation	10	0.890
5. Process control and improvement	8	0.883
6. Product design	8	0.839
7. Quality system improvement	5	0.925
8. Employee participation	8	0.883
9. Recognition and reward	6	0.857
10. Education and training	6	0.885
11. Customer focus	6	0.875

5.3.2 Item Analysis

Table 5.2 lists the correlation matrix for the 11 scales of the TQM implementation (Scales 1-11) and their measurement items. This table shows that all values of item to scale correlations were greater than 0.50. The complete correlation matrix presented in Appendix 4 further shows the items correlated highly with the scales they intended to measure (shown in bold in Appendix 4). For instance, Item 1 in Scale 1 had correlations of 0.784, 0.581, 0.631, 0.587, 0.555, 0.560, 0.525, 0.559, 0.466, 0.540, and 0.538 with the 11 scales of the TQM implementation, respectively. Since the value of Scale 1 (Leadership) was the average of the eight items, the high correlation between Scale 1 and its Item 1 was expected. In addition, since Item 1 showed relatively smaller correlations with the other scales, it was concluded that Item 1 in Scale 1 had been assigned appropriately to this scale. All other items were similarly examined.

Table 5.2 Item to Scale Correlation Matrix (Pearson Correlation)

	Item number									
Scales	1	2	3	4	5	6	7	8	9	10
Scale 1	.784	.810	.709	.702	.851	.624	.751	.816	--	--
Scale 2	.741	.787	.816	.690	.683	.753	--	--	--	--
Scale 3	.844	.861	.553	.861	.859	.863	.652	.823	--	--
Scale 4	.741	.738	.768	.703	.656	.772	.769	.627	.653	.692
Scale 5	.725	.666	.755	.713	.800	.754	.790	.721	--	--
Scale 6	.688	.649	.642	.726	.636	.570	.802	.765	--	--
Scale 7	.782	.913	.914	.939	.844	--	--	--	--	--
Scale 8	.765	.760	.804	.698	.741	.777	.639	.761	--	--
Scale 9	.756	.718	.801	.766	.745	.800	--	--	--	--
Scale 10	.828	.863	.846	.680	.703	.854	--	--	--	--
Scale 11	.813	.737	.838	.849	.649	.813	--	--	--	--

Notes: Item number in this table is the same as the item number in the instrument.
The symbol "--" means not available.

From the figures in Appendix 4, it was obvious that all items had relatively high correlations with the scales to which they were originally assigned, compared with all the other scales. Therefore, it was concluded that all items had been appropriately assigned to scales.

5.3.3 Construct Validity

The program of SPSS 7.5.2 was used to perform factor analysis, each scale being factor analyzed separately. The detailed results are listed in Table 5.3. From this table, it was clear that all of the items had high factor loadings greater than 0.50 on Factor 1. When the items in a scale loaded on more than one factor, the rotated (varimax, quartimax if necessary) solution was examined. The factor analysis showed that the items in 9 of the 11 scales formed a single factor, except for Scales 4 (Evaluation) and 5 (Process control and improvement). In the cases of these scales, two factors emerged according to the rule that the eigenvalues are greater than 1, which are listed in Tables 5.4 and 5.5. According to Hair et al. (1992), the latent root criterion (eigenvalue) is the most commonly used method of judging whether items are loading on one factor. In principal component analysis, only the factors having eigenvalues greater than 1 are considered significant; all factors with eigenvalues less than 1 are considered insignificant and disregarded. It should be noted that percentage of variance and scree test can also be used as criteria for judging whether items in a scale load on one factor. However, these two criteria are not easy to use in practice. For example, in the social sciences, where information is often less precise, it is not uncommon for the analyst to consider a solution that accounts for 60% of the total variance (and in some instances even less) as a satisfactory solution (Hair et. al., 1992). Further, it is not easy to make the judgement based on the scree test.

Table 5.6 lists the unrotated factor and rotated factor matrix for Scale 4 (Evaluation). From this table, it was clear that Items 5, 6, 7, and 8 constituted a factor, which can be interpreted as the factor "Use of quality-related information". The other items in Scale 4 were in the other factor, which formed that of "Audit". Therefore, the construct of evaluation has two dimensions, namely, audit (Items 1, 2, 3, 4, 9, and 10) and use of quality-related information (Items 5, 6, 7, and 8).

Table 5.7 lists the unrotated factor and rotated (varimax and quartimax) factor matrix for Scale 5 (Process control and improvement). After orthogonal and oblique factor rotation was done, it was not easy to decide whether Item 5 belonged to Factors 1 or 2 as it loaded very significantly on both factors. After its content was examined, it was decided that Item 5 (Our processes are designed to be "foolproof" in order to minimize the chance of employee error) should be deleted from this scale. Thus, Items 1, 2, 3, and 4 formed a factor that can be interpreted as that of "Process control". Similarly, Items 6, 7, and 8 constituted a factor that can be interpreted as that of "Use of quality management methods". Therefore, the construct of process control and improvement has two dimensions, namely, process control (Items 1, 2, 3, and 4) and use of quality management methods (Items 6, 7, and 8).

Table 5.3 Results of Exploratory Factor Analysis for the Eleven TQM Implementation Scales

Scales	Factor number	Eigenvalues	Factor loadings Item1	Item2	Item3	Item4	Item5	Item6	Item7	Item8	Item9	Item10	% of variance
1	1	4.620	0.784	0.802	0.725	0.677	0.839	0.644	0.770	0.816			57.750
2	1	3.394	0.748	0.808	0.817	0.696	0.665	0.737					55.820
3	1	5.095	0.848	0.861	0.531	0.875	0.873	0.873	0.630	0.815			63.692
4	2	5.106 (Factor 1)	0.737	0.679	0.731	0.751	0.701	0.671	0.797	0.785	0.647	0.627	51.062
		1.009 (Factor 2)	0.223	0.170	0.269	0.020	-0.094	-0.379	-0.294	-0.589	0.273	0.444	10.095
5	2	4.405 (Factor 1)	0.727	0.677	0.765	0.725	0.793	0.751	0.777	0.714			55.060
		1.019 (Factor 2)	0.313	0.492	0.395	0.138	-0.080	-0.408	-0.333	-0.469			12.734
6	1	3.797	0.709	0.665	0.661	0.712	0.637	0.572	0.789	0.745			47.469
7	1	3.878	0.795	0.904	0.902	0.940	0.855						77.561
8	1	4.443	0.754	0.740	0.806	0.705	0.754	0.781	0.637	0.773			55.539
9	1	3.514	0.761	0.699	0.759	0.776	0.747	0.810					58.572
10	1	3.834	0.833	0.858	0.844	0.674	0.718	0.848					63.895
11	1	3.710	0.819	0.748	0.825	0.842	0.657	0.813					61.883

Note: Eigenvalue greater than 1 was used as criterion for factor extraction.

Table 5.4 Factor Extraction (Evaluation)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,106	51,062	51,062	5,106	51,062	51,062	3,322	33,222	33,222
2	1,009	10,095	61,157	1,009	10,095	61,157	2,794	27,935	61,157
3	,911	9,107	70,263						
4	,587	5,873	76,137						
5	,552	5,518	81,654						
6	,473	4,727	86,381						
7	,424	4,244	90,625						
8	,359	3,590	94,215						
9	,318	3,181	97,396						
10	,260	2,604	100,000						

Extraction Method: Principal Component Analysis.

Table 5.5 Factor Extraction (Process Control and Improvement)

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,405	55,060	55,060	4,405	55,060	55,060	2,722	34,025	34,025
2	1,019	12,734	67,794	1,019	12,734	67,794	2,702	33,769	67,794
3	,638	7,970	75,764						
4	,511	6,389	82,153						
5	,451	5,643	87,796						
6	,357	4,459	92,256						
7	,346	4,324	96,579						
8	,274	3,421	100,000						

Extraction Method: Principal Component Analysis.

Table 5.6 Factor Matrix for Scale 4 (Evaluation)

	Unrotated factor		Rotated factor (Varimax)	
Scale 4	1	2	1	2
Item 1	.737	.223	.<u>701</u>	.319
Item 2	.731	.170	.<u>661</u>	.354
Item 3	.751	.269	.<u>742</u>	.294
Item 4	.701	.020	.<u>540</u>	.447
Item 5	.671	-.094	.442	.<u>513</u>
Item 6	.797	-.379	.348	.<u>811</u>
Item 7	.785	-.294	.395	.<u>739</u>
Item 8	.647	-.589	.098	.<u>870</u>
Item 9	.627	.273	.<u>652</u>	.209
Item 10	.679	.444	.<u>803</u>	.114

Table 5.7 Factor Matrix for Scale 5 (Process Control and Improvement)

	Unrotated factor		Rotated factor (Varimax)		Rotated factor (Quartimax)	
Scale 5	1	2	1	2	1	2
Item 1	.727	.313	.295	.734	.753	.245
Item 2	.677	.492	.134	.826	.833	.077
Item 3	.765	.395	.264	.820	.836	.208
Item 4	.725	.138	.417	.609	.636	.375
Item 5	.793	-.080	.619	.503	.544	.583
Item 6	.751	-.408	.820	.240	.295	.802
Item 7	.777	-.333	.786	.311	.364	.763
Item 8	.714	-.469	.837	.171	.228	.823

It should be noted that two factors emerged for Scales 4 (Evaluation) and 5 (Process control and improvement). This result was obtained according to the rule of eigenvalues greater than 1. A careful examination of the two eigenvalues for the two scales was undertaken; the two eigenvalues for Factor 2 were only 1.009 and 1.019, just a little bit greater than 1. After the contents of items in Scales 4 and 5 were carefully examined, it was clear that the aim of using quality-related information is for evaluation. Similarly, the aim of using quality management methods is for controlling and improving process. Therefore, for subsequent data analysis, the construct of evaluation was not divided into two constructs. Similarly, neither was the construct of process control and improvement. Note that Item 5 in Scale 5 was deleted. Thus, Scale 5 consisted of 7 measurement items.

5.3.4 Summary

After the reliability analysis, item analysis, and validity analysis had been conducted, it was concluded that the TQM implementation instrument is reliable and valid. The data obtained through this instrument can be used for subsequent data analysis. The tested and validated TQM implementation instrument had 11 scales that consisted of 78 measurement items. One item in Scale 5 was deleted after factor analysis.

Compared to the other quality management instruments developed by Saraph et al. (1989), Flynn et al. (1994), and Ahire et al. (1996), the instrument developed in this study has the highest external validity for manufacturing industries in general and for Chinese manufacturing firms in particular. The reason for this is that the author used data from 212 Chinese manufacturing firms in nine industrial sectors for testing and validating this instrument. While its internal consistency falls behind the Flynn et al. and the Ahire et al. instruments, it is however better than that of Saraph et al. Saraph et al. (1989) used data from 162 general and quality managers in 89 divisions of 20 manufacturing and service firms. A main strength of their instrument is its highest level of external validity for manufacturing and service industries (Ahire et al., 1996). Flynn et al. (1994) employed data from 716 respondents at 42 plants in the transportation components, electronics and machinery industries. The focus of their instrument is more on manufacturing industries within limited

sectors. Their instrument, therefore, has the second highest internal validity. Its external validity is, however, better than the Ahire et al. instrument. Ahire et al. (1996) utilized data from 371 manufacturing firms in a single industry–motor vehicle parts and accessories for validating their instrument. Their instrument therefore has the highest internal consistency, but its external validity is the lowest. Ahire et al. (1996) summarized the differences and similarities of the three instruments in their paper.

5.4 Overall Business Performance Instrument

In this study, four constructs of overall business performance were identified: Employee satisfaction, product quality, customer satisfaction, and strategic business performance. These constructs were measured by one, seven, two, and five items, respectively. For details, please refer to Appendix 2. For testing and validating the four scales of overall business performance, internal consistency analysis, item analysis, content validity, and exploratory factor analysis should be conducted. In fact, content validity has already been addressed in Subsection 5.2.3. It was assumed that the four scales for measuring overall business performance had content validity. In this section, however, only internal consistency analysis, item analysis, and exploratory analysis are presented. The detailed analysis results are listed in Tables 5.8, 5.9, and 5.10, respectively. Appendix 3 lists the relative frequency distributions and means of respondents' responses to items that measure overall business performance constructs.

5.4.1 Employee Satisfaction

In this study, only one item was used to measure perceived overall employee satisfaction. Therefore, it was not necessary to conduct internal consistency reliability analysis, item analysis, and factor analysis for this scale; it can be assumed that it is reliable and valid. For details, please refer to Chapter 3.

5.4.2 Product Quality

Table 5.8 shows that the reliability alpha was 0.931, which indicated that this scale is reliable. The coefficients of item to scale correlation were greater than 0.50, which indicated that the items had been assigned to the scale appropriately. Table 5.9 shows the results of exploratory factor analysis; it can be concluded that the construct of product quality had two dimensions according to the rule of eigenvalues greater than 1. Table 5.10 shows the results of rotated exploratory factor analysis. It was evident that Items 1, 2, 3, and 4 formed a factor, which could be interpreted as that of "Product performance". Similarly, Items 5, 6, and 7 formed another factor that could be interpreted as "Quality loss". Thus, the construct of product quality has two dimensions: Product performance and quality loss. However, Table 5.9 shows that all factor loadings on Factor 1 were greater than 0.50, while factor loadings on Factor 2 were less than 0.50. In addition, the eigenvalue for Factor 2 was slightly greater than 1. Therefore, for subsequent data analysis, the construct of product quality was not divided into two constructs. In fact, this construct is a large concept that consists of the

dimensions of product performance and quality loss. Thus, the scale for measuring product quality has good construct validity.

5.4.3 Customer Satisfaction

There were only two items for measuring the scale of customer satisfaction. Table 5.8 shows that the reliability alpha was 0.868, which indicates this scale is reliable. Table 5.8 also shows that the values of item to scale correlation were greater than 0.50. Table 5.9 suggests that factor loadings were greater than 0.50. Therefore, it can be concluded that this scale for measuring customer satisfaction is reliable and valid and can be used for subsequent data analysis.

5.4.4 Strategic Business Performance

Although the Cronbach's alpha for the scale of strategic business performance was 0.642 (see Table 5.8), it is common practice to consider 0.60 an acceptable value in management science research (Nunnaly, 1978). Therefore, this scale for measuring strategic business performance is reliable. According to item analysis, the coefficients of item to scale correlation were greater than 0.50 (see Table 5.8), which indicates that the items had been assigned to the scale appropriately. Table 5.9 shows the results of exploratory factor analysis. It can be concluded that the construct of strategic business performance has two dimensions according to the rule of eigenvalues greater than 1. It was clear that all factor loadings on Factor 1 were greater than those on Factor 2. However, the absolute values of the three factor loadings on Factor 2 were greater than 0.50. This result further indicated that this construct had two dimensions. Table 5.10 shows that Items 1, 4, and 5 formed a dimension that could be interpreted as the factor of "Firm size". Items 2 and 3 formed another dimension, which can be interpreted as the factor of "Profitability". These two dimensions of strategic business performance receive a great deal attention by the Chinese manufacturing firms and the Chinese government. In this study, the construct of strategic business performance was regarded as a complete concept. Therefore, for subsequent data analysis, this construct of overall business performance was not divided into two constructs.

Table 5.8 Reliability Analysis and Item Analysis

Scales	Items	CA	Item-total correlation						
			Item1	Item2	Item3	Item4	Item5	Item6	Item7
PQ	7	0.931	0.835	0.885	0.870	0.837	0.792	0.844	0.849
CS	2	0.868	0.936	0.945					
SBP	5	0.642	0.716	0.637	0.660	0.633	0.564		

Notes: CA means Cronbach's alpha; PQ for product quality; CS for customer satisfaction; SBP for strategic business performance.

Table 5.9 Unrotated Exploratory Factor Analysis

Scales	EV	Factor loadings							% of
		Item1	Item2	Item3	Item4	Item5	Item6	Item7	variance
PQ	5.005	0.846	0.897	0.886	0.853	0.770	0.826	0.834	71.497
	1.055	-0.348	-0.271	-0.325	-0.342	0.487	0.473	0.421	15.078
CS	1.770	0.941	0.941						88.497
SBP	2.084	0.732	0.659	0.704	0.611	0.493			41.677
	1.153	0.345	-0.579	-0.533	0.525	0.373			23.065

Notes: EV means Eigenvalue and Eigenvalues greater than 1 were used as criterion for factor extraction.
PQ means product quality; CS for customer satisfaction; SBP for strategic business performance.

Table 5.10 Rotated Exploratory Factor Analysis (Varimax)

Scales	Factors	Rotated (Varimax) factor loadings						
		Item1	Item2	Item3	Item4	Item5	Item6	Item7
Product quality	Factor 1	0.870	0.859	0.886	0.872	0.271	0.324	0.363
	Factor 2	0.283	0.374	0.326	0.292	0.870	0.896	0.860
Strategic	Factor 1	0.770	0.09	0.152	0.805	0.615		
Business performance	Factor 2	0.247	0.873	0.870	0.03	0.06		

5.4.5 Summary

In summary, the instrument for measuring overall business performance is reliable and valid. The data obtained from this instrument can be used in subsequent data analysis to test the theoretical models hypothesized in this research.

5.5 Conclusions

Reliability, item, and validity analyses were used to test and validate the measurement instruments. The procedures for testing the reliability and validity of the instruments (TQM implementation and overall business performance) have been described in greater detail in this chapter. After reliability, item, and factor analyses were conducted, the instruments for measuring TQM implementation constructs and overall business performance constructs were empirically tested and validated for their reliability and validity. One item in the scale of process control and improvement was deleted after factor analysis since it loaded significantly on two factors. Thus, for subsequent data analysis, only 78 items were used for measuring TQM implementation. Through their evaluation, it can be concluded that the instruments for measuring TQM implementation and overall business performance are reliable and valid. The data obtained from the two instruments can be used for testing the theoretical models hypothesized in this study. Practitioners can use the validated instruments

for measuring their TQM implementation and overall business performance, and researchers can use them to study the effects of TQM implementation on overall business performance.

Chapter 6 Results of Model Testing[17]

6.1 Introduction

This chapter presents the results of testing the two theoretical models hypothesized in this study. Section 6.2 describes the methodology used for testing the two theoretical models. Section 6.3 tests the theoretical model of TQM implementation and overall business performance. Section 6.4 presents the result of testing the theoretical model of TQM implementation constructs and overall business performance. Section 6.5 provides brief interpretations of model testing results. Finally, Section 6.6 summarizes this chapter with a number of conclusions.

6.2 Methodology

Structural equation modeling[18] (LISREL) was employed in testing the theoretical models hypothesized in this research. There are two ways of estimating a LISREL model. First, all paths of the measurement model and structural model are estimated simultaneously. Second, the paths of both models can be estimated separately, which is two-stage analysis. Many researchers are now proposing a two-stage process of structural equation modeling (Hair et al., 1992). In this research, however, the total observations were only 212, which was not sufficient for estimating the measurement and structural models simultaneously. Therefore, the two-stage analysis approach was selected for estimation. In this chapter, only the structural model is estimated.

The path analysis technique can be used to test the plausibility of putative causal relationships between one variable and another in non-experimental conditions. Path analysis is the basis for the empirical estimation of the strength of each causal relationship depicted in the path model, and is based on calculating the strength of the causal relationships from the correlation among the constructs. The procedure can be formulated as one of estimating the coefficients of a set of linear structural equations representing the cause and effect relationships hypothesized by researchers (Jöreskog and Sörbom, 1996). The system of relationships involves variables of two kinds: Independent (or cause) variables X_1, X_2, …, X_q and dependent (or effect) variables Y_1, Y_2, …, Y_p.

In this research, two theoretical models were hypothesized. One was to combine all of the 11 TQM implementation constructs into one independent variable, which was used to test the relationships between TQM implementation and overall business performance. The other model was to investigate the relationships between the 11 TQM implementation constructs and overall business performance. In this case, the 11 TQM implementation constructs are

[17] Parts of this chapter were published in Zhang (2000c, 2000d, 2000e, 2000f).
[18] According to Hair et al. (1992), structural equation modeling is simply known by the name of LISREL analysis, which is the name of one of the more popular software packages.

independent variables. Estimating a path analysis model with LISREL is entirely straightforward. LISREL treats the model as a system of equations and estimates all the structural coefficients directly. The path coefficients (γ, β) are displayed in Figures 6.1 and 6.3.

6.2.1 Selection of Input Matrix Types

There are many discussions concerning which types of input matrices should be used for LISREL. The selection of an input matrix is highly dependent on the data types. Since social science data typically derive from attitudinal questionnaires or interviews that are structured in a Likert-type format, they are representative of an ordinal scale. Nonetheless, it has been common practice in structural equation modeling, if the number of response categories of a variable is greater than two, to treat these variables as if they were on a continuous scale (Byrne, 1998). However, according to Jöreskog and Sörbom (1996), ordinal variables are not continuous variables and therefore should not be treated as such. Ordinal variables have no metric; their means, variances, and covariances are not meaningful. As a result, data analysis using LISREL may produce biased estimates. When data comprise variables that are ordinal data or a combination of ordinal and continuous data, data analysis using LISREL should be based on the polychoric or polyserial correlation matrix (Jöreskog and Sörbom, 1996). In this research, however, the measurement and structural models are estimated separately. In addition, in estimating the theoretical models, independent and dependent variables in the two models are treated like directly observed variables (they are actually latent variables). In LISREL, a variable is assumed to be continuous if there are more than 15 values. In this study, most constructs were based on the sum of more than four item-scores and thus had more than 15 values. The employee satisfaction construct was measured between 0 and 10 to one place of decimal point. Thus, it had more than 15 values. Only one construct, that is, customer satisfaction was the sum of two items, and had nine values. If this variable was treated as ordinal data, then PRELIS could only calculate Pearson and polyserial correlation coefficients. If customer satisfaction was treated as continuous data, the PRELIS could only calculate Pearson correlation coefficients. Based on personal communication with Boomsma[19], the data of the customer satisfaction variable could be treated as continuous. Therefore, the Pearson correlation matrix should be selected as the input matrix for LISREL instead of the combination of Pearson and polyserial correlations.

6.2.2 Model Estimation

LISREL 8.14 provides different methods for estimating structural models. Among them are the maximum likelihood (ML), the generalized least squares (GLS), and the generally weighted least squares (WLS). In this research, the Pearson correlation matrix was selected as the input matrix. According to Jöreskog and Sörbom (1996), the WLS estimation method should be used, however, the problem with this method is that a rather large sample is

[19] On 5 March 1999, the author had an in-depth discussion with Mr. Boomsma (LISREL course lecturer) during the LISREL course. According to his suggestion, the data of customer satisfaction could be treated as continuous in this study.

required (Kemp, 1999). According to De Jong (1999), ML estimates are consistent (the probability that the parameter estimate approaches the true parameter value increases with the size of the sample), and ML estimates are efficient (they produce the most reliable estimates). Kemp (1999) and De Jong (1999) adopted the ML estimation method for testing their theoretical models, which produced reliable results. Therefore, it was decided that the ML estimation method would be used for testing the two theoretical models.

6.2.3 Assumptions

The structural equation model shares three assumptions with the other multivariate methods: Independent observations, random sampling of respondents, and the linearity of all relationships. Furthermore, this model is more sensitive to the distributional characteristics of the data, particularly the departure from multivariate normality or a strong kurtosis or skewness in the data. A lack of multivariate normality is particularly troublesome since it substantially inflates the Chi-square statistic and creates upward bias in critical values for determining coefficient significance (Hair et al., 1992). For testing multivariate normality, PRELIS 2.14 can be used. Based on a rule of thumb that the skewness and kurtosis should not exceed the absolute value of 1 (Hair et al., 1992). The ML estimation method can produce the best estimates if the variables have a multinormal distribution.

6.2.4 Structural Model Fit

LISREL provides not only estimated coefficients but also standard errors and calculated t-values for each coefficient. A hypothesis is confirmed if the estimated path coefficient is significant and has the hypothesized sign. In this study, one-tailed significance levels are used since the hypotheses formulate explicit predictions of the direction of the effect of one variable on another. A t-value larger than 1.282 corresponds to $p<0.10$ (weakly significant), a t-value larger than 1.645 to $p<0.05$ (moderately significant), and a t-value greater than 2.326 to $p<0.01$ (strongly significant) (Harnett and Murphy, 1985).

6.2.5 Overall Model Fit

In theoretical model testing, a major issue is whether the theoretical model is in conflict with reality as observed in the sample; namely, how well the theoretical model fits the data (De Jong, 1999). Many indicators are calculated by LISREL 8.14, which can be used to evaluate the global model-fit. Five common measures for judging goodness-of-fit are the Chi-square (χ^2), the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the root mean square error of approximation (RMSEA), and the root mean square residual (RMR) (Byrne, 1998; Hair et al., 1992; Jöreskog and Sörbom, 1996).

The most fundamental measure of overall fit is the likelihood-ratio Chi-square statistic, the only statistically based measure of goodness-of-fit available in a structural equation model. A p-value larger than 0.05 is generally considered acceptable. An important criticism of the Chi-square measure is that it is too sensitive to sample size differences, especially in cases

where the sample size exceeds 200 respondents. As sample size increases, this measure has a greater tendency to indicate significant differences for equivalent models. Moreover, when the sample size nears 100 or goes even lower, the Chi-square test will show acceptable fit even when none of the model relationships are shown to be different ways to both small and large sample sizes (Hair et al., 1992).

The goodness-of-fit index (GFI) is a nonstatistical measure ranging in value from 0 (poor fit) to 1.0 (perfect fit), which measures the degree to which the actual input matrix is predicted by the estimated model. Higher values indicate a better fit, but no absolute threshold levels for acceptability have been established. The adjusted goodness-of-fit index (AGFI) differs from the GFI only in the fact that it adjusts for the number of degrees of freedom in the specified model. For both indices, a value larger than 0.90 is considered an acceptable, good fit (Byrne, 1998; De Jong, 1999; Hair et al., 1992; Kemp, 1999).

The fourth indicator, the root mean square error of approximation (RMSEA) takes into account the error of approximation in the population. The RMSEA value is the discrepancy per degree of freedom, and is measured in terms of the population, not just the sample used for estimation. The value is representative of the goodness-of-fit that could be expected if the model were estimated in the entire population, not just the samples drawn for estimation. It is commonly considered that values less than 0.05 indicate a good fit; values from 0.05 to 0.08 represent a fair fit; values ranging from 0.08 to 0.10 indicate a poor fit; and those greater than 0.10 indicate a very poor fit (Byrne, 1998; De Jong, 1999).

The fifth indicator is the root mean square residual (RMR), which is the square root of the mean of the squared residuals – an average of the residuals between observed and estimated input matrices. If a correlation matrix is used, the RMR is in terms of an average residual correlation (Hair et al., 1992). The standardized RMR therefore represents the average value across all standardized residuals, and ranges from 0 to 1.00. Byrne (1998) suggested that in a well-fitting model this value will be smaller than 0.05.

6.2.6 Model Modification

Obtaining an acceptable level of fit does not assure that the best model has been found. Many alternative models may exist that provide an even better fit. A possible model modification should be conducted in order to improve the theoretical explanations or the goodness-of-fit of the model. As a means of evaluating the estimated model with alternative models, overall model comparisons can be performed. The most critical error in developing a theoretically based model is the omission of one or more key predictive variables, known as specification error. The implication of omitting a significant variable is to bias the assessment of the importance of other variables. Modification of the model should be based on theory; modifications to the original model should be made only after deliberate consideration (Hair et al., 1992).

6.3 Model of TQM Implementation and Overall Business Performance

In this hypothesized theoretical model, TQM implementation is an independent variable, the value of which can be calculated by summing the scores of all of the 78 items. There are four dependent variables: Employee satisfaction, product quality, customer satisfaction, and business performance. There is one item to measure employee satisfaction (0-10, to 1 place of decimal point), seven items to measure product quality, two items to measure customer satisfaction, and five items to measure strategic business performance. The four dependent variables can be represented as Y_1, Y_2, Y_3, and Y_4, respectively.

PRELIS 2.14 was used in calculating the Pearson correlation matrix and checking normality of inputting data. The correlation matrix calculated served as the input matrix for LISREL in estimating the hypothesized theoretical model. Table 6.1 lists the summary statistics of the five variables, and shows that the variables have a relatively normal distribution since the skewness and kurtosis do not exceed the absolute value of 1. Therefore, LISREL can be used to estimate the theoretical model.

Table 6.1 Summary Statistics for the Five Variables

Variables	Mean	St. dev.	Skew.	Kurt.	Min.	Freq.	Max.	Freq.
Employee satisfaction	7.51	2.07	-0.69	-0.35	0.50	1	10.00	23
Product quality	26.78	5.23	-0.22	-0.30	9.00	1	35.00	24
Customer satisfaction	8.09	1.49	-0.85	0.89	2.00	1	10.00	40
S.B. performance	13.63	4.64	-0.06	-0.73	5.00	10	25.00	1
TQM implementation	291.84	47.25	-0.34	-0.66	171.00	1	385.00	1

Note: S.B. performance means strategic business performance.

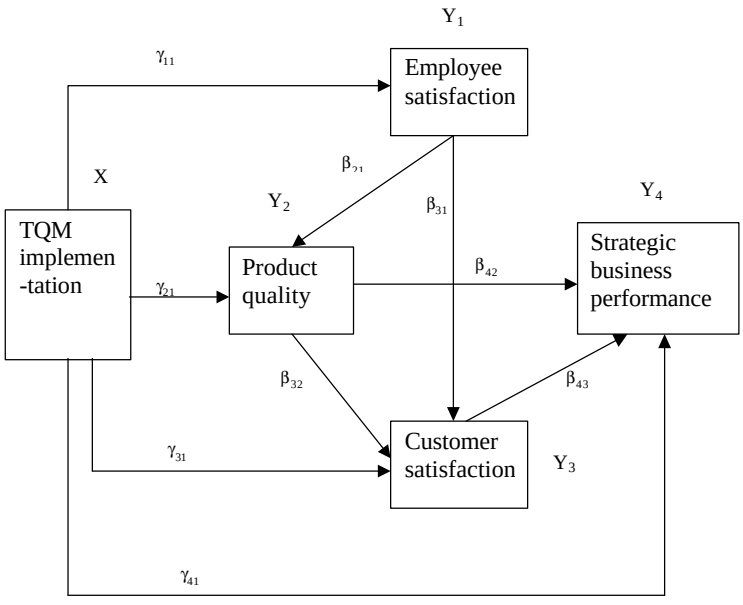
The theoretical model of TQM implementation and overall business performance incorporates nine hypotheses that will be tested simultaneously. A hypothesis is confirmed if the estimated path coefficient is significant. All the path coefficients are displayed in Table 6.2 and Figure 6.2. Seven hypotheses were strongly confirmed by the empirical data since the t-values were greater than 2.326. One hypothesis between employee satisfaction and customer satisfaction was moderately confirmed, since the t-value was 2.32. The relationship between customer satisfaction and strategic business performance was not significant since the t-value was only 1.11. Therefore, the hypothesis that customer satisfaction has a positive effect on strategic business performance was not confirmed. Table 6.2 also lists the overall goodness-of-fit statistics.

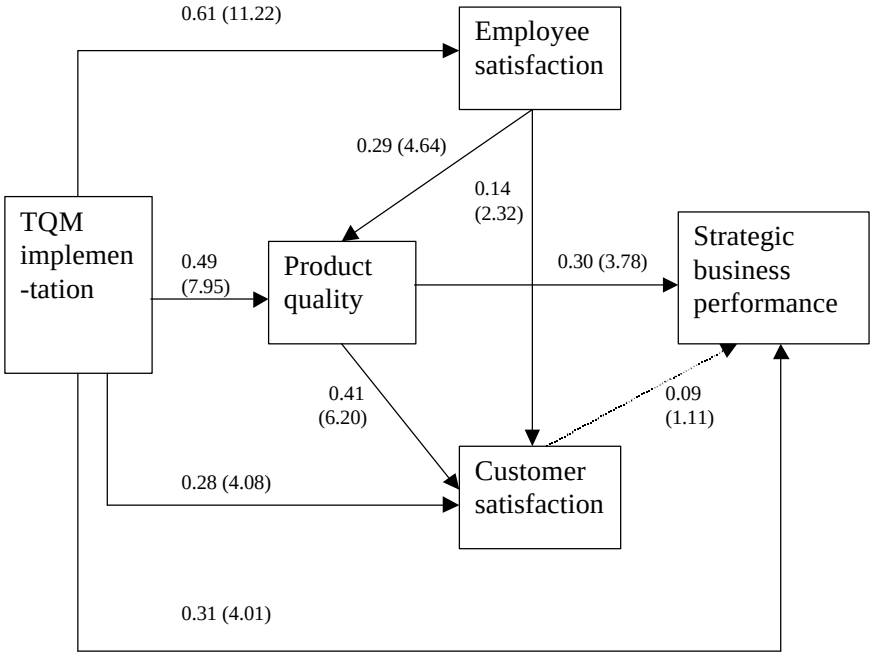
Table 6.2 Maximum Likelihood Estimates

Parameters	Coefficients	T-values
γ_{11}	0.61	11.22
γ_{21}	0.49	7.95
γ_{31}	0.28	4.08
γ_{41}	0.31	4.01
β_{21}	0.29	4.64
β_{31}	0.14	2.32
β_{32}	0.41	6.20
β_{42}	0.30	3.78
β_{43}	0.09	1.11
Chi-square	0.071	--
Degree of freedom	1	--
P-value	0.79	--
GFI	1.00	--
AGFI	1.00	--
RMSEA	0.00	--
RMR	0.0028	--

Note: The symbol "--" means not available.

Figure 6.1 Theoretical Model of TQM Implementation and Overall Business Performance





Notes: T-values are in parentheses.
A t-value larger than 1.645 corresponds to $p<0.05$.
A t-value larger than 2.326 corresponds to $p<0.01$.
Hypothesis were confirmed (⟶).
Hypothesis was not confirmed (⋯⋯▶).

Figure 6.2 Testing the Theoretical Model of TQM Implementation and Overall Business Performance

6.4 Model of TQM Implementation Constructs and Overall Business Performance

The hypothesized theoretical model consists of 11 TQM implementation constructs and four overall business performance constructs, and has 17 hypotheses that will be tested simultaneously by LISREL. The 11 TQM implementation constructs are treated as directly observed or measured variables, which are independent. The values of each construct can be calculated by summing the scores of each item in that construct. X_1, X_2, …, X_{11} are used to represent the 11 independent variables. There are four dependent variables: Employee satisfaction, product quality, customer satisfaction, and strategic business performance. There is one item to measure employee satisfaction (0-10, to 1 decimal point), seven items to measure product quality, two items to measure customer satisfaction, and five items to measure strategic business performance. The four dependent variables can be represented as Y_1, Y_2, Y_3, and Y_4, respectively.

Before running the LISREL 8.14 program, PRELIS 2.14 should be used to calculate the Pearson correlation matrix and check multivariate normality of inputting data. The correlation matrix can serve as the input matrix for LISREL in estimating the hypothesized theoretical model. Table 6.3 lists the summary statistics of the 15 variables and shows that they have a relatively normal distribution since the skewness and kurtosis do not exceed the absolute value of 1. Therefore, the inputting data meet the assumption needed for running LISREL.

Table 6.3 Summary Statistics for the Fifteen Variables

Variables	Mean	St. dev.	Skew.	Kurt.	Min.	F.	Max.	F.
Employee satisfaction	7.51	2.07	-0.69	-0.35	0.50	1	10.00	23
Product quality	26.78	5.23	-0.22	-0.30	9.00	1	35.00	24
Customer satisfaction	8.09	1.49	-0.85	0.89	2.00	1	10.00	40
S.B. performance	13.63	4.64	-0.06	-0.73	5.00	10	25.00	1
Leadership		31.22	5.55	-0.36	-0.63	18.00	2	
40.00 14								
Supplier management	22.08	4.03	-0.42	-0.19	9.00	1	30.000	4
Vision and plan	30.61	5.94	-0.44	-0.59	15.00	2	40.00	9
Evaluation	36.82	6.52	-0.18	-0.56	20.00	1	50.00	4
Process control	25.70	4.59	-0.35	-0.44	12.00	1	35.00	3
Product design	29.08	4.86	-0.13	-0.34	15.00	1	40.00	3
Quality system	18.67	4.97	-0.34	-0.96	8.00	3	25.00	38
Employee participation	29.44	5.17	-0.17	-0.57	16.00	1	40.00	2
Recognition and reward	22.18	4.06	-0.27	-0.18	10.00	2	30.00	9
Education	22.05	4.17	-0.11	-0.91	13.00	1	30.00	6
Customer focus	23.99	3.87	-0.45	0.10	11.00	1	30.00	17

Note: S.B. performance means strategic business performance; F. means frequency.

The path coefficients are listed in Table 6.4 (second column) and Figure 6.4, respectively. Among the 17 hypotheses, eight were strongly confirmed by the empirical data ($p<0.01$), two were moderately confirmed ($p<0.05$), one was weakly confirmed ($p<0.10$). Six hypotheses were not confirmed. The overall goodness-of-fit indices are also listed in Table 6.4. The value of the goodness-of-fit index (GFI = 0.96) is satisfactory since it is larger than the threshold value of 0.90. The value of the adjusted goodness-of-fit index (AGFI = 0.85) is slightly below the threshold value of 0.90. The value of the root mean square error of approximation (RMSEA = 0.077) is below the value of 0.08, which indicates a fair fit. The root mean square residual (RMR = 0.028) is smaller than the value of 0.05, which indicates a better model fit. The Chi-square, 71.69 with 33 degrees of freedom, is significant ($p = 0.00$), which indicates a bad model fit. This may be partly due to the sample size in this study being greater than 200. In a word, the overall model-fit of model M_0 is mediocre. One thing should be mentioned here: The 11 TQM implementation constructs are related. In testing the model M_0, their relationships were taken into account. For clarity, their relationships (arrows) are not shown in the theoretical model.

However, an acceptable fit alone can never guarantee that another model will not fit even better. Opportunities for improving the model-fit can be obtained from the largest values of the standardized residuals, the modification index, and the expected change parameter.

In this research, the theoretical model M_0 was changed once according to the information provided by LISREL. This was a sequential process; after each round of modification, the

results were analyzed and new changes introduced. During this sequential process of model modification, the Model M_0 was used as a benchmarking model. On the basis of Model M_0, the largest standardized residual was 4.03 for quality system improvement and strategic business performance. LISREL suggested to add a path from quality system improvement to strategic business performance. Thus, the theoretical model M_0 was modified by removing the non-significant paths and adding the new one. This change resulted in Model M_1. Table 6.4 shows the overall model-fit of Model M_1 and path coefficients in comparison with Model M_0. The path coefficients are also presented in Figure 6.5. The values of the GFI, AGFI, and p-value increase. The values of the RMSEA, the RMR, and the Chi-square decrease. Therefore, Model M_1 has a better model-fit compared with Model M_0.

Table 6.4 Maximum Likelihood Estimates for Models M_0 and M_1

Parameters	Model M_0	Model M_1
γ_{11}	0.33(3.69)	0.34(3.95)
γ_{22}	-0.05(-0.54)	--
γ_{23}	0.22(1.87)	0.26(3.16)
γ_{24}	0.05(0.41)	--
γ_{25}	0.23(2.41)	0.28(3.56)
γ_{26}	0.10(1.15)	--
γ_{27}	-0.02(-0.19)	--
γ_{18}	0.15(1.29)	0.15(1.45)
γ_{19}	0.18(1.91)	0.19(2.03)
$\gamma_{1\ 10}$	0.01(0.12)	--
$\gamma_{3\ 11}$	0.30(5.09)	0.30(5.09)
γ_{41}	0.27(3.83)	0.13(1.79)
γ_{47}	--	0.30(4.17)
β_{21}	0.29(4.83)	0.27(4.58)
β_{31}	0.15(2.47)	0.15(2.49)
β_{32}	0.42(6.67)	0.42(6.70)
β_{42}	0.34(4.28)	0.33(4.87)
β_{43}	0.10(1.25)	--
Chi-square (χ^2)	71.69	57.48
Degree of freedom	33	38
P-values	0.0001	0.022
GFI	0.96	0.97
AGFI	0.85	0.89
RMSEA	0.077	0.051
RMR	0.028	0.022

Notes: T-values are in parentheses. Symbol "--" means not available.

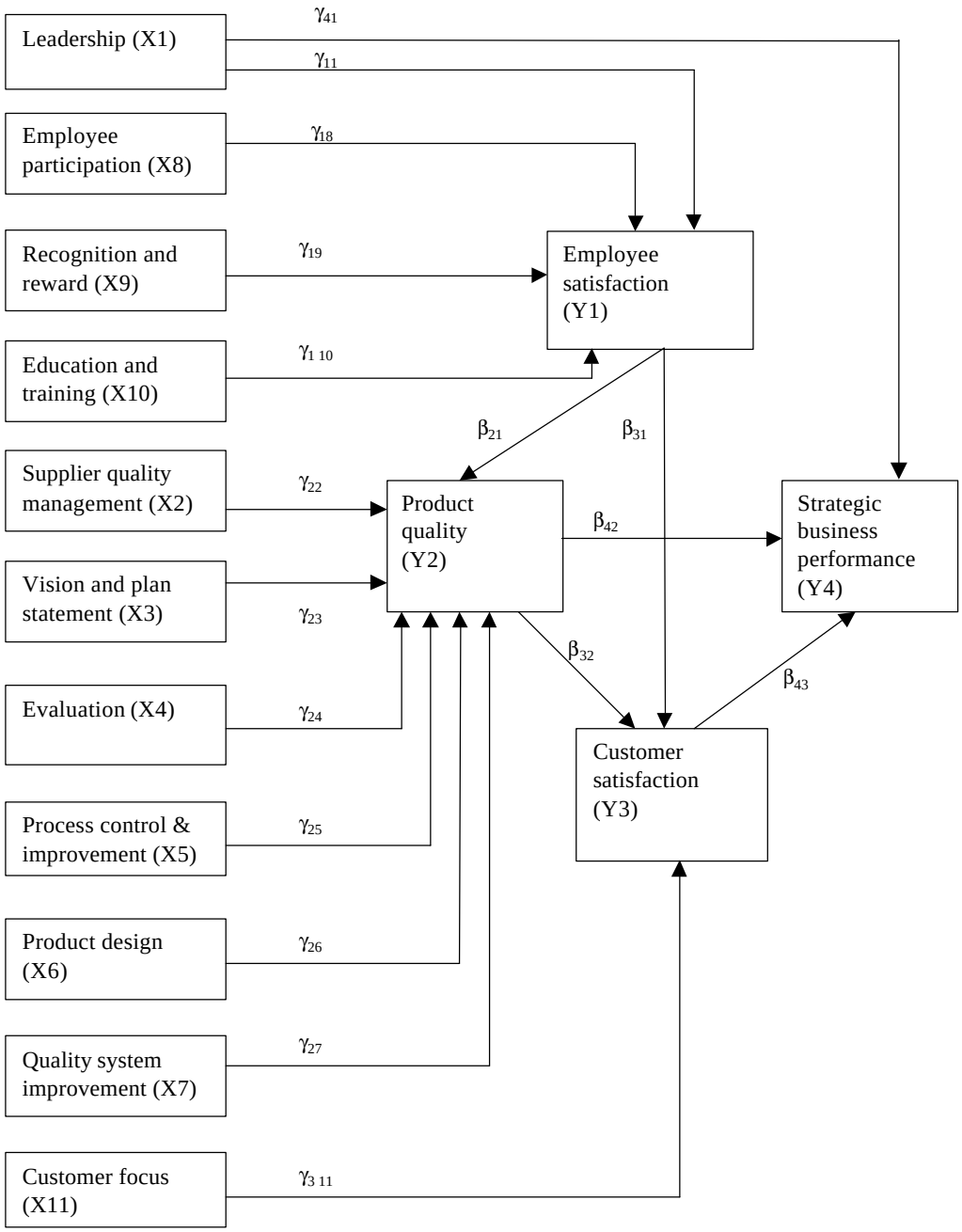


Figure 6.3 Theoretical Model of TQM Implementation Constructs and Overall Business Performance

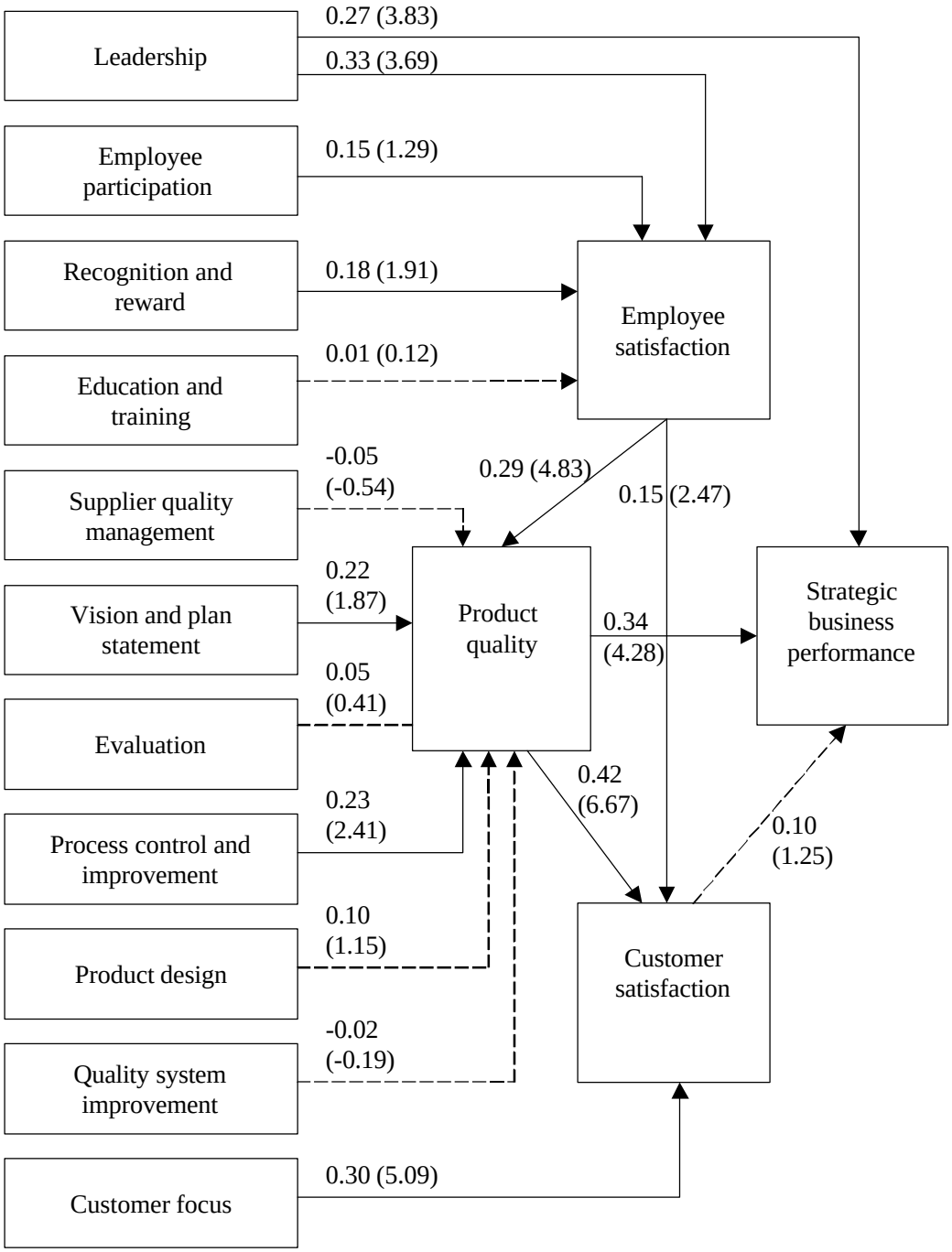


Figure 6.4 Testing the Theoretical Model of TQM Implementation Constructs and Overall Business Performance (M_0)

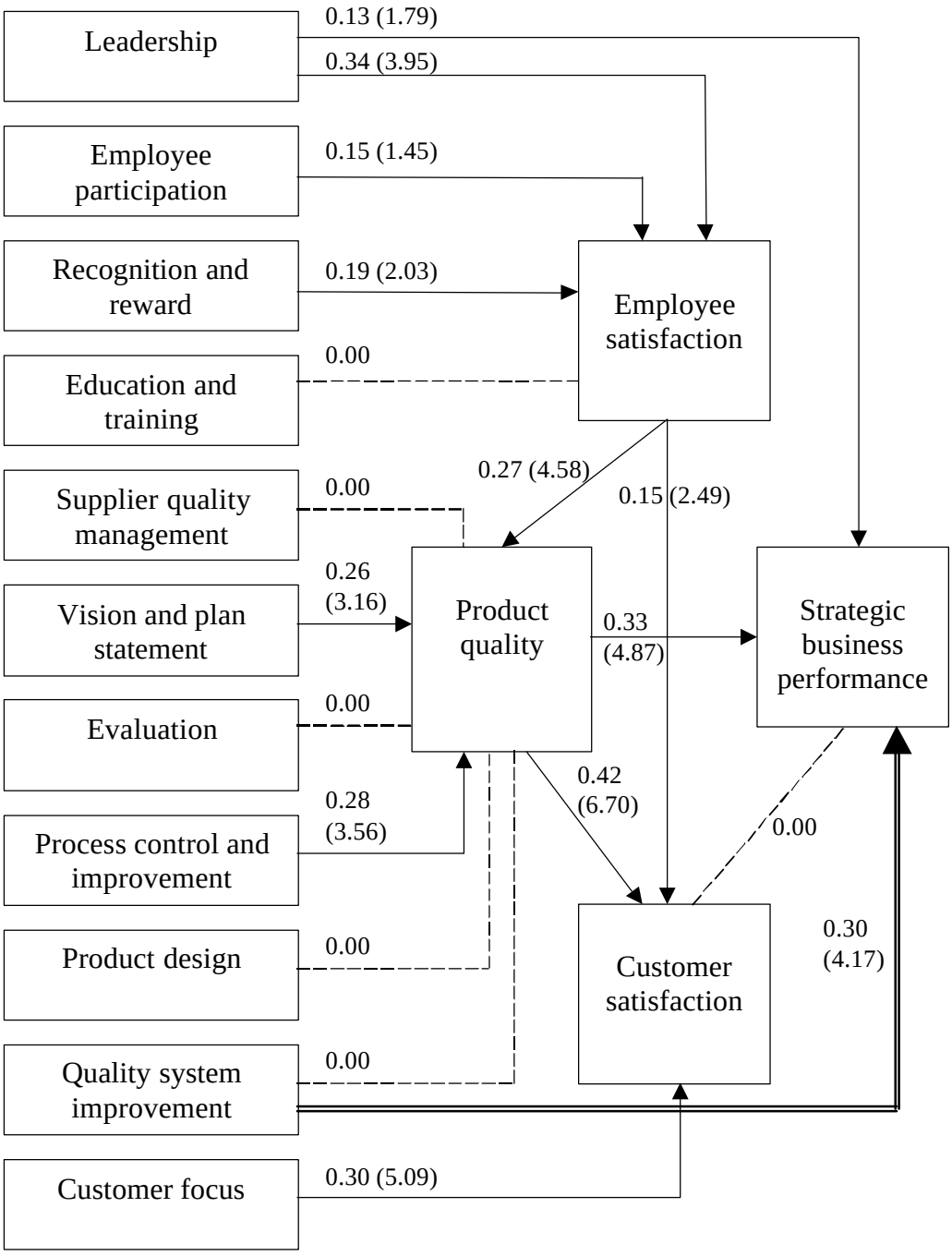


Figure 6.5 Testing the Theoretical Model of TQM Implementation Constructs and Overall Business Performance (M_1)

6.5 Interpretations of Results

One of the most interesting parts of conducting empirical research is to interpret the research findings, however, caution should be exercised in interpreting the results obtained from statistical data analysis (Madu, 1998). There may be a temptation to overstate the findings. In fact, interpretations should be based on a total view of the sampling frame. For example, the use of small samples may reduce the power of the test. Therefore, care should be taken not to overgeneralize the results. There are several inherent weaknesses in the questionnaire survey. When analyzing the data in questionnaires, it is important to keep in mind the following issues:

- The results might be affected by the position of the respondents in the firms. For example, in most cases the persons who had the most responsibilities for quality management completed the questionnaires. These respondents' views might be different from those of other persons in the firms.
- The results might be affected by the education and quality management knowledge of the respondents.
- Some respondents might tend to answer questions in a way that would show their firms in a positive light.
- Some respondents might tend to answer questions in a way that would show their firms in a negative light.

Thus, consideration should be given to these factors when interpreting research findings. In this study, the ten structured interviews and existing research findings were used to help the author interpret the questionnaire findings. Thus, the bias of interpretations might be avoided. More explanations were provided for the hypotheses that were not confirmed by the data.

6.5.1 TQM Implementation

From the results of testing the model of TQM implementation and overall business performance, it can be concluded that TQM implementation has positive effects on employee satisfaction, product quality, customer satisfaction, and strategic business performance. Therefore, this research supports many findings from other researchers. It is not necessary to further discuss the effects of TQM implementation on overall business performance. Concerning the effects of the 11 constructs of TQM implementation on overall business performance, the following paragraphs provide detailed explanations.

Leadership

The questionnaire findings revealed that leadership has positive effects on employee satisfaction ($P<0.01$) and strategic business performance ($P<0.05$). If the characteristics of Chinese manufacturing firms are taken into account, it is much easier to understand the important roles of top management in Chinese firms. China is now trying to establish

modern firm systems. Various firms (including state-owned) have received more decision-making autonomy than ever before. Regarding day-to-day operations, the government has no direct administrative authority. Officially, state-owned firms are owned by "the whole of the people" whereas collective firms are owned by "part of the people". In fact, a firm's general manager is the person legally in charge of the firm under the Firm Manager Responsibility System. It is the role of top management to determine the firm's vision, strategy, policy, long-term goals, and the way to achieve these objectives. Top management is in charge of managing employees, motivating them to participate in quality improvement activities, encouraging them to share in the firm's vision, empowering them to solve quality problems, arranging resources for their education and training, and rewarding them for their quality improvement efforts. The ten interviews indicated that top management is the most important factor leading to the success of TQM implementation and strategic business performance. Although most interviewees stated that employees' income was the most important factor affecting employee satisfaction, a few others indicated that employees being treated equally by top management was the most important factor for overall employee satisfaction. One interviewee said: "We do not want to ask more. We just want to be treated equally by top management." According to the results of interviews, leadership is the second most important factor affecting employee satisfaction. As a result, the questionnaire findings are consistent with the results obtained from the structured interviews.

Supplier Quality Management

The questionnaire survey findings did not provide significant statistical evidence to support the hypothesis that supplier quality management has a positive effect on product quality. The ten interviews helped the author explain this seemingly conflicting research finding. All interviewees stated that the long-term cooperative relations with their suppliers had not yet been established. They had to conduct inspection for purchased materials from their suppliers in order to ensure specified quality levels. Poor product quality from suppliers was one of the major factors impeding the improvement of product quality. Nine of ten interviewed firms had product quality problems because of poor quality products from their suppliers. Most interviewed firms had to purchase relatively low quality products since such products' producers did not require buyers to pay immediately. Suppliers that can produce high quality products always require buyers to pay immediately, however, due to the problem of "Triangle debt" in China, the interviewed firms did not have sufficient money for immediate payment. On average, each of these firms owed RMB 88 (USD 10.6) million to their respective suppliers. Under such a circumstance, there was a desire for them to have more suppliers in order to ensure availability of supply and to provide purchasing leverage. According to the current practices of these firms, it was not necessary for them to participate in supplier quality management if suppliers could provide high quality products. They were only involved in supplier quality management if these suppliers provided low quality products. It is better to say that firms' supplier quality management activities were always related to such suppliers that produced relatively low quality products. The more they were involved in supplier quality management, the more quality problems the suppliers had. Therefore, it is understandable that the hypothesis that supplier quality management has a positive effect on product quality was not confirmed by the data. One interviewee pointed out that because of the limited buying power for many consumers, and the far-from-perfect market, price was still the decisive factor in buying a product. Many inexpensive products,

while low in quality, still had quite a large market. Therefore, they believed that to survive in the short term, they had to sacrifice high quality for cheaper price. One interviewee said, “We can manufacture our product better in quality if we use imported materials. But the cost will be higher too. It will be very difficult to find the market for such products. What do you want: High quality for long term, or short term for survival?”

Vision and Plan Statement

The questionnaire survey strongly confirmed the hypothesis that a vision and plan statement has a positive effect on product quality ($p<0.01$). Of the 10 firms interviewed, nine had vision statements that had been made mainly by top and middle management. Only three interviewees stated that their employees were involved in drawing up the vision statements. All of the firms had various plans such as strategic business performance plans, quality policies, quality goals, and quality improvement plans. In most cases, quality goals and strategic business performance plans were assigned by the administrative bureaus. However, these firms had their own objectives that were based on the plans from the administrative bureaus. Generally, top and middle management made these plans. On average, approximately 80% of employees knew their firms’ vision and plan statements. According to the interviewees, their vision and plan statements effectively encouraged employees to work hard to improve product quality, reduce costs, and satisfy customers. Therefore, the results obtained from the questionnaire survey are consistent with those obtained from the structured interviews.

Evaluation

The hypothesis that evaluation has a positive effect on product quality was not confirmed by the questionnaire survey data. All the quality managers interviewed said that various evaluation activities had been adopted in order to improve their competitive advantages. “Due to fierce market competition we are facing, we have to pay more and more attention to our product quality”, one quality manager said. In fact, these firms did understand their problem areas through evaluation activities, however, how to solve these problems was another issue. One quality manager said, “It should be clear that identifying problems is much easier than solving these problems. A number of problems cannot be solved under the current situation. For example, our production equipment is very outdated, and cannot fully meet production requirements. We cannot innovate equipment because of a money shortage. We can improve our product quality if we buy high quality products from qualified suppliers. We cannot do that since we do not have enough money available to pay our purchasing materials immediately”. When asked to describe the relationships among product quality, cost reduction, and customer satisfaction, quite a few interviewees regarded the three as equally important. Some believed that under certain circumstances cost reduction was the most important. One quality manager said, “We have to reduce costs in order to make our products more competitive in the marketplace. Price is still the decisive factor for selling a product in the market. China has different layers of consumers. Many cheaper products with relatively low quality still have quite a large market for low-income consumers.” Another said, “We have a very formal organizational structure, which is the large number of staff sections with responsibilities overlapping those within production workshops. The major problem of this formal structure is that it seems everyone is

responsible, but no one is really responsible. Therefore, it is difficult to implement improvement actions." According to these interviewees, the implementation was more difficult than the formulation. Evaluation activities cannot directly lead to improving product quality if improvement actions cannot be implemented effectively. One interviewee said, "Quality improvement plans can be implemented if money is not required. Quality improvement plans are more difficult to implement if money is needed". It should be noted that evaluation activities cannot improve product quality automatically if no actions are taken. Some figures, for example, defective rate, only tell how many items of a given type were produced last month, with comparisons month to month and year to year. Such figures only tell management how things have been happening, but do not point the way to improvement. According to these interviewees, effective evaluation activities can contribute to product quality improvement if improvement actions formulated on the basis of evaluation activities can be taken in practice.

Process Control and Improvement

The hypothesis that process control and improvement has a positive effect on product quality was strongly confirmed by the data ($p<0.01$). The results from interviews also support this questionnaire finding. According to the interviewees, they paid much attention to process control and improvement in order to ensure that their products performed the functions for which they were intended to meet manufacturing and safety requirements. They also stated that they adopted incoming, in-process, and final inspection in order to ensure that the finished products could meet the requirements of specifications. They used various quality tools and techniques such as statistical process control, the seven QC tools, and the PDCA cycle, which had positive effects on improving their product quality. Concerning process control and improvement, one problem was that their equipment was obsolete and sometimes could not meet production requirements. Much energy had to be spent on equipment maintenance. The other problem was that the work ethic was relatively undeveloped and skill levels as a whole were relatively low. Many employees still needed a great deal of supervision.

Product Design

This questionnaire survey data provided no significant statistical support for the hypothesis that product design has a positive effect on product quality. The frame of respondent firms and the interviews were used to explain this disconfirmation, which is listed as follows. First, several respondent firms might not have their own research & development departments. Thus, they did not have their own product design activities. Such firms only produced products according to their customers' requirements, generally using drawings from their customers. Therefore, the estimation between product design and product quality might have been biased to some extent. Second, it was not clear as to what kinds of products these respondent firms produced. If they produced standardized products, product design had less influential power on final product quality. For such firms, the main goal of product design was to meet the national standards for product quality. Thus, their product design did not tend to affect final product quality. Third, some firms could design products with high quality performance. The problem was that they could not produce such products using obsolete equipment and thus had to compromise between product design and production

capabilities. Fourth, production costs might be a reason affecting product design. For example, firms had to reduce design standards so that they could produce these products with less production cost. However, the ten structured interviews revealed that product design has positive effects on product quality. Why did this seemingly conflicting result emerge? The reason is as follows: Compared with the respondent firms for the questionnaire survey, these ten interviewed firms were above average in terms of their TQM implementation. All of the ten interviewed firms had their own R&D departments. They produced non-standardized products. Therefore, their product design activities greatly influenced their final product quality. Thus, it is not difficult to understand why the hypothesis that product design has a positive effect on product quality was not confirmed by the questionnaire survey data.

Quality System Improvement

It was interesting to find that quality system improvement does not have a positive effect on product quality, while quality system improvement has a positive effect on strategic business performance ($P<0.01$). In this study, quality system improvement means to establish a quality system according to ISO 9000 requirements. ISO 9000 has been introduced nationwide in China since 1993. Undoubtedly, governmental policies and regulations have played a very important role in encouraging firms to implement ISO 9000. By the end of 1998, 8,117 firms in China had received ISO 9000 certification, 556 in Liaoning Province (CNACR, 1999).[20]

The hypothesis that quality system improvement has a positive effect on product quality was not confirmed by the questionnaire survey data. Several reasons might lead to this disconfirmation. First, it was estimated that most of the respondent firms had established their quality systems according to ISO 9000 requirements. A number of respondent firms had obtained ISO 9000 certification, however, the exact number of those implementing ISO 9000 and receiving ISO 9000 certification was unclear. Thus, the estimation between quality system improvement and product quality might have been biased to a certain degree. Second, it might be possible that some respondent firms had already been implementing TQM for a long time. These firms already had good quality systems in place. Implementing ISO 9000 or obtaining ISO 9000 certification could not improve such firms' product quality. Third, it might be possible that some certification bodies did not audit quality systems very well. Some certified firms did not effectively establish their quality systems according to ISO 9000 requirements. For such firms, implementing ISO 9000 and obtaining ISO 9000 certification were just a formality. This research finding was consistent with the results obtained from the state supervision and inspection of product quality. In the first quarter of 1996, the China State Bureau of Quality and Technical Supervision sampled 17 kinds of products for inspection from 16 manufacturing firms that had ISO 9000 certification. The

[20] China has two ISO 9000 certification systems, one organized by the China State Bureau of Quality and Technical Supervision and the other by the China State Administration of Import and Export Commodity Inspection. The figures presented here are only from China National Accreditation Committee for Quality System Registration Bodies under the China State Bureau of Quality and Technical Supervision. The exact number of ISO 9000 certificates in the country remained unclear.

sample conformity rate was only 76.5%, and the average sample conformity rate in 1996 was 77%[21]. These figures showed that there was no difference in terms of product quality between firms with ISO 9000 certification and those without. This finding further revealed that ISO 9000 is not a guarantee of higher product quality.

This study found that quality system improvement has a positive effect on strategic business performance ($P<0.01$), possibly due to the following reasons: Before 1991, China had the programs of the Excellent-Quality Product Prize and the Quality Management Prize. If firms received such prizes, they were regarded as excellent. Unfortunately, the State Council terminated these award activities in 1991[22]. Thus, it seemed that no universal criteria existed for assessing firms' quality management. Since ISO 9000 was introduced in China in 1993, it has become a fad in Chinese industries. Due to misconceptions about ISO 9000, many practitioners thought that it was a panacea. ISO 9000 certification was regarded as a passport to the world market. Thus, more and more firms began to implement ISO 9000 even though some managers did not understand what it was. Some firms required their suppliers to implement it and obtain ISO 9000 certification. The Chinese government also made relevant policies to encourage firms to implement it. For example, firms without ISO 9000 certification were not permitted to tender for key state projects. Therefore, some firms had to implement it and finally obtained ISO 9000 certification. According to the firms interviewed, most of them had increased their annual sales, market share, profits, sales growth, and exports since they received ISO 9000 certification. According to these interviewees, if they had not obtained certification, their strategic business performance would have been declining. ISO 9000 certification is a strong marketing promotion tool in China.

Employee Participation

The hypothesis that employee participation has a positive effect on employee satisfaction was weakly confirmed ($p<0.10$) by the questionnaire survey data. Chinese society has historically been dominated by respect for age and hierarchy of authority (Hofstede, 1980; Shenkar and Ronen, 1987), which may inhibit technical and organizational innovation. Face consideration may inhibit critical discussion of issues. The power/authority dynamic lies at the very heart of Chinese culture and society. According to Adler (1991), participatory management models are not appropriate for cultures with large power distance. This implies that it may not be appropriate to implement employee participation in China or it should perhaps be implemented differently.

According to the ten interviewed quality managers, employee participation in their respective firms was actually "forceful" and not based on the free will of the employees. This is a remarkable characteristic of Chinese employee participation, which is different from Western countries. Suggestion activities were normally organized by the trade unions, which are becoming increasingly involved in the day-to-day management of the firms. One of their principal tasks is to develop the employees' roles as masters of their firms. Employee participation can also be undertaken through workers' congresses, generally held twice a year

[21] This was obtained from Zhang (2000b).
[22] This was obtained from Zhang (2000b).

in a firm. At these congresses, the firm's manager generally reports the business progress so far and proposes a plan for the next scheduled period. Representatives from different departments at the congress will discuss every detail of the manager's report, and decide whether to approve it. All representatives are encouraged to put forward their opinions, suggestions, and possible modifications about the report. The congresses also examine all rules and regulations issued in the firm, involve important decision-making, as well as check, supervise and appraise the firm's management. In Chinese firms, the workers' congress stands for the principle of "democratic management".

All of the ten interviewed firms used some type of teams as part of their TQM efforts. These teams included, for example, cross-functional teams, within-functional teams, and QC circles. Cross-functional teams were usually appointed by top management, while within-functional teams and QC circles were formed by different functional departments. In terms of the effects of these teams, cross- and within-functional teams were better than QC circles, as they usually dealt with some important issues. Therefore, management provided the teams with sufficient resources. QC circles, conversely, dealt with some unimportant issues. Compared with cross- and within-functional teams, they had less support from top and middle management. Concerning the effects of QC circles, different interviewees had different views. Seven interviewed firms stated that their QC circles had effects on improving product quality and financial profits. Three interviewees stated that they did not see such effects. However, one quality manager said, "Even though we do not see such effects, we still think it is still necessary to organize QC circle activities in our firm. QC circle participants can share their values and learn from each other. QC circles can enhance employees' enthusiasm for work and commitment to quality improvement activities." According to the most interviewees, employee participation activities as a whole have a positive effect on employee satisfaction.

Recognition and Reward

The hypothesis that recognition and reward has a positive effect on employee satisfaction was moderately confirmed by the survey data ($p<0.05$). Although Deming (1986) argued persuasively that the focus on individual performance and related evaluation and reward practices causes major dysfunctions and organizational ineffectiveness, the research conducted by Jenner et al. (1998) suggested that it is very important for having a successful TQM implementation in Chinese firms if the contributions made by all employees toward TQM implementation is clearly linked to rewards. In fact, recognition and reward activities have been used extensively in various Chinese firms for many years. All the interviewed firms had regulations regarding recognition and reward. These activities included, for example, public recognition, salary increasing, promotion, bonus, non-monetary rewards (spirit rewards). According to the quality managers interviewed, these recognition and reward activities did motivate employees to enhance their commitment. However, attempts to motivate employees through ideology and politics have become increasingly less effective compared with some years ago. According to the ten interviewees, employee recognition and reward programs do contribute to employee satisfaction.

Contrary to recognition and reward, both monetary and non-monetary penalties have been used by the ten interviewed firms. China's firm reform is under way. The introduction of the

contract system in most Chinese firms means that their retained profits have become linked to economic returns, while employees' incomes have been tied to individual performance. A very high portion of employee income is dependent upon employees' performance. According to the ten interviewees, the penalty schemes forced employees to follow regulations, especially low educated employees who were lax in work discipline. Otherwise, employees could not realize the importance of quality. One interviewee said, "If we do not penalize employees who do not follow regulations, highly performed employees will be de-motivated. In fact, penalties are special recognition and 'reward', that is, for poorly performing employees. Our firm's quality management is highly dependent on penalties. They do work." Since China began to establish the modern firm system, many firms have laid off excessive employees, especially in Liaoning province. Liaoning is an old industrial base in China created by the State through huge investments in the 1950s and 1960s. However, since the early 1990s, many state-owned firms have been pushed to the brink of bankruptcy due to serious debts. As a result, numbers of employees have been laid off. A survey of provincial departments indicated that about 2 million employees in the province were laid off from 1994 to 1998 as firms struggled to cut costs (Jiang, 1999). Therefore, if employees had not performed well, they would face being laid off.

Education and Training

The questionnaire survey data did not support the hypothesis that education and training has a positive effect on employee satisfaction. According to the interviewees, the main objectives of their education and training programs were to improve employees' skills and enhance their commitment. Thus, employees had the capacity to do their jobs better. In fact, improving employee satisfaction was not the major goal of education and training. Compared with other TQM implementation constructs, such as leadership, recognition and reward, and employee participation, education and training had less influential power on employee satisfaction. These interviewees admitted that education and training is very important for the success of their TQM implementation. Their statements supported the research findings by other researchers. The study by Kassicieh and Yourstone (1998) suggested that TQM training is a key to successful implementation of TQM along the dimensions of cost reduction and profit increase. Employee competencies on TQM principles and techniques are the basis of TQM's success. Green (1990) stated that if China is to become more competitive as a manufacturing locale, it must strive to educate its workforce, from management levels down, to integrate the concept of quality at all stages of production.

All firms interviewed had education and training programs related to quality management. These programs covered ISO 9000, quality consciousness, working discipline, statistical process control, and special job skills. Different firms had different training programs for various functional people, according to their job requirements. However, ISO 9000 was their training focus and all firms had ISO 9000 training programs. Employees were trained to follow documented procedures to perform their jobs. Consistent with the finding by Yu et al. (1998), three of the ten firms had training programs for statistical process control. Most had training programs of quality consciousness and labor discipline. However, one interviewee even said, "We used penalties instead of the programs of quality consciousness and labor discipline. Penalties are the best way to educate irresponsible employees." The

major problem regarding education and training in these interviewed firms was money shortage; six out of ten interviewees said money used for education and training was not sufficient. Money is the major limitation that impedes education and training in these firms.

It is no doubt that education and training is very important. However, its effects should not be overestimated. According to the interviewees, it has more positive effects on intellectuals than on production line operators in terms of job satisfaction. According to Cherrington (1995), when absenteeism and turnover are high and when employees express dissatisfaction, many managers think that the obvious solution is a firm-wide training program. Unfortunately, the benefits of training and education are sometimes overestimated. Training programs do not cure all organizational problems, although they certainly have the potential to improve many situations if conducted properly.

Customer focus

The hypothesis that customer focus has a positive effect on customer satisfaction was strongly confirmed by the survey data ($p<0.01$). According to China Daily (July 13, 1999), the biggest state-owned firm in the Liaoning region departed the heaven of the planned economy and stepped into the market economy. Product quality, efficiency, and service became its top priorities. In this study, all the quality managers interviewed admitted that the implementation of a market economy in China has caused competitive pressures to increase. They have had to pay more attention to the quality of products and services. The current situation is totally different from several years ago. All the firms interviewed conducted market investigations and customer satisfaction investigations in order to improve their quality of products and services. All of them established formal feedback systems in order to collect customer complaint information and provided quality warranty and after-sales services in order to pursue customer satisfaction. Some even provided quality guarantee deposit. According to the interviewees, these customer-oriented measures contributed to customer satisfaction in one way or another. Therefore, the interviews support the questionnaire finding.

6.5.2 Overall Business Performance

Effects of Employee Satisfaction

The hypotheses that employee satisfaction has a positive effect on product quality and customer satisfaction were confirmed by the questionnaire survey data. Therefore, it is not necessary to provide more explanations here. In fact, within firms, employees are the ones who deliver satisfaction to their customers. They are a firm's eyes and ears for transferring customer needs and expectations into products and services. Employees are enablers of the firm's vision and strategies to deliver value to customers and make the firm competitive in the marketplace. The interviewees also admitted that satisfied employees could make more contributions to the improvement of product quality and customer satisfaction. To value customers, a firm must first value its employees.

Effects of Product Quality

The questionnaire survey data confirmed the hypotheses that product quality has a positive effect on customer satisfaction and strategic business performance. These findings are consistent with the results obtained from the interviews. Therefore, it is not necessary to provide more explanations here. Quite a few interviewees stated that reducing costs and improving product quality were equally important. Customers would be satisfied if firms could provide high quality products with reasonable price. Firms' strategic business performance would be improved on the basis of cost reduction and product quality improvement. Firms can gain returns from their efforts to product quality.

Effects of Customer Satisfaction

However, the hypothesis that customer satisfaction has a positive effect on strategic business performance was not confirmed by the questionnaire survey data. Some interviewees admitted that their efforts to improve customer satisfaction led to the success of strategic business performance. Quite a few interviewees had different opinions. One said, "Market competition is now very fierce. Sluggish demand on the global market has hampered exports of Chinese commodities, leaving supply larger than demand on the Chinese market. We have to increase local market share through providing excellent after-sales services. We have sales offices and after-sales service personnel in every province in China. This effort costs a lot of money every year. Although our customer satisfaction increases, our profits decrease. In the long run, we may gain benefits from our customer focus efforts." Another said, "Fierce price wars break out in the industrial sector. Many manufacturing firms faced with a slack market resulting from an oversupply of goods resort to price discounts to secure market share. However, instead of benefiting from heavy discounting, many firms, already tottering on the brink of bankruptcy, are dragged deeper into the mire. Customers get benefits from discounting. Firms lose profits." Currently, many organizations in China face the difficulties of a lack of money. Therefore, price is one of the most effective competitive weapons. Means of competition that reduces price among repeat buyers is therefore becoming increasingly important. In fact, today's customers are much harder than ever before; it is very difficult to delight them. They are smarter, more price-conscious, more demanding, less forgiving, and approached by more competitors with equal or better offers. If the firm increases customer satisfaction by lowering its price or increasing its services, the result may be lower profits or lower annual sales. Spending more to increase customer satisfaction might divert funds from increasing the satisfaction of other partners such as employees and suppliers.

Of the five indicators of strategic business performance, exporting is a different issue. It is highly dependent on a firm's policy, targeted markets, market competition, selected manufacturing areas, and international environments. Although the Chinese government strongly promotes manufacturing firms in exporting products to foreign countries (exporting firms can enjoy an approximately 15% tax rebate rate), many Chinese manufacturing firms have still sold their products in the local market. Of the 212 respondent firms, only half exported products to foreign countries. Thus, the estimation between customer satisfaction and strategic business performance might be biased. Exporting products is highly dependent on the international marketing environment. In fact, customer satisfaction is only one of the

factors that affect a firm's exports. Compared with other factors, it may have less influence on exports. Based on the interviews and analysis mentioned above, it can be concluded that customer satisfaction does not necessarily lead to increasing annual sales, sales growth, profits, market share, and exports. According to Fornell (1992), it is far from certain that market share and customer satisfaction are positively correlated. In fact, the opposite could well be the case. The impact of customer satisfaction on repeat business is not the same for all industries. All firms are not equally affected by customer satisfaction. If a firm serves a large number of customers, it is possible that it has some problems with customer dissatisfaction. It is more difficult for the firm with a large market share to have a high average level of customer satisfaction, especially if customer tastes are heterogeneous. Although the hypothesis that customer satisfaction has a positive effect on strategic business performance was not confirmed by the empirical data, it cannot be assumed that customer satisfaction is unimportant and can be ignored. However, in the long run, it is possible that customer satisfaction goes along with strategic business performance. The economic returns from improving customer satisfaction are not immediately realized (Anderson et al., 1994).

6.6 Conclusions

Data from 212 Chinese manufacturing firms were used to test the two theoretical models. Contrary to what was hypothesized in the models, a number of hypotheses were not confirmed by the data. Several conclusions obtained from testing the hypothesized models are: (1) TQM implementation has positive effects on employee satisfaction, product quality, customer satisfaction, and strategic business performance; (2) Leadership has positive effects on employee satisfaction and strategic business performance; (3) Employee participation, recognition and reward have positive effects on employee satisfaction; (4) Education and training does not have a positive effect on employee satisfaction; (5) Supplier quality management, evaluation, product design, and quality system improvement do not have positive effects on product quality; (6) Vision and plan statement, process control and improvement have positive effects on product quality; (7) Quality system improvement has a positive effect on strategic business performance; (8) Customer focus has a positive effect on customer satisfaction; (9) Employee satisfaction has positive effects on product quality and customer satisfaction; (10) Product quality has positive effects on customer satisfaction and strategic business performance; and (11) Customer satisfaction does not have a positive effect on strategic business performance.

It is important to view this study in the context of its limitations. First, data used to test the model came from only 212 manufacturing firms with annual sales more than RMB 10 million in the Liaoning region. Strictly speaking, the generalization is limited. Second, customer satisfaction data were obtained from respondents rather than from customers. Thus, the data would not be very reliable and the research findings might have been biased to a certain degree. Third, the measure of perceived employee satisfaction in particular is relatively weak, because it asked respondents for their general perceptions of overall employee satisfaction in their respective firms. Thus, research findings might have been biased.

The research findings have some practical implications. First, TQM implementation has positive effects on overall business performance. Implementing TQM does payoff. Second, leadership is the decisive factor in determining the success of organizational overall business performance. In other words, without strong leadership, it is impossible for a firm to achieve good overall business performance. Third, the research findings can imply that it is not necessary for all the TQM elements to be present to ensure the success of the TQM programs and overall business performance. In other words, even if a few of the elements are not present, it is possible to obtain the required level of overall business performance. Finally, in this study, some hypotheses were not confirmed by the questionnaire survey data. This disconfirmation does not imply these constructs are unimportant or useless. Instead, firms should identify the problem areas of these constructs and implement them more effectively. For example, firms should pay more attention to balancing customer satisfaction and strategic business performance. They should emphasize the implementation of actions that are formulated on the basis of various evaluation activities. They should establish their quality management systems according to the requirements of ISO 9000 effectively. Thus, quality management systems will be effectively implemented in practice. Firms should implement different education and training programs in order to meet the requirements of different employees. They should emphasize supplier quality management in order to select suppliers on the basis of product quality rather than price alone.

In this study, the two theoretical models were formulated mainly on the literature that was developed in Western contexts. However, the models were tested using data from 212 Chinese manufacturing firms. Therefore, a theory of quality management related to Chinese manufacturing firms was developed. It was found that the research findings presented in this study support the quality management theory developed largely in Western contexts. Nevertheless, can quality management theory developed in Western countries actually be applicable in a Chinese context?

China differs from Western countries on a multitude of variables, such as culture, society, political, and economic systems (Shenkar and von Glinow, 1994). It potentially represents the most serious challenge to paradigms developed in the West. Shenkar and von Glinow suggested that organizational theories vary in their degree of applicability to the Chinese context. While some theories such as population ecology seem to be clearly inapplicable, others such as the equity theory of motivation are more suitable. However, no research findings have been reported concerning the universal applicability of quality management theory developed in Western countries in relation to China. In fact, the universal applicability of quality management theory is still the subject of debate. Recently, Rungtusanatham et al. (1998) replicated Anderson et al.'s (1995) empirical evaluation of a Deming-based theory of quality management in an Italian context. The results from their replication study do not fully support the findings obtained from the research conducted by Anderson et al. (1995) in an American context. Therefore, Rungtusanatham et al. (1998) implied that quality management theory developed in one country is best applicable to that country. According to Adler (1983), the conclusion that the results are universal based on a study of two cultures is unwarranted. Although the research findings in this study support the quality management theory developed largely in Western countries, it can be conservatively interpreted to be indicative of possible universality rather than confirming universality. In fact, quality management theory developed in Western countries cannot be universally applicable in a Chinese context due to culture differences. For example, Chinese society has historically

been dominated by respect for age and hierarchy of authority (Hofstede, 1980; Shenkar and Ronen, 1987). The power/authority dynamic lies at the heart of Chinese culture. According to Adler (1991), participatory management models are not appropriate for cultures with large power distance. This implies that it may not be suitable to implement participation, or participation should perhaps be implemented differently in China. This was supported by the results obtained from the interviews in the ten Chinese manufacturing firms. These structured interviews clearly showed that the firms implemented employee participation differently.

Chapter 7 Development of A TQM Implementation Model

7.1 Introduction

This chapter presents the development of a TQM implementation model for Chinese manufacturing firms. The development of this model was based on the TQM literature review, the structured interviews in ten Chinese manufacturing firms, the questionnaire findings from 212 Chinese manufacturing firms, and the general characteristics of Chinese manufacturing firms. This model provides users with a number of practices, drawn mainly from the ten Chinese firms' experiences in general and their failures and problems in particular. The lessons learned from the ten structured interviews were used intensively to develop this model, which has been designed so that it can be taken from the body of the thesis and employed as a stand-alone document. The model can assist its users in evaluating the strengths and weaknesses of their TQM implementation, targeting their improvement areas, setting up an action plan for improvements, and tailoring a special part to the needs of their firms. The TQM implementation model developed in this study consists of:

- A framework of TQM that consists of the 11 elements of TQM and the four elements of overall business performance;
- A set of TQM implementation practices;
- A set of indicators of overall business performance;
- Processes of using this TQM implementation model in practice;
- Practical guidance providing guidelines to assist users in selecting and/or formulating the most effective TQM implementation plans.

Section 7.2 presents a framework of TQM. Section 7.3 provides a set of TQM implementation practices and their explanations. Section 7.4 presents a set of indicators of overall business performance. Section 7.5 involves processes of using this TQM implementation model in practice. Section 7.6 focuses on providing guidelines to assist users in selecting and/or formulating the most effective TQM implementation plans. Finally, a number of conclusions are provided in Section 7.7.

7. 2 A Framework of TQM

The framework of TQM was formulated on the basis of the theoretical model of TQM implementation constructs and overall business performance. The combination of the elements of TQM and overall business performance was the framework of TQM, which is displayed in Figure 7.1. Thus, the framework of TQM consists of the 11 elements of TQM and the four elements of overall business performance. This framework was based on the hypothesis that TQM implementation has effects on employee satisfaction, product quality, customer satisfaction, and strategic business performance. These hypotheses were confirmed by the questionnaire survey data from 212 Chinese manufacturing firms. Of the 11 TQM elements leadership is the most important, a finding obtained from the ten structured interviews in Chinese manufacturing firms. Of the four elements of overall business

performance, employee satisfaction has effects on product quality and customer satisfaction; it also has an indirect effect on strategic business performance through product quality and customer satisfaction. Product quality has effects on customer satisfaction and strategic business performance. As discussed previously, in the long run, customer satisfaction may have positive effects on strategic business performance. In this framework of TQM, the 11 TQM elements as a whole are regarded as enablers that can lead to improvements of overall business performance. In other words, overall business performance is the result of TQM implementation.

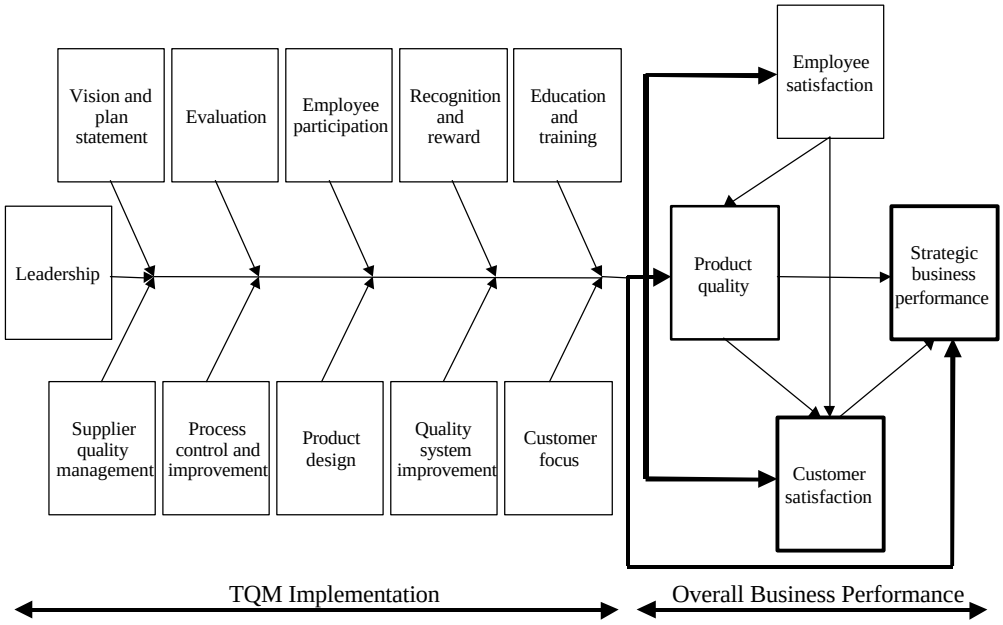


Figure 7.1 A Framework of TQM

7.3 TQM Implementation Practices

A set of TQM implementation practices and their explanations are presented in this section. In fact, implementing TQM is to implement the 11 TQM elements. There is a set of TQM implementation practices supporting the implementation of each element. Based on the literature review and the results obtained from the structured interviews in Chinese manufacturing firms, a number of TQM implementation practices were considered important for Chinese manufacturing firms. These practices are presented in Figure 7.2. In fact, a firm is a dynamic system; many activities are interrelated. Therefore, some practices presented in one element may be suitable for another. This section presents the explanations, suggestions, or potential benefits of these TQM implementation practices, which were based on existing TQM knowledge and the TQM implementation in the ten interviewed Chinese manufacturing firms. Such information may assist or encourage firms to use these practices

to improve their TQM implementation efforts and overall business performance. It should be noted that each TQM practice is only briefly described in this section due to the text limitation. Thus, the descriptions of these TQM practices are not complete. In order to bridge the gap, more references were provided for these practices. Readers can refer to these references for a better understanding of these TQM practices.

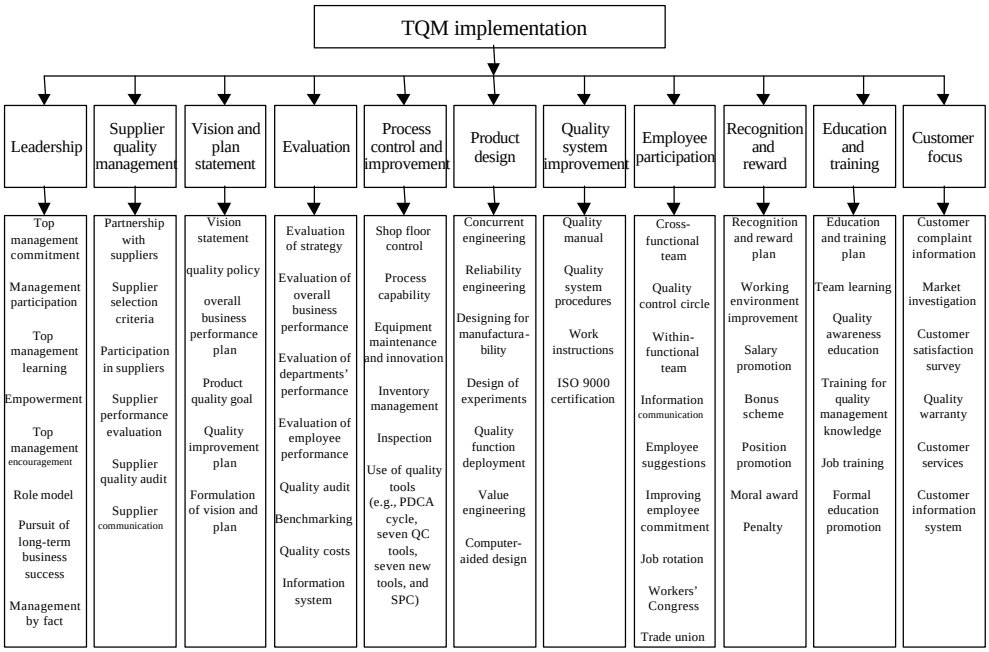


Figure 7.2 A Model of TQM Implementation Practices

7.3.1 Leadership

Top Management Commitment

Top management commitment is the first step and prerequisite for a firm's TQM implementation efforts. Lack of management commitment is one of the reasons for the failure of TQM efforts (Brown et al., 1994). Top managers need to demonstrate their commitment through their actions rather than words. Top management commitment can positively affect employees' commitment to TQM and culturally change people involved. If top management views quality as more important than cost, more important than meeting product schedules, employees' quality awareness is easily improved. To implement TQM, top managers should be committed to establishing a firm that continually views quality as a primary goal. If the organizational culture does not embody quality, any quality improvement effort is probably shallow and short-lived (Dale, 1999; Juran and Gryna, 1993).

Top Management Participation

It is very difficult to improve product quality and quality management if top managers do not lead and participate. Quality improvement involves making decisions and creates something that did not exist before. It is not sufficient for top managers to stand on the sidelines and shout "improve product quality and intensify quality management". There is no way that a manufacturing firm can implement quality improvement activities if the top managers are bystanders. Particularly in a firm with an autocratic general manager, there is a strong trend that employees act on something only in proportion to the manager's degree of interest. Top management participation is crucial to a firm's quality improvement efforts; it obviously helps in spreading quality consciousness throughout a firm (Dale, 1999; Ikezawa, 1993).

Top Management Learning

Top managers need to improve their managerial abilities through continuous learning. To implement TQM, they must first know what it is. Learning TQM is an important step toward implementing it. Top managers should be modest enough to learn from their employees and value the ability of their creativity. Top managers also need to learn from other organizations' successful and unsuccessful experiences, as well as modern management methods from foreign firms. Above all, top managers should combine these insights into an approach that fits the specific conditions, problems, and challenges of their own firms. Through top management learning, a learning organization can be established. Finally, the effectiveness of leadership can be improved and the ability of decision-making enhanced (Anderson et al., 1994a; Bergman and Klefsjö, 1994; Dale, 1999; Ikezawa, 1993; Juran and Gryna, 1993).

Top Management Empowerment

Empowerment means giving permission to the workforce to unleash, develop, and utilize their skills and knowledge to their fullest potential for the firm. Empowerment has many benefits such as increasing employees' motivation to reduce mistakes, increasing the opportunity for creativity and innovation, improving employee loyalty, and allowing top and middle management more time for strategic planning. It is necessary to utilize the strategy of moving toward more humanistic management as the specific objective of improving quality management. The masses have boundless creative power. Top management needs to empower employees to solve various problems and should rely on employees wholeheartedly (DuBrin, 1995; Juran and Gryna, 1993; Kolarik, 1995).

Top Management Encouragement

Top managers should strongly encourage employee involvement in quality management and improvement activities, attach great importance to employees' suggestions, take responsibility for employees' actions as well as those of the people who report to them, and be open and willing to listen to the voices of employees. When TQM is implemented, top managers must have more enthusiasm than their employees. This enthusiasm should be demonstrated by a positive attitude, especially when employees are unwilling. Top managers should trust employees and believe that they can do things better, as well as encourage them

to list the firm's shortcomings and report their own working problems. Such employees should be praised instead of criticized. Top managers should implement TQM, adopting a humanistic approach that considers the value of human existence in a new age (Ikezawa, 1993; Kolarik, 1995).

Top Management's Role Model

Top managers need to act as role models, leading by example. A Chinese proverb states "Example is better than precept". Employees always look to top managers for a standard of correct behavior. The manner in which top managers conduct themselves is more influential than any instructions they may give or any discipline they may impose. Any infringement upon the firm's rules and values can negatively affect employees' satisfaction and commitment. It is vital that top managers handle matters impartially and set an example for their employees to follow. Their model role can positively affect employees' commitment, satisfaction, participation, confidence, initiatives, and creativity (obtained from the ten interviews).

Pursuit of Long-Term Business Success

Top managers should pursue long-term business success instead of short-term benefits. They should focus on product quality rather than yields. Hasty pursuit of short-term profits, short-term sales, and short-term production often results in quality being relegated to third place behind concerns for costs and delivery time. TQM requires long-term commitment and endurance; there are no quick fixes. TQM implementation requires investment. In return, it can lead to an impressive increase of overall business performance. However, the findings from the ten interviewed firms showed that there are no simple ways to gear the profits. Only after much effort and commitment were the firms able to see the effects of their TQM implementation efforts. Top management must realize that improvement takes time. Things can be improved as TQM implementation continues (obtained from the ten interviews).

Management by Fact

One of the most important jobs of top management is to make decisions. It is impossible to make good decisions without suitable information; it is extremely important to have a decision-supporting information system to assist managers in making decisions. It is also vital to have an information system that can provide past, present, and future information appropriate for planning, organizing, and controlling the operations of a functional area in the firm. For example, a firm wants to improve its product quality. It must make decisions and determine what actions should be taken. Note that 'take actions' means to dig out the real causes of defects, to trace them all the way to their origins, and to prevent their recurrence. Generally, symptoms and causes need to be distinguished. To dig out causes requires fact-finding. Real causes cannot be guessed at, thus there is a definite need to observe the facts carefully. It is important to know that data show symptoms rather than real causes. Therefore, it is essential to manage a firm by fact rather than by imagination (Bergman and Klefsjö, 1994; Ikezawa, 1993).

7.3.2 Supplier Quality Management

Partnership with Suppliers

Supplier partnership can be defined as a mutual, ongoing relationship between a buying firm and a supplying firm involving a commitment over an extended time period, and entailing a sharing of information as well as a sharing of the risks and rewards of the relationship (Cali, 1993). In modern businesses, the interdependence of buyers and suppliers has increased dramatically. The emphasis on inventory reduction provides a further focus on product quality received from suppliers. In this regard, firms should try their best to establish long-term partnership relations with their suppliers. The basic purchasing policy should place priority on mutual trust and understanding, and aim at long-term stable business relationships on the basis of mutual survival and prosperity. Firms need to treat their suppliers as partners, as an extension of their own firms (Bergman and Klefsjö, 1994; Dale, 1999; Deming, 1986).

Supplier Selection Criteria

Firms must obtain from their suppliers information sufficient to judge whether they have the capability to provide products and services that meet all fitness-for-use requirements. The selection of suppliers must be based on the reputation of the supplier, the investigation of its manufacturing facility, and other relevant information about the supplier. Product quality should be regarded as one of the most important factors in selecting suppliers. Total costs (e.g., incoming inspection, internal and external failure costs) should be taken into account during the selection process. In the end, only those suppliers who can compete on quality, price, and close working relationships with a firm can be kept in its supplier list (Deming, 1986; Feigenbaum, 1991; Ishikawa, 1985).

Participation in Suppliers

Firms need to participate in supplier activities related to quality improvement. These activities may include, for example, supplier training and supplier quality improvement projects. Supplier training is undertaken by the purchaser in order to improve the suppliers' quality of products, services, processes, and employees. Supplier quality improvement projects are also organized by the purchaser, to actively assist its suppliers in implementing quality management methods or providing technical assistance. Through participation in suppliers, the quality of suppliers' products and services can be improved. Thus, non-value added incoming inspection activities can be reduced or avoided (Dale, 1999; Deming, 1986; Ishikawa, 1985).

Supplier Performance Evaluation

Firms should frequently evaluate the performance of products and services that they receive from suppliers, and give feedback on the performance of suppliers' products and services. In order to conduct supplier performance evaluation, the firm should have a supplier information system that stores detailed performance information about different suppliers.

Supplier rating can be used in supplier performance evaluation. Supplier rating is an index of the actual performance of a supplier in terms of its product quality, service quality and delivery performance, among other criteria (Feigenbaum, 1991; Juran and Gryna, 1993).

Supplier Quality Audit

Supplier quality audit is an assessment of a supplier's product and service quality, quality control capability, manufacturing practice, and quality assurance system. An audit consists of a visit to the supplier's facility by a team of examiners from different departments such as quality, technology, production, purchasing, and R&D. This team conducts the supplier quality audit in various areas. Thus, supplier quality is monitored in order to ensure that products and services received from suppliers can meet requirements (Deming, 1986; Feigenbaum, 1991; Juran and Gryna, 1993).

Supplier Communication

Firms need to keep their suppliers informed of any change that they make in terms of design and production. Failure to provide adequate design change information to suppliers has been a distinct obstacle to supplier quality management. Such problems can be solved by setting up multiple channels of communication: Designers must communicate directly with designers, quality staff with quality staff, etc. In the single-channel approach, a specialist in the buyer's firm must work through the purchasing personnel, who in turn speak with the salesperson in the supplier's firm, to obtain information. Multiple channels are much better than the single channel (Dale, 1999; Feigenbaum, 1991; Juran and Gryna, 1993).

7.3.3 Vision and Plan Statement

Vision Statement

A vision statement comprises a detailed visualization of the desired future state of the overall business and serves as the target or objective for which all strategies, goals and standards are established. A vision statement should be clear and concise, which according to Hutchins (1990) should satisfy three fundamental criteria: It must address all levels, be stated in such a way that everyone believes in it, and be aggressive and growth-orientated. The vision statement should be communicated to employees so that they understand the firm's values, aspirations, and purposes. An effective vision statement tends to encourage employee commitment to quality improvement and make the workforce aware of the firm's philosophy. Once the vision statement is developed and agreed on, it should not be frequently changed. Otherwise, employees may be frustrated. Finally, top managers must become 'vision salespersons' and continually and consistently discuss and reinforce the vision of the firm (Bergman and Klefsjö, 1994; Dale, 1999).

Quality Policy

A quality policy is overall intentions and direction of an organization with regard to quality, as formally expressed by top management (ISO 8402, 1994). The quality policy involves

statements that should be brief, clear, and believable. It can be used as a touchstone for all employees to gauge whether actions are in conformance with the standards and values of the firm's quality policy. The firm should set quality goals based on its quality policy, which should not be too often changed. Otherwise, employees may get frustrated (Burrill and Ledolter, 1999; Randall, 1995).

Overall Business Performance Plan

A firm should have overall business performance plans that describe its goals and objectives. Two kinds of overall business performance plans exist: Long-term and annual. In fact, long-term performance plans are formed based on a vision statement, whereas annual performance plans are formed based on long-range performance plans and are the sum of different departmental annual targets and goals. Overall business performance plans achieve nothing if firms do not have suitable strategies to realize them; they should be set in such a way that they are achievable. Setting unrealistic goals creates frustration and hurts employees' morale. If reasonable objectives are set, successes are more easily reached. Various factors should be taken into account when overall business performance plans are made (Bergman and Klefsjö, 1994; Dale, 1999). Section 7.4 provides more information about overall business performance.

Product Quality Goal

In order to improve product quality, firms should have detailed product quality goals. Quality goals are statements of the desired quality results to be achieved within a specified time. Tactical goals are short range (e.g., 1 year) and strategic goals are long range (e.g., 5 years). Quality goals may include, for example, performance, reliability, durability, conformity rate, defect rate, internal failure costs, and external failure costs. Goals should be formulated in such a way that they can be realized through hard work. Setting unrealistic goals creates frustration and hurts morale. Based on continuous improvement, a high quality goal can finally be set up and can be realized practically (Feigenbaum, 1991; Juran and Gryna, 1993).

Quality Improvement Plan

Quality improvement plans are activities that establish the objectives and requirements for quality and the application of quality system elements (ISO 8402, 1994). The plans should be made in such a way that they can be implemented in practice, and should focus on eliminating the major problem areas. When quality improvement plans are drawn up, how to implement them should be well developed. Of course, firms need to arrange sufficient resources in order to ensure that the quality improvement plans can be implemented; they are useless if they cannot be implemented in practice. Note that merely drawing up plans at the start of every year without any follow-up action is insufficient. A firm that only makes plans and implements nothing will go nowhere (Burrill and Ledolter, 1999; Kolarik, 1995).

Formulation of Vision and Plan

A successful process of formulating visions and plans demands a holistic and cross-functional approach. The alignment of visions, strategies, plans, policies, objectives, measurements, and performance assessment at all levels is considered essential. Visions and plans cannot be formulated by imagination; the fuel for their formulation is the abundance, richness and quality of information available. Employees from different levels should be involved in making visions, strategies, policies and plans. This process helps employees think in terms of how their work supports the realization of the overall visions and various plans. A large gap should not exist between the vision and plan statement and a firm's current practices. Otherwise, employees may be frustrated (Burrill and Ledolter, 1999; Mann, 1992).

7.3.4 Evaluation

Evaluation of Strategy

A strategy is the total pattern of the decisions and actions that position the firm in its environment and are intended to achieve its long-term goals (Slack et al., 1995). Strategies specify how the vision statement will be accomplished. Normally, there are three levels in the strategy hierarchy: Corporate, business, and department strategies (Meredith and Shafer, 1999). Various decision-supporting systems and relevant information available are essential to strategy evaluation, through which firms can seek opportunities to improve their strategies. More importantly, firms should adjust their strategies on the basis of the result of strategy evaluation, thus, keeping competitive advantages in the marketplace (Burrill and Ledolter, 1999).

Evaluation of Overall Business Performance

The objective of implementing TQM is to improve a firm's overall business performance. Therefore, overall business performance should be evaluated regularly. Otherwise, the effects of implementing TQM remain unclear and more effective TQM implementation approaches cannot be formulated. Implementation depends on the evaluation of overall business performance. In other words, the analysis and investigation of overall business performance can provide adequate input for TQM implementation, identification of improvement areas, and areas caused attention. Overall business performance consists of employee satisfaction, product quality, customer satisfaction, and strategic business performance. The firm can use the latest information on overall business performance to compare with itself (e.g., previous performance, planned objectives), its competitors, and the best practices in the same industry. Through evaluation, firms identify the areas that need action or draw attention (Dale, 1999; Rummler and Brache, 1995).

Evaluation of Departments' Performance

The realization of organizational overall objectives is highly dependent on different functional departments. Therefore, firms do need to regularly evaluate different departments' performance in order to seek opportunities to improve organizational health. Thus, they must develop criteria for evaluating different departments' performance. The criteria should

be drawn up objectively, rationally, and fairly. It is imperative that departmental objectives be aligned with the organizational objectives; otherwise, organizational objectives are difficult to achieve. The result of evaluation can be used as the input for subsequent recognition and reward. Note that the major aim of departmental evaluation is to seek improvement opportunities rather than criticism (from the ten interviews).

Evaluation of Employee Performance

Employee performance evaluation is a process by which a firm establishes measures (targets) and evaluates an individual employee's behavior and accomplishments within a finite time period. Employees' performance as a whole affects the success of the firm. Therefore, the firm needs to regularly evaluate employee performance against set targets. Individual targets should be established on the basis of job requirements, potential contributions to organizational objectives, teamwork, working attitudes, etc. The results of employee performance evaluation can serve as input for employees' recognition, reward, dismissal, education, and training. Such information is also valuable for recruiting new employees and improving overall human resource management (from the ten interviews).

Quality Audit

A quality audit is a 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 (ISO 8402, 1994). One purpose of a quality audit is to evaluate the need for improvement or corrective action. Through quality audits, problem areas are identified and necessary measures can then be taken to solve them. Quality audits can be conducted by people within or outside the firm. The outputs of quality audits are very valuable for quality improvement activities (Burrill and Ledolter, 1999; Randall, 1995).

Benchmarking

Benchmarking is the process of understanding one's practice and performance, comparing them against that of competitors or best-in-class firms, learning how they practice and perform, and using that information to improve one's own practice and performance. It is an effective catalyst for change and an effective tool for continuous improvement. Benchmarking can stimulate creativity and provide a stimulus that enables operations to better understand how they should be serving their customers. To conduct benchmarking, firms should know their own situation and identify what and who to benchmark. In order to use benchmarking effectively, the firm should have sufficient information from its competitors or best-in-class organizations. Thus, benchmarking can be conducted (Dale, 1999; Juran and Gryna, 1993; Kolarik, 1995; Slack et al., 1995).

Quality Costs

A firm needs to collect the data of quality-related costs, which it can use to seek improvement opportunities. There are four categories of quality-related costs: Internal failure, external failure, appraisal, and prevention. Internal failure costs are associated with

defects found prior to transfer of the products to the customer. External failure costs are associated with defects found after products are shipped to the customer. Appraisal costs are incurred in determining the degree of conformity to quality requirements. Prevention costs are those caused by quality planning, process control, quality audit, supplier quality assessment, and training (Juran and Gyrna, 1993). It should be noted that to have data on quality-related costs is not enough. Without carefully investigating the data of quality costs, actions cannot be effective and chronic quality problems cannot be eliminated. Through analyzing quality costs, more improvement opportunities can be identified (Dale, 1999; Dale and Plunkett, 1991).

Information System

A firm should have an inter-integrated computerized information system, which collects, stores, analyzes, and disseminates information for various specific purposes. Such an information system can manage large amounts of information and provide sufficient information for management to make decisions. Additionally, different departments can share resources through the information network. Thus, communication barriers between different departments are reduced. If information technology remains at a primitive level, an effective information system is impossible. Various information from suppliers, customers, employees, different functional departments, data on performance of competitors, and data on "best in class" organizations should be stored in the system. Information system can support the process of decision-making and evaluation. Note that information is gathered so it can be acted on. If it cannot be used, then it is worthless. There is plenty of data in a firm. Only useful information should be collected and stored in the information system. In addition, information stored in the system should be valid, complete, and accurate (Burrill and Ledolter, 1999; Turban et al, 1999).

7.3.5 Process Control and Improvement

Shop Floor Control

Shop floor is the combination of workshops, production lines, and certain other facilities. A firm needs to keep its shop floor neat and clean at all times. Every employee of the firm should be assigned responsibility for cleaning one's own working area. In addition, the firm must pay sufficient attention to determining an appropriate temperature range and lighting intensity, reducing noise level, and improving air quality. Thus, employees can be in a good mood for work, are encouraged to care for the production facilities, and may be more productive and less liable to make mistakes. Good housekeeping can allow employees to notice and correct process problems more quickly. Good housekeeping can also counteract the accumulation of dust on moving parts and in lubricating oil, which may cause the parts to function erratically or jam, thereby giving rise to poor items (Feigenbaum, 1991; Juran and Gryna, 1993).

Process Capability

Process capability measures the extent to which a firm's production systems can meet design specifications. As a machine wears out, its process capability may degrade to the point that it cannot hold the tolerances specified by engineering design. Therefore, the firm should study its process capability and calculate a process capability index in order to determine whether a process is stable, investigate any sources of instability, seek their causes, and take actions to eliminate them. Process capability information can provide designers with important information in setting realistic specification limits (Dale, 1999; Juran and Gryna, 1993; Feigenbaum, 1991; Kolarik, 1995).

Equipment Maintenance and Innovation

Maintenance is the term that refers to the way in which a firm tries to avoid failure by taking care of its physical facilities. A maintenance system can be divided into two parts: Breakdown maintenance and preventive maintenance. Breakdown maintenance means to execute repair when production equipment breaks down. Preventive maintenance, on the other hand, means to carry out maintenance activities regularly in order to prevent production equipment from breaking down. There are many benefits to conducting maintenance, such as enhanced safety, increased reliability, lower operating costs, longer life span, and higher ability to produce high quality products. All employees who use the operational equipment should take responsibility for maintenance tasks. In addition, it is also valuable to study how to use equipment effectively and efficiently. In order to improve the firm's production capabilities and enhance its competitive advantages, the firm needs to innovate its production equipment regularly (Dale, 1999; Slack et al. 1995).

Inventory Management

Inventory (incoming materials, unfinished products, and finished products) management determines how many inventories to keep. A firm needs to strengthen its inventory management by establishing an effective computerized inventory management system, which can identify items' quantity and location in the warehouse, automatically update stock records, generate purchase orders and inventory reports, forecast sales volumes and so on. Efforts should be made to reduce inventories and thus save capital. Purchasing materials can be optimized and reduced through various efforts such as improving relations with suppliers, organizing production effectively and efficiently, and enhancing the accuracy of forecasting. Organizing production effectively and increasing the accuracy of marketing forecast can optimize unfinished product inventories. The inventories of finished products can be reduced by improving relations with customers, organizing production according to orders, and improving the accuracy of forecasting customers' purchasing (Slack et al., 1995).

Inspection

Inspection refers to activities such as measuring, examining, testing and gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity (ISO 8402, 1994). Note that inspection actually does not build quality; quality is built into the process. Inspection itself is not a value-added process, but a waste of human resources and cause of extra cost. If quality can be ensured, it is not

necessary to implement inspections. In fact, defective products cannot be reduced merely by making improvements at the inspection stage, although such improvements may eliminate defects in delivered goods. When a defect shows up, the information should be sent back to the work stage so that processing can be corrected. Thus, defects occurring are prevented in the first place. At any rate, it is meaningless that processing produces defects, and all that inspection can do is find those defects (Feigenbaum, 1991; Juran and Gryna, 1993; Kolarik, 1995).

Use of Quality Tools

Quality tools[23] play a key role in an organization-wide approach to continuous improvement, and their use is a vital component of any successful improvement process (Dale, 1999). The PDCA Cycle is composed of four basic stages: Plan, do, check, and act (Deming, 1986). It continues forever in a cycle of never-ending improvement. The seven QC tools are Pareto analysis, cause and effect analysis, stratification analysis, scatter diagram, check sheet, Histogram, and process control chart (Ishikawa, 1985). The seven new tools are relations diagram, affinity diagram, systematic diagram, matrix diagram, matrix data analysis, process decision program chart, and arrow diagram (Gitlow et al., 1989). Statistical process control (SPC) is the application of statistical methods to the measurement and analysis of variation in a process, and can judge the quality of processes. Such information can be used for process control and improvement (Dale, 1999; Kolarik, 1995; Zhang, 2000a). Note that some of these tools can also be applied to other purposes.

7.3.6 Product Design

Concurrent Engineering

Concurrent engineering emphasizes the establishment of cooperative relationships throughout the product design process. Representatives from the firm's different departments, as well as external suppliers and customers, meet with the design staff to articulate the details of product design. Concurrent engineering can ensure that fewer problems occur during the subsequent production or assembly process. Note that the skills of the design engineers are critical to the success of new product design. Design engineers are required to have not only shop floor experience but also marketing experience. They need to go out into the marketplace and acquaint themselves with customers' needs and expectations. Such information from only the marketing or sales department is not sufficient (Burrill and Ledolter, 1999; Dale, 1999; Juran and Gryna, 1993).

Reliability Engineering

Reliability is the ability of a product to function within given performance limits, under specified operation conditions, over a specified time period. Reliability deficiencies can result in impaired or lost performance, compromised safety and increased cost due to device repair, spare parts replenishment and maintenance. Reliability engineering helps to find the

[23] Quality tools are sometimes also called "quality techniques" and "quality methods".

cause of failures, set overall reliability goals, identify critical parts, review the design process, increase the failure resistance of the product and the tolerance of the product against failures, and achieve low failure rates (Bergman and Klefsjö, 1994; Feigenbaum, 1991).

Designing for Manufacturability

Designing for manufacturability focuses on simplifying a design to make it more producible. The emphasis is to reduce the total numbers of parts, of different parts, and of manufacturing operations (Juran and Gyrna, 1993). Key practices include the use of modular designs, avoidance of unnecessary parts, and design for ease of manufacturing and assembly. Designing for manufacturability reduces assembly errors and other sources of quality problems during manufacturing. To achieve such a goal, designers need to have additional experience in the manufacturing department to give them a better understanding of how to design parts for greater produceability. They should also spend time in field service work so that they are exposed to the actual conditions of use, the problems diagnosing field failures, and the difficulties encountered in making repairs (Feigenbaum, 1991).

Design of Experiments

Experimental design has been widely regarded as one of the most significant techniques used for new product design. Blake et al. (1994) state that "experimental design is a strategic weapon to battle competitors worldwide by designing robust products, reducing time to market, improving quality and reliability, and reducing life-cycle cost". The main advantage of adopting experimental design is that one obtains an amazing amount of information about a new product using a limited number of experimental runs. Through analyzing the information obtained from experimental design, various parameters relating to a new product can be easily and accurately determined (Dale, 1999; Zhang, 2000d).

Quality Function Deployment

The key aim of quality function deployment is to try to ensure that the final design of a product or service actually meets the needs and expectations of customers. Quality function deployment consists of a set of tools for building the voice of the customer into product design. It is a team tool that captures customer requirements and translates those needs into characteristics of a product or service. Quality function deployment uses matrix charts to define and prioritize customer wants and needs, and to focus efforts on meeting the customer's true desires (Dale, 1999; Juran and Gryna, 1993; Kolarik, 1995).

Value Engineering

The purpose of value engineering is to reduce costs and prevent any unnecessary costs before producing the product or service. Value engineering tries to eliminate any costs that do not contribute to the value and performance of the product or service. It is usually conducted by project teams consisting of designers, purchasing staff, operations managers, financial experts, etc. Value engineering requires innovative and critical thinking and ideas (Dale, 1999; Juran and Gryna, 1993).

Computer-Aided Design (CAD)

CAD can be interpreted as a method of designing a new product with the help of a computer. It is a system that enables design drawings to be constructed on a computer screen and subsequently stored, manipulated, and updated electronically. CAD systems provide the computer-aided ability to create and modify product drawings. The advantage of CAD systems is that their ability to store and retrieve design data quickly as well as to manipulate design details can considerably increase the productivity of the design activity. CAD systems can enhance the flexibility of the design activity, enabling modifications to be made much more rapidly. CAD can reduce the time-to-market, the number of designers needed to perform the same amount of work, and design errors. Through CAD, customized products can be made quickly and inexpensively (Juran and Gryna, 1993).

7.3.7 Quality System Improvement

Quality Manual

A quality manual is a document stating the quality policy and describing the quality system of an organization (ISO 8402, 1994). It includes the firm's quality policy and addresses each of the requirements of ISO 9000 in broad terms related to the activities of the firm. In drawing up a quality manual, various people in the firm should be involved and relevant ISO 9000 standards referenced. The manual should be terse and easy to understand. Prior to issuing the manual, it should be subjected to review by responsible individuals to ensure clarity, accuracy, suitability, and proper structure. Finally, it must be reviewed and approved by the general manager (Bergman and Klefsjö, 1994; Burrill and Ledolter, 1999; Dale, 1999; Randall, 1995).

Quality System Procedures

Documented quality system procedures describe the activities of individual functional units needed to implement the quality system elements (ISO 10013, 1995). Thus, responsibilities and authorities of different functional departments are clearly defined by system procedures. To define quality system procedures, it is important to solve the interface issues among different departments. Quality system procedures should cover all the applicable elements of the quality system standard. They should describe the responsibilities, authorities, and interrelationships of the personnel who manage, perform, verify or review work affecting quality, how the different activities are to be performed, and the documentation to be used and the controls to be applied. As a rule, documented procedures should not enter into purely technical details of the type normally documented in detailed work instructions (Burrill and Ledolter, 1999; Dale, 1999; Randall, 1995).

Work Instructions

Work instructions consist of detailed work documents such as instructions for performing the job. A firm should develop various work instructions so that all tasks can be conducted in a consistent manner. Work instructions are referred to in the procedures and give precise details of how individual operations are to be carried out to enable them to be performed to the required quality. Work instructions should be easy to understand and not cause confusion. To achieve this, every department should be involved in drawing up relevant work instructions. Every activity in the firm should be examined in greater detail before the work instructions are made. Thus, the work instructions can be implemented in practice (Burrill and Ledolter, 1999; Dale, 1999; Randall, 1995).

ISO 9000 Certification

After the quality system documents have been established, the firm should implement its quality systems. In order to understand whether these documents can be effectively implemented the firm should conduct quality audits and management review, thoroughly assessing its quality systems. Such an assessment can identify the suitability of the quality systems to the firm and their conformance to the requirements of the ISO 9000 standard (e.g., ISO 9001, 2, or 3). As a result, the quality systems can be improved. Finally, the firm may prepare and plan for ISO 9000 certification. Note that the firm is operating in a dynamic environment. Many factors can affect the changes of the firm's operations. Therefore, the firm must keep its quality systems continuously changing and improving (Burrill and Ledolter, 1999; Dale, 1999; Randall, 1995).

7.3.8 Employee Participation

Cross-Functional Team

A cross-functional team aims to solve or investigate cross-functional problems or improvement opportunities associated with many functions or departments. Sometimes people from external organizations, such as suppliers and customers, also participate. Top management usually delegates the team and is therefore committed to assigning it sufficient resources in the forms of time, money, and personnel. The team usually consists of professional staff and is normally disbanded after its task is finished. Team members are chosen according to their potential contribution. Through cross-functional teams, different people from different departments work together and learn from each other. Thus, problems can be easily solved. Cross-functional teams are effective in solving cross-functional problems (Dale, 1999; Mann, 1992).

Quality Control (QC) Circle

A QC circle is a small group of employees, usually from the same department, who volunteer to meet regularly (on working time or their own time) to discuss ways of improving the quality of their work (Lillrank and Kano, 1989). QC participants need to accept training for problem-solving techniques. The organizational environment should be

supportive for implementing QC circles. More importantly, top management and supervisors should support QC circles, provide necessary resources for their activities, and recognize and reward participants. The benefits of QC circles can be measured in economic terms or by improvements of products, processes, and working environments. Implementing QC circles can also bring some intangible benefits, found in the form of improved communication within work groups and between workers and supervisory layers of the firm, increased employee commitment and motivation, and employees' enhanced understanding of the difficulties faced by the firm (Dale, 1999; Juran and Gryna, 1993; Robson, 1992; Vries and Water, 1992).

Within-Functional Team

A within-functional team aims to solve or investigate problems/opportunities within the same department and is normally disbanded after its task is complete. Team members are chosen according to their potential contribution. Within-functional teams are different from QC circles, dealing with certain important issues or urgent problems. The major objective of such a team is to discuss and identify problems encountered, obtain facts and data regarding these problems, and develop feasible solutions. Problems may relate to quality, productivity, safety, and so on. A within-functional team usually holds regular meetings during working time (Dale, 1999; Mann, 1992).

Information Communication

In order to stimulate employee participation, a firm should have an effective information communication channel. Information communication is a means by which employees share ideas, clarify thinking and create a common understanding. Communication can be conducted between different departments, top management and employees, supervisors and employees, and employees themselves. The firm needs to communicate its vision, strategies, policies, and business plans to its employees. Employees can access necessary information sources needed for conducting their jobs. Relevant information available is the basis for problem-solving and employee participation. Many changes take place daily in a firm and it is important that they are communicated effectively to employees. Various means can be used to communicate, such as regular meetings, Intranets, newsletters, posters, videos, and broadcasting (Dale, 1999; Juran and Gryna, 1993; Kolarik, 1995).

Employee Suggestions

Employees have normally been working at a position for a long time and are very familiar with their work. It is easier for them to identify their working problems, find the causes of the problems, and develop solutions. Therefore, employees should be encouraged to submit their suggestions, which should be listened to and valued by the management. Since the solutions are suggested by the employees directly involved with the problem, implementation is usually ensured. Note that suggestions cannot be useful if they are not evaluated or implemented. In this regard, the firm needs to establish such a system that suggestions are carefully examined. After evaluation, some suggestions should be practically implemented. Since most suggestion programs are oriented toward the lowest levels (the

workers who actually perform the work) in the firm, the role of the first-line supervisor is critical. Negative comments, attitudes, and feedback from the supervisor can quickly kill the interest and enthusiasm of employees. In addition, it is also important to recognize and financially reward employees who submit good suggestions (Bergman and Klefsjö, 1994; Dale, 1999; Juran and Gryna, 1993).

Improving Employee Commitment

The aim of improving employee commitment is to encourage employees to make more contributions to the success of the firm. Employee commitment can be established only on the basis of confidence among employees and management. Top management and supervisors should encourage and motivate employees to develop and utilize their full potential, trust and care for employees, encourage and support employees in job- and career-related development/learning objectives, respect and value employees' talents and creativity, and treat employees as valuable resources of the firm. Every employee should be encouraged to function as a supervisor. Thus, employee commitment can be increased through responsibility (Ikezawa, 1993). More importantly, they should be treated equally, fairly, and rationally. Employee commitment can be cultivated step by step; it is an incremental process (Bergman and Klefsjö, 1994; Kolarik, 1995).

Job Rotation

Job rotation means periodically moving individuals between different sets of tasks to provide some variety in their activities. Job rotation can increase skill flexibility and make a contribution to reducing job monotony. Through job rotation, employees can learn more work skills, know more processes, and understand more about the importance of their current jobs. As a result, the workforce becomes more diversified and multi-skilled. Through job rotation, employees can have a better understanding of the influence of their jobs on the subsequent process. Thus, they can be stimulated to perform their current work better. Additionally, the partnership between employees (internal customers) is easily established (Slack et al., 1995).

Workers' Congress

Workers' congress stands for the principle of democratic management in China. Workers' congresses are organized by the trade union in order to discuss various issues such as the firm's strategies, business plans, financial budgets, funds for welfare and bonus provisions, changes of organizational structure, payment system, and training provisions. Through workers' congress, management personnel are checked, examined, and supervised by employees. This expresses the status of the working people as masters of the firm. The principle of relying on the working class whole-heartedly is realized mainly through workers' congress in the firm. Therefore, the role of workers' congresses should be strengthened. The firm should increase the extent to which congress representatives can have a say in the firm's decision-making. Thus, a system to manage and supervise top management can be established. The transparency in making important decisions can be ensured. Otherwise, top management's abuse of power, illegal behavior, selfishness, and corruption cannot be easily terminated (from the ten interviews).

Trade Union

Chinese trade unions are ideologically regarded as “mass organizations of the working class led by the Communist Party”, functioning as a bridge between the Party and the masses. Their major functions are to protect the economic benefits of the workers, establish smooth labor-management relations, safeguard the workers’ democratic rights by giving the workers’ congress more say in firm management and decision-making, encourage employees to participate in firm management, and help employees exercise their full initiative and creativity. In this regard, trade unions play an important role in improving labor relations and further strengthening the status of workers as “the masters of the country”. Therefore, they should perform their duties strictly according to trade union law and other laws, instead of being only spokesmen or agents of management. Their real functions should be brought into full play (from the ten interviews).

7.3.9 Recognition and Reward

Recognition and Reward Program

Firms should institute a serious recognition and reward program. First, the recognition and reward must be consistent with organizational values and objectives. If individual or team efforts cannot contribute to the realization of the overall organizational objectives, they cannot be recognized and rewarded. Therefore, objectives of individuals or teams need to be continuously reviewed and updated. Second, criteria should be objective and measurable; otherwise, it is not easy to ensure that the recognition and reward can be conducted fairly. Third, the recognition and reward should be meaningful and fit the organizational culture. Otherwise, it is useless. Fourth, the program should be approved by the workers’ congress. Fifth, once the program is approved, it should be strictly implemented. Otherwise, recognition and reward activities cannot effectively stimulate employee commitment, enthusiasm, and creativity. Finally, recognition and reward can be provided at several levels: Individual, team, department, or business unit (Burrill and Ledolter, 1999; Cherrington, 1995; Ishikawa, 1985; Kolarik, 1995).

Working Environment Improvement

The firm needs to continuously improve working conditions in order to recognize employee quality improvement efforts. For example, a clean working environment, a cordial and friendly atmosphere, a factory canteen, showers, and sports provisions are important ways to show recognition for employees’ contributions to the firm. Firms also need to maintain a work environment conducive to the wellbeing, morale, and growth of all employees. The firm should improve workplace health, safety, and ergonomic factors; consider each person as an individual, a resource to benefit from rather than a commodity to be used. The firm should try its best to reduce employees’ working strains and protect their health by providing suitable equipment, devices, or tools (Deming, 1986).

Salary Promotion

Salary level is an important factor affecting employee satisfaction and contributions. The salary range should be sufficiently wide to allow for adequate differentiation of salary based on performance. The most important requirement for an effective merit pay incentive program is to measure performance against clearly defined objectives. However, other aspects of employees' performance should also be considered, such as attendance, positive work attitudes, or initiatives. The firm should pay more for employees who have demonstrated knowledge, skills, and performance. Highly skilled employees must have high salaries; otherwise, their potential cannot be fully exercised. Salary promotion should be fair and rational. Otherwise, problems can be created. In a word, the firm should carry out diverse distribution forms with "to each according to his work" as the main form, and establish an effective incentive mechanism (Cherrington, 1995).

Bonus Scheme

In order to encourage employees (teams, departments, or business units) to make more contributions to the firm, a bonus scheme should be implemented. A bonus scheme offers monetary rewards to employees for meeting set targets. To ensure an effective bonus scheme, it is very essential to set up targets for different employees (teams, departments, or business units). These targets may be related to quality, yields, productivity, customer satisfaction, profits, and other performance measures. Note that such defined targets should be aligned with the overall organizational business objectives. The success or failure of a bonus scheme is highly dependent on the defined targets. Therefore, great attention should be given to identifying major factors impacting the effect of a bonus scheme. The firm should move toward more performance-oriented pay. The principle of "distribution according to work" should be thoroughly implemented (Cherrington, 1995).

Position Promotion

Position promotion must be based on, for example, employees' capabilities, skills, performance, and contributions to the firm, and must not be based on the employees' personal relationships with the director of the firm. An effective and rational position promotion mechanism should be established. If position holders cannot fulfill their duties due to lack of skills, capabilities, performance, or support from their colleagues, more qualified personnel should take over. Every employee in the firm can see the hope of promotion opportunities if he or she performs well. Thus, employees' enthusiasm, creativity, and active participation are encouraged. In a word, the appointments and removals of managerial personnel must be done according to the principle of equal competition, fairness, and rationality (from the ten interviews).

Moral Award

Moral award can be used to recognize the quality performance of employees or teams. It may take the form of thank-you note, oral praise, a letter of praise, sending an employee to a seminar or a conference, presentation of individual or team achievements, award certification, award ceremony, etc. Note that moral award is more effective with intellectuals

than with manual line employees. Moral award should be fair and rational; otherwise, negative effects are created (from the ten interviews).

Penalty

In order to intensify the firm's management and establish a strict responsibility system at different levels and stages, the firm needs to have various kinds of rules and regulations, which can force employees to abide by work discipline. Evidence shows that penalties are effective in enhancing employees' commitment and responsibilities, adhering to various regulations, and sticking to work discipline. To have an effective penalty scheme the firm should set up penalty criteria, which should be approved by the workers' congress. More importantly, the firm should implement the penalty scheme seriously and impartially. Otherwise, penalty cannot be effective and negative effects can be created. Note that penalties are special recognition and "reward" activities for employees who cannot perform their work well, or violate the firm's rules and regulations (from the ten interviews).

7.3.10 Education and Training

Education and Training Plan

The firm's education and training plan should be drawn up in line with the firm's strategies, objectives, available resources, current employees' skills, and employee job requirements (Dale, 1999). The firm needs to identify its short- and long-term training needs, design training programs that address technical and behavioral issues, and have an evaluation system in place to check whether the training and development programs meet its objectives. It is important to arrange sufficient resources to implement the plan; otherwise, it is useless. In short-term, education and training costs money, while in long-term, it saves money. The firm should view employees as resources that can yield economic returns, and trained employees as investments of the firm. Employees should be regarded as valuable, long-term resources worthy of receiving education and training throughout their careers. People are the only real source of the firm's competitive advantage (Burrill and Ledolter, 1999; Cherrington, 1995).

Team learning

Team learning is a process through which a team creates knowledge for its members, for itself as a system, and for others. Teams learn through the collective learning of their members. Team learning can promote synergy whereby teams produce extraordinary results and the individual members grow more rapidly than they could have otherwise. In today's competitive environment, it is especially critical that firms identify, develop and utilize individuals' talents to the fullest. Employees are developed through teamwork. Employees' skills are improved by working in teams. The firm needs to establish a good learning environment to encourage employees' effective learning. Highly skilled employees can obtain more opportunities for position promotion and higher pay. Thus, employees can have high motivation to learn. In addition, team members should be given more opportunities to present their learning experiences publicly, making it much easier for them to share their experiences (DuBrin, 1995).

Quality Awareness Education

Quality awareness education is designed to ensure that employees have a common understanding of the importance of concepts including product quality, service quality, process quality, and customer satisfaction. It aims to ensure that employees know their roles within the firm, and to build a desired organizational quality culture. Quality awareness is a very important indicator in determining the final quality of a firm's offerings. It is obvious that employees need to accept quality awareness education regularly. Newly recruited employees specially need to accept such education extensively (from the ten interviews).

Training for Quality Management Knowledge

Employees need to accept education and training on quality management knowledge. This includes, for example, TQM, ISO 9000, the seven QC tools, the seven management tools, statistical process control, quality function deployment, and experimental design. To achieve a good training result, the training program should be well designed. Different types of employees require different levels of training. Even for the same quality tool or technique, the learning objective is also different. The aim of training is to apply quality management knowledge in quality improvement activities. Therefore, it is critical to define the most appropriate quality management knowledge that is of particular benefit to the firm. More importantly, employees can use quality management knowledge that they have learned in their practical work (from the ten interviews).

Job Training

Job training is specific training for different employees to meet the requirements of their jobs. Every employee in the firm needs to accept necessary job training so that they can perform their jobs better. Different employees need different skills and should accept different training. Therefore, the firm needs to develop criteria for job requirements and identify characteristics and skills needed by employees. For example, design engineers need to have not only new product development techniques but also some knowledge of marketing, consumer behavior, production, etc. Note that the development of employees' skills and capabilities should be harmonized with the development of technology in the firm. Job requirements should be continuously changed according to the new technology adopted. In order to make the firm more productive and competitive, managers should invest further in training employees, as this can result in more competent and, hopefully, more committed employees (from the ten interviews).

Formal Education Promotion

Today, a nationwide vocational and technical education and training network has been established. Various education and training institutions are available, such as worker-staff colleges and TV universities. These institutions enroll part-time and full-time trainees and usually offer only a two or three-year college associate diploma. Firms should encourage their employees to study in such institutions in their spare time. For example, after

employees successfully finish their studies, they can enjoy a higher salary scale. If possible, firms may partially or entirely cover their tuition fee (from the ten interviews).

7.3.11 Customer Focus

Customer Complaint Information

Customer complaint information is valuable for the firm in pursuing quality improvement and customer satisfaction. The firm needs to collect various pieces of complaint information from customers extensively, as well as create a central complaint registration system, which registers various complaints from customers. Customer complaints should be resolved effectively and promptly. All complaints received need to be aggregated and analyzed for use in improvement. The firm that does not respond to customer complaints creates a negative corporate image. Customers may share their negative experiences with other existing customers or potential customers. Bad news travels faster than good news! The firm should see complaints as opportunities to improve the quality of products and services. After customer complaints are received, the firm needs to identify the "vital few" serious complaints that demand in-depth study to discover their basic causes and to remedy those causes (Juran and Gryna, 1993; Kolarik, 1995).

Market Investigation

Faster and more flexible response to customers is now a more critical requirement. Without a sound and systematic process for listening to the customers, the firm cannot know what pleases the customers. Market investigation can help the firm ensure that there is a demand for the product and that the requirements and expectations of the customers can be met. Market investigation can obtain various suggestions for improving the quality of the firm's products and services. It is also essential to anticipate future customer requirements and expectations in order to develop such products in advance. The firm should be sensitive to changing and emerging customer and market requirements, competitors' offerings, and the factors that drive customer satisfaction and retention. Through market investigation, the strengths and weaknesses of the products and services of a firm and its competitors can be identified. Such information can be used for benchmarking so as to determine the improvement areas of one's own firm. Obtaining valuable information through market investigation is vital to the success of the firm (Burrill and Ledolter, 1999; Juran and Gryna, 1993; Kolarik, 1995).

Customer Satisfaction Survey

The aim of the customer satisfaction survey is to obtain the customer satisfaction level with the products and services that the firm provides. Methods used to conduct the customer satisfaction survey include questionnaire surveys, formal and informal feedback from customers, personal interviews, telephone surveys, and seminars. Regular customer satisfaction surveys can track customer perceptions of the quality of a firm and its competitors. This information can be used to improve the quality of products, services, and processes. Finally, the firm needs to move from satisfying customers to delighting them. In order to successfully conduct a customer satisfaction survey, a measurement instrument

should be well developed, and should not be too frequently changed. Thus, the time dimension of customer focus efforts can be studied (Naumann and Giel, 1995).

Quality Warranty

A quality warranty is a form of assurance that a product is fit for use or, failing this, that the user can receive some kind of compensation-for example, free repair, replacement or return, or monetary compensation. In this sense, a quality warranty constitutes a system for reducing user costs of poor quality. In fact, the commitment to quality warranty reflects the quality of the firm's products and services (Juran and Gryna, 1993). Firms must provide a quality warranty on products sold to customers (Dale and Plunkett, 1991).

Customer Services

The firm needs to provide necessary assistance for the customers before purchasing, during the process of purchasing, and after purchasing. In order to improve sales efficiency and customer service quality, it is crucial that the firm computerizes its sales system and establishes its service standards. The survey showed that total customer service contributes to total customer satisfaction. Therefore, the firm should strictly fulfill contracts signed with its customers. Customers are at a great advantage today. They are more knowledgeable about the availability and quality of products and services. They demand ever more detailed information about products and services. Therefore, it is important that the firm develops an Internet homepage in order to deliver customers' required information promptly. It is also important to improve the skills of sales and service personnel. Service quality is increasingly becoming a more important factor affecting customer satisfaction, customer retention, and customer loyalty (Dale, 1999; Naumann and Giel, 1995).

Customer Information System

The firm should cater to the market and make timely adjustments in accordance with the customers' needs and wants. To do so, it needs a continuous flow of information on customer requirements and expectations. Information about existing and potential customers is critical to success. Therefore, a customer information system should be established. Such a system can be mainly used for several purposes: Collecting data on customers, demographics (age, sex, income level), preferences; collecting and storing customer feedback from sales visits, reports, customer satisfaction surveys, customer complaints, customer conferences, etc.; storing customers' order information; and recording various customer service activities (Burrill and Ledolter, 1999; Dale, 1999).

7.4 Overall Business Performance

7.4.1 Employee Satisfaction

The firm should regularly evaluate its employee satisfaction level in order to seek the solution to improving employee satisfaction[24], commitment, and motivation. There are two ways to measure employee satisfaction. One is to obtain direct information from the employees. Thus, the firm should develop a measurement instrument that can be used for obtaining employee satisfaction information directly. In order to obtain relatively accurate information, employees should be asked to fill in survey questionnaires anonymously. The alternative way of assessing employee satisfaction can be conducted by a group of people from the top management team and different functional departments within the firm. These people can assess employee satisfaction according to their perceptions. These two methods of assessing employee satisfaction are based on a set of facets that may affect employee satisfaction in the firm. Through obtaining employee satisfaction data, areas with which employees are not satisfied can be identified. Such information can be used to improve the firm's TQM implementation efforts. Also, employee satisfaction information can be used to study the time dimension of TQM implementation. Many facets (Spector, 1997) may affect employee satisfaction; they are listed as follows:

- Annual income (e.g., salary, bonus);
- Equity, fairness, and equal opportunities;
- Recognition and reward schemes;
- Job security;
- Democratic management (e.g., involvement in setting the firm's policies, strategies, and plans);
- Leadership style and ability;
- Top managers' and supervisors' conduct;
- Relationships with top managers and supervisors;
- Relationships with coworkers;
- Promotion opportunities;
- Nature of jobs (e.g., work loads, job content);
- Career development (e.g., training, retraining, and target setting);
- Working conditions (e.g., safety, noise, and pollution).

7.4.2 Product Quality

[24] To test the theoretical models, the global approach of employee satisfaction was adopted since this study examines global employee satisfaction in relation to other variables such as product quality, customer satisfaction, strategic business performance, and TQM implementation. However, in this TQM implementation model, the facet approach was used to find out which parts of the job produce satisfaction or dissatisfaction. This can be very useful to firms that wish to identify areas of dissatisfaction that they can improve. Both approaches can be used to get a complete picture of employee satisfaction (Spector, 1997).

There are two ways to measure product quality. The first is to measure relative product quality in terms of comparing the firm's own product quality with other product quality provided by other firms in the same industrial sector in China. The second way is to merely measure absolute product quality in terms of the seven indicators listed below. Through the analysis of product quality, firms can understand their product quality status by comparing with their competitors, identify problem areas, and determine a solution to improve product quality. Measuring product quality should be conducted continually. Thus, immediate actions can be taken. The following indices can be used to measure the firm's product quality:

- Performance;
- Reliability;
- Durability;
- Conformity rates (finished products);
- *Internal defect rates (during manufacturing process)*[25]*;*
- *Internal failure costs as a percentage of annual output value;*
- *External failure costs as a percentage of annual sales (e.g., warranty costs and claims costs).*

7.4.3 Customer Satisfaction

Customer satisfaction can be measured by comparing product quality and service quality with those in other firms in the same industrial sector. Use of customer satisfaction information can provide a focus and direction for continuous improvement throughout the entire firm. Such information can be used to improve TQM implementation efforts, seek opportunities to improve product and service quality, and study the time dimension of TQM implementation. The measures of product quality have been described previously. In this subsection, only the measures of service quality are provided and are listed as follows (EFQM, 1994; Naumann and Giel, 1995):

- Delivery (e.g., on-time delivery, delivery frequency, lead time);
- Complaints (e.g., complaint response time, effective resolution, time to resolve complaints, percent of complaints resolved on first contact, complaint levels, total number of complaints);
- Warranty and guarantee provisions;
- Support (sales support, technical support, product training, spare part availability);
- Transportation (e.g., logistics information, packing for delivery).

7.4.4 Strategic Business Performance

Strategic business performance is the highest level of a firm's business performance, reflecting the firm's efforts in implementing TQM, enhancing employee satisfaction,

[25] These three indicators in italics are not used to measure customer satisfaction.

improving product quality, and increasing customer satisfaction. As described previously, typical measures of strategic business performance are as follows:

- Annual sales;
- Annual sales growth;
- Profits;
- Market share;
- Exports.

7.5 Processes of Model Implementation

This section provides processes of using the TQM implementation model in practice. Figure 7.3 displays the primary processes of implementing TQM, consisting of seven steps. First, in order to have an effective TQM implementation, top management should be committed to implementing this model. Second, based on top management commitment, a team should be established to steer the TQM implementation in the firm. Third, the current TQM implementation practices and overall business performance must be evaluated according to the TQM implementation practices presented in Section 7.3 and major indicators of overall business performance presented in Section 7.4. Fourth, a PDCA cycle should begin. The cycle starts with the Plan stage, which involves an evaluation of the firm's current TQM implementation and overall business performance. This stage includes collecting and analyzing data so as to formulate a plan of action intended to improve TQM implementation and overall business performance. Fifth, once a plan for improvement has been agreed on the next step is the Do stage, during which the plan is implemented in practice. This stage may itself involve a mini-PDCA cycle as the problems of implementation are resolved. Sixth comes to the Check stage. In this stage, the effects of implementing the improvement plan are measured and used to compare with the plan. The goal of the firm's overall business performance is used to confirm the effects of implementing the improvement plan. Seventh, things move to the Act stage, during which the change is consolidated or standardized if it has been successful. Alternatively, if the change has not been successful, the lessons learned from the "trial" are formalized before the cycle starts again. Such information is used by top management and the TQM implementation team in formulating further improvement plans. Finally, it is essential to restart the PDCA cycle, which is the most important part of implementation. Implementing TQM is like the PDCA cycle – never-ending!

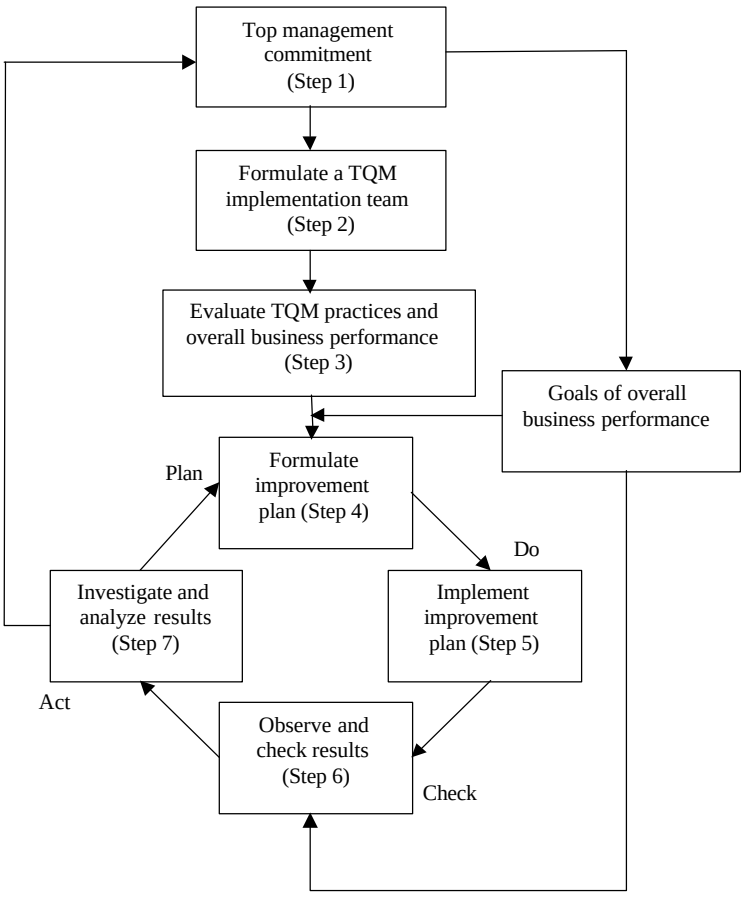


Figure 7.3 TQM Implementation Processes

7.5.1 The Role of Top Management

Top management must be committed to implementing this model; top management commitment is the most important factor determining the success of TQM implementation. TQM is the prime responsibility of top managers, thus they need to become immersed in it. Without top management commitment this TQM implementation model cannot be implemented, and nothing of significance will happen. It is also essential that top management be personally involved in implementing this model. If they fail to become involved, it is likely that the implementation process will stagnate and disillusionment will set in among employees. In addition, top management must provide sufficient resources in order to ensure the implementation of this model. These resources include, for example, time, personnel, and capital. Furthermore, top management should study this TQM implementation model in order to have a better understanding of these TQM practices and

their potential benefits. They should understand that TQM is a long-term and not a short-term intervention-TQM implementation is an arduous process. Finally, top management should make the decision about what kinds of TQM practices should be implemented in practice. Without a deep understanding of the TQM practices, the most effective TQM improvement plan cannot be developed.

7.5.2 Formulation of TQM Implementation Team

On the basis of top management commitment, a TQM implementation team should be established. Such a team may consist of people from the top management team and various functional departments. Selection of team members should be based on their potential contributions to TQM implementation. The main responsibility of the team is to evaluate the firm's current TQM practices as well as its overall business performance, formulate improvement possibilities, prioritize the improvement possibilities, transfer these possibilities into the improvement plan, and finally steer or supervise the implementation of the improvement plan. It should be noted that the multi-disciplinary TQM implementation team must be set up and chaired by the general manager of the firm, who should also fully support the team in conducting its implementation work.

7.5.3 Evaluation of TQM Implementation and Overall Business Performance

Evaluation of TQM Implementation

In order to help the firm evaluate its TQM implementation practices easily, an assessment tool was developed on the basis of these TQM implementation practices. This assessment tool was translated from TQM implementation practices into concrete areas to be addressed. The model of TQM implementation practices contains 73 practices. In each of these, there is (are) specifically addressed area(s) which should be emphasized by the firm. Thus, it is easy for the firm to identify its strengths and weaknesses in TQM implementation. The assessment tool can provide an effective and efficient way to identify areas for improvement, and can provide significant practical assistance in evaluating the firm's TQM implementation. Appendix 5 lists the assessment tool and the method of using it. This assessment tool can be used by the TQM implementation team to evaluate the firm's implementation practices and measure the firm's implementation progress over time. Through using this assessment tool, the firm can quickly learn which areas urgently need improvement.

Evaluation of Overall Business Performance

The firm may develop its own specific measurement system that can better measure employee satisfaction, product quality, customer satisfaction, and strategic business performance. All indicators of overall business performance presented in Section 7.4 can be used as reference in developing measurement system that can better fit the firm. Appendix 5 presents an assessment tool for overall business performance, which can assist the TQM implementation team in evaluating the firm's overall business performance. Thus, the firm

can use the assessment tool to measure its overall business performance, which can be used as a major indicator to test the effects of TQM implementation practices. Additionally, the indices of overall business performance can be used to formulate an effective TQM implementation plan. The firm should continually measure its overall business performance. Such information should be compared with the firm's goals and its competitors' overall business performance. Through such analysis, the firm can identify improvement areas, which are valuable in formulating the firm's improvement plan. Then actions can be taken. Improving overall business performance is a never-ending process.

Note that the scoring criteria in the two assessment tools provide a fact-based measurement, help the firm learn the strengths and weaknesses of its current approach and deployment of TQM implementation, and assist the firm in pinpointing improvement possibilities. The strengths and weaknesses of the firm's TQM implementation practices and overall business performance are judged by the numeric scores assigned to them.

7.5.4 Formulation of Improvement Plan

Through using the assessment tools, the firm can identify many improvement possibilities. However, the firm's resources are limited; it cannot implement all these improvement possibilities at one time. Therefore, it is important for the firm to formulate an improvement plan that consists of a few critical improvement possibilities that are essential to the firm. Such an improvement plan should be aligned with the firm's limited resources (e.g., financial resources, human resources) so they can be allocated more wisely. To determine which improvement possibilities to implement, the firm should adopt a holistic approach. Various conditions (e.g., organizational structure, employee level of education, employee attitude to change, traditional working methods, overall business performance) should be taken into account in making such a plan. Various potential improvement possibilities should be prioritized according to their potential effects. The evaluation of the firm's overall business performance should be seriously considered during the process of formulating the improvement plan. The score obtained using the assessment tools can only be used as reference in formulating the plan, not as the only standard for selecting critical improvement possibilities. This is because each specifically addressed area is not equally important in practice-some are more important than the others. Even the same addressed area is treated differently by different firms. Determining an appropriate improvement plan is essential to the success of using this TQM implementation model. Section 7.6 provides more details on how to formulate the improvement plan.

7.5.5 Implementation of Improvement Plan

Once the improvement plan has been agreed on, top management should be committed to it and the firm should implement it in practice. Continuous support from top management is essential to the success of its implementation. Effective implementation requires a sound understanding of the underlying principles and ideas of the improvement plan. In order to ensure success of implementation, it is critical to educate and train relevant employees

involved. In addition, sufficient resources should be provided for implementing the plan. Note that the improvement plan is nothing if it cannot be implemented by the firm.

7.5.6 Check of Implementation

The implementation of the improvement plan needs to be continually monitored or checked for two aspects. First, it should be monitored in order to understand whether things are going according to the plan and causing the expected change in terms of implementing TQM practices. This process also includes checking immediate results of implementing the improvement plan in order to understand whether the system is functioning. If necessary, corrective measures should be taken to ensure that the plan is effectively implemented. Second, the effects of implementing the improvement plan on overall business performance should be checked. The measurement of overall business performance and the goals for the firm's overall business performance can be used for this. It is meaningless to implement the improvement plan if the firm's overall business performance cannot be improved. However, it should be noted that implementing TQM practices demands a process that takes time and does not immediately pay off. In the long run, overall business performance can be spectacular. The implementation of TQM practices not only asks for a deep breath but also the ability to accept that there are no "quick fixes" and "instant results" to be expected. Patience and tenacity are truly needed.

7.5.7 Analysis of Implementation Results

After the implementation of TQM practices is checked, the firm can obtain a great deal of information about its TQM implementation and its effects on overall business performance. It is important to know that data show symptoms rather than the real causes behind the data. Therefore, it is essential to analyze the results obtained from the Check stage. The analysis of results operates by considering whether the implementation of the plan effectively improves TQM practices or overall business performance. If the analysis concludes that the implementation has not been effective, the PDCA cycle returns to the Plan stage to search for other improvement plans that may have better effects. If the implementation of the improvement plan has produced the desired results, the firm should consider how to consolidate the results of implementing TQM practices. For example, it may standardize its TQM implementation process in order to ensure that TQM practices can be continually implemented. Hence, the PDCA cycle continues forever in the never-ending improvement.

7.6 Guidance for Formulating Improvement Plan

In China, there are many types of manufacturing firms in terms of ownership such as state-owned, collective-owned, township, joint venture, private-owned, and wholly foreign-owned. Firms also differ in terms of size and industrial sector. Firms have different organizational characteristics, goals, business activities, and quality management maturity. They have different resources, quality management problems, and urgent areas for improvement. Therefore, different firms should implement TQM adopting different TQM

practices. Section 7.5 briefly presented the seven steps of implementing TQM. In practice, one of the most difficult steps facing firms is formulating the improvement plan. Therefore, this section provides guidance to assist firms in formulating their most effective improvement plans.

Through the evaluation of the firm's TQM implementation and overall business performance, a number of weaknesses of its TQM implementation can be identified. These weak areas can be used as improvement possibilities in formulating the firm's improvement plan. These improvement possibilities can be further divided into four categories: Structurally impossible improvement possibilities, temporary barrier improvement possibilities, ineffective improvement possibilities, and feasible improvement possibilities. With the continuous changing of the firm's internal and external environments, these improvement possibilities can also be changed. Figure 7.4 displays the dynamic relationships of the four types of improvement possibilities. For example, structurally impossible improvement possibilities can be changed to temporary barrier, ineffective or feasible improvement possibilities with the changing of firms' internal and external environments. The detailed explanations of the four improvement possibilities are presented in the following subsection.

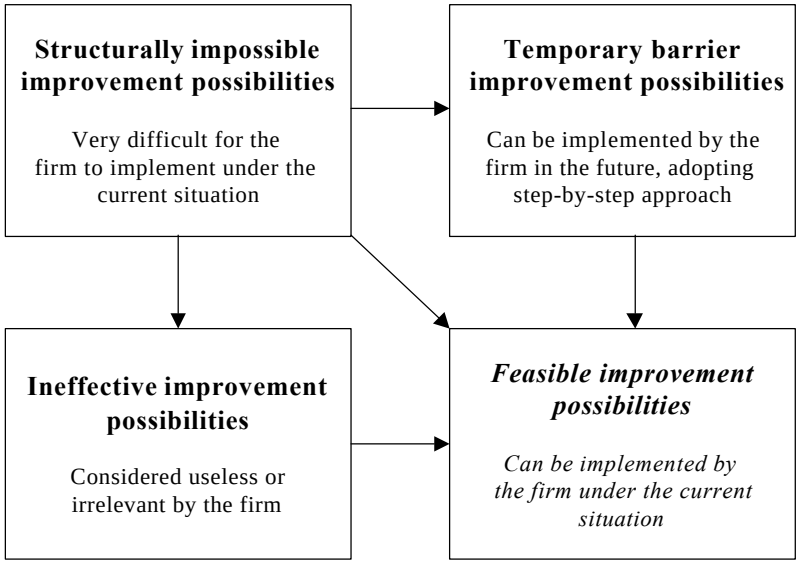


Figure 7.4 Four Categories of Improvement Possibilities

7.6.1 Four Categories of Improvement Possibilities

Structurally Impossible Improvement Possibilities

Such improvement possibilities are very difficult for the firm to implement under the current situation. The structured interviews conducted in the Chinese manufacturing firms indicated that a few improvement possibilities would be very difficult for state-owned firms to implement under the current situation. These structurally impossible improvement

possibilities may include, for example, equipment innovation, partnership with suppliers, and pursuit of long-term business performance. The reason was that state-owned firms pursued short-term benefits instead of seeking long-term business success, due to the institutional systems. Currently, state-owned firms are enjoying more and more management autonomy of decision-making in most issues compared with ever before. These issues include decision-making power in areas of production planning, sales, purchasing, labor and personal management, organizational change, financial investment, the formation of alliances with other firms and so on. However, these general managers still run state-owned firms under the contract responsibility system, in which the administrative bureaus set a number of targets for the firms. Thus, the administrative bureaus control the general managers in terms of their firms' business performance; if firms perform well, the general managers stay in their positions for a longer time. Otherwise, the general managers face the risk of being dismissed. Under such a situation, the general managers must try their best to accomplish the yearly business performance indices set up by the administrative bureaus-especially the index of profits generally considered the most important of all the business performance indices.

Structurally impossible improvement possibilities can also be found in other types of firms. For example, many small-sized township and private firms have no formal quality management systems for their products and services; they do not use any kind of quality tools or techniques. Employees working in these firms usually just do their jobs, often with carelessness about quality, since they are not provided with training or education on quality. Management in these firms is typically "fire-fighting". There is no quality planning, monitoring or control, not to mention improvement. Many weaknesses of these small-sized firms' TQM implementation can be identified based on the TQM implementation model. In fact, it is very difficult for such firms to implement these improvement possibilities due to their very limited resources.

Temporary Barrier Improvement Possibilities

Improvement possibilities can be implemented by the firm in the future by adopting step-by-step approach. Generally, such improvement possibilities cannot be implemented immediately under the firm's current situation. For example, large-sized state-owned firms currently have redundant employees due to China's previous planning economy. For those firms, job rotation may be implemented in the near future after they lay off redundant employees. Some firms may implement benchmarking after they have enough data from their competitors or the best-class firms in China (or in the world). It is an incremental process of gaining benchmarking data through external cooperation. If managers of small-sized township or private firms have visions of leading the firms toward better performance, more formal quality management systems are necessary. If small-sized firms expand or become bigger, they truly need to develop suitable approaches to organizing for quality management, in order to control and ensure the quality of their products and services. Hence, for small-sized firms to compete effectively and survive in turbulent markets, it is vital to implement some TQM implementation practices in the future, adopting a step-by-step approach, which can contribute to firms' long-term success.

Ineffective Improvement Possibilities

Ineffective improvement possibilities are those that are useless or irrelevant to the firm under the current situation. The TQM implementation model consists of a number of practices, not all of which are relevant to the firm. Therefore, based on the evaluation of the firm's TQM implementation and overall business performance, some improvement possibilities can be identified as ineffective and should be ignored. For example, if the firm does not have product design function, all improvement possibilities in the element of product design are ineffective. If the firm has a product design department and manufactures nationally standardized products, under such a situation it may be ineffective for the firm to use techniques such as experimental design and quality function deployment. Firms are different in nature and there are no uniform rules to follow in identifying ineffective improvement possibilities. Determining whether improvement possibilities are ineffective is highly dependent on different firms' characteristics such as ownership, production activities, and employee education levels; firms should take their own situations into account. For example, some firms may feel that empowerment should be implemented in the future, while it is also possible that other firms regard it is an ineffective improvement possibility.

Feasible Improvement Possibilities

Feasible improvement possibilities can be implemented by the firm under the current situation. Based on the weak parts of the firm's TQM implementation and overall business performance, a number of improvement possibilities can be considered feasible by the firm. 'Feasible improvement possibilities' does not mean that such improvements can be implemented without any attention or difficulty; hard efforts are needed. There may be many feasible improvement possibilities, however, the firm cannot implement them all at the same time. It must select critical feasible improvement possibilities for practical implementation. Therefore, the firm should prioritize its feasible improvement possibilities in order to determine a number of critical improvement possibilities. How to prioritize feasible improvement possibilities, how to select critical improvement possibilities, and how to formulate an improvement plan are described in the following subsection.

7.6.2 Formulation of Improvement Plan

Although a dinner may seem assured to a snake that notices a rat walking nearby, there is no guarantee of nourishment. If the rat is extremely large, it may get stuck in the snake's throat; snakes have, on occasion, died when their 'eyes were too large for their throats'. And if the rat is just a baby, consumption and digestion are easy, but there is little real nourishment.

The ten structured interviews in Chinese manufacturing firms showed that many factors should be taken into account when improvement plans are formulated. These factors include targeted areas of overall business performance, understanding of these feasible improvement possibilities, the firm's available resources, understanding of the firm's current situation, time schedules for plan implementation, and the major departments responsible for implementing improvement plans. Figure 7.5 displays these factors.

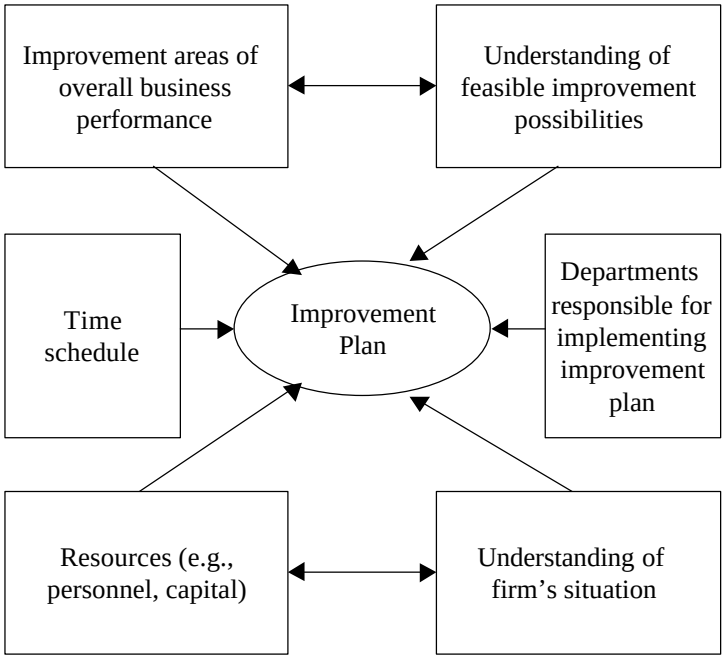


Figure 7.5 Factors Affecting the Formulation of the Improvement Plan

TQM implementation is a systematic approach-it is not at all for fun. Its major aim is to improve overall business performance. Therefore, the major targeted areas of overall business performance should be considered the most important factor in formulating the improvement plan. Based on the targeted improvement areas, the effects of feasible improvement possibilities should be ranked in terms of their potential contributions to the improvement. In order to rank them easily and accurately, these feasible improvement possibilities should be carefully studied; a good understanding of them is the prerequisite to formulating the most effective improvement plan. It should be noted that the empirical results obtained from the 212 Chinese manufacturing firms can only be used as reference in ranking these feasible improvement possibilities. Although a number of the hypotheses were not confirmed by the questionnaire survey data, it cannot be interpreted that these TQM elements are useless or should be ignored. Instead, firms should pay sufficient attention to these elements when feasible improvement possibilities are ranked.

The second most important factor in formulating the improvement plan is the firm's available resources. These include, for example, personnel, information, capital, and employees' levels of education and skills. In fact, the firm's resources are always limited. In order to use the limited resources more wisely, the firm should select such improvement

possibilities that the firm's resources can ensure that such improvement possibilities can be implemented in practice. Also, such improvement possibilities can make the improvements to the targeted areas of overall business performance if implemented effectively. In order to understand the amount of the firm's available resources, the implementation team should have a better understanding of the firm's current situation. Thus, information from relevant functional departments within the firm is essential. Resources needed to implement feasible improvement possibilities vary in different firms. For example, a training program is less costly in a small firm than in a large firm. It is very difficult to provide a practical formula for firms to estimate the amount of resources needed to implement a specific feasible improvement possibility. In any case, it is very important to understand the firm's situation, available resources, and feasible improvement possibilities. Based on the resources needed for implementing the feasible improvement possibilities, the ranked improvement possibilities in terms of their potential contributions to business performance improvement will be re-ranked. Some improvement possibilities cannot be implemented due to the limitation of the firm's resources; these should be deleted from the list and left for the next stage of improvement. Thus, the firm should implement the improvement possibilities that remain on the list. Note that it is not always wise to implement many improvement possibilities at the same time even though the firm has sufficient resources. In doing so, the firm may lose its focus.

An improvement plan should include the time dimension; it is otherwise never complete. If the plan is formulated in a detailed manner, its subsequent implementation can be easily ensured. The time dimension involves information such as time for preparation (e.g, training, communication, announcement within the firm, or pilot projects if necessary), the actual start of the implementation, observing and checking the results of implementation, and investigating and analyzing results. The time dimension can be used to guide the firm in implementing the improvement plan. It should be noted that a rapid change in the firm's normal practices may produce negative results. A step-by-step approach is highly recommended when the implementation team sets a time schedule for implementing the improvement plan.

An improvement plan should also include the departments mainly responsible for its implementation. Thus, responsible departments and people should be informed about the amount of time that will be required of them in implementing the improvement plan. Some people should be totally (100% of their working time) involved in the implementation of the plan. Others may be partly involved. Selecting different employees for involvement is the important determinant for ensuring the success of implementing the plan. In this regard, selection of people should be based on their potential contributions to the implementation of the plan.

Because of the varieties of different types of firms in China and different motivation for improvement, it is not possible to identify a universal process detailing the order in which specific improvement possibilities should be implemented; the guidelines presented in this section are only for reference. Different firms should combine the principles presented in this section with their actual situations and develop their own improvement plans, which may better suit their firms. In a word, the firm should choose such improvement possibilities that can be digested by the firm and provide real nourishment. The firm should avoid selecting many improvement possibilities at the same time, which would prevent 'digestion' or cause

the firm to get stuck. Also, the firm should not choose unimportant improvement possibilities, which cannot provide real nourishment to the firm.

It should be noted that the improvement plan is formulated on the basis of the weak areas in the firm's TQM implementation and overall business performance. This practice does not indicate that the strong areas of the firm's TQM implementation and overall business performance do not have room for improvement. The strong and weak areas of the firm's practices are judged in relative terms. When the firm starts to implement the improvement plan, it must not ignore its strong areas but should instead pay sufficient attention to consolidating them. Thus, the firm can better implement the improvement plan.

7.7 Summary and Conclusions

In summary, the TQM implementation model presented in this chapter is like a cookbook. There are many normative statements. This model shows that the application of these TQM practices in combination can lead to improvements in overall business performance. In order to assist users in applying this model in practice, the processes of its use and the guidance of formulating the improvement plan are presented. However, these guidelines are not a universal panacea, but are only for users' reference. Please note that there is no single or best way to implement this model. Firms are different in terms of their people, culture, history, goals, structure, products, services, technologies, processes, and operating environments. Therefore, they should combine their own uniqueness with this model and consequently develop their own ways to excellence. Thus, firms can optimize the use of this model by blending it with and applying it to their own situations, allowing their own methods to better suit their situations. The most important thing is to focus on practical implementation. Firms should set ambitious targeted goals, formulate effective improvement plans, get the pilot projects up and running, and get the people involved and motivated. They then should measure the results, compare them to the benchmarks, and start all over again – all of this as fast as possible. Doing it is the key to truly instilling a new set of values and attitudes into the heart of the firm. Implementing TQM is a never-ending process. Please note that investing in TQM implementation does pay off, though it often implies a choice for a long-term effort that requires a great deal of energy, management attention, money, patience, and tenacity.

Is there actually such a thing as the TQM implementation model for Chinese manufacturing firms? Based on the process of developing this model, it was asserted that the model presented here could be labeled as a model for Chinese manufacturing firms. It can serve as a prototype for guiding Chinese manufacturing firms in implementing TQM. This is due to the fact that the information obtained from Chinese manufacturing firms was used extensively in developing this model.

Although this model was initially developed for manufacturing firms in China, firms in other countries also can use it as reference since existing quality management knowledge was used in its development. Therefore, some principles and practices presented in this model can be used for firms in other countries. However, some practices are particularly applicable to Chinese manufacturing firms, and may not be particularly applicable to firms in other

countries. It should be noted that there are many types of firms in terms of ownership in China. Additionally, different firms are involved in different businesses. Some practices presented in the model are not applicable to all kinds of Chinese firms. Therefore, Chinese firms must tailor some practices to meet their own requirements.

Although this model was initially developed for Chinese manufacturing firms, it is hoped that it can also be helpful to service and public organizations in China. This is possible since the basic philosophy of TQM is applicable to any type of organization. It is not surprising that some principles and practices presented in the model are key to the success of any organization; however, that is not to say that they are a panacea or can be implemented without attention to specific circumstances and characteristics.

Chapter 8 A Case Study

8.1 Introduction

This chapter presents the results of the case study conducted in a Chinese state-owned manufacturing firm. Section 8.2 describes how the study was conducted according to its objective. Section 8.3 provides a brief introduction of the firm in which the study was conducted. Section 8.4 involves the evaluation of the firm's TQM implementation practices and overall business performance with the comparisons of the TQM implementation model. Section 8.5 presents the four categories of improvement possibilities obtained from the evaluation of the firm's TQM implementation and overall business performance. Section 8.6 provides the formulation of the improvement plan that can be implemented by the firm in order to improve its TQM implementation and overall business performance. Finally, Section 8.7 presents a number of conclusions along with brief discussion.

8.2 Case Study Description

The major aim of the case study was to provide a practical example of how to use the TQM implementation model in practice. To achieve this goal, it is necessary to present the model to a firm and investigate how the firm uses it in practice. Thus, according to the processes of implementing the TQM implementation model presented in Chapter 7, the firm should follow seven steps in implementing the model in practice. If this were done, it would take a long time to conduct the case study. Due to the time limitation, the study was conducted in such a manner that the firm was not asked to implement this TQM implementation model in practice, but only to support the author in evaluating the firm's TQM implementation and overall business performance based on the TQM implementation model. If the author could formulate an improvement plan that would be accepted by the firm's top management, it could be concluded that the TQM implementation model developed in this study is applicable in practice. The process of conducting the case study can provide a good example of using this TQM implementation model in practice.

According to the TQM implementation processes presented in the TQM implementation model, the first step is top management commitment. Through introduction by the author's friends, the top managers of the firm were committed to providing sufficient support for the author to conduct the case study in the firm. This step can be regarded as the first step in implementing the TQM implementation model. With the commitment from top management, the author easily obtained enough information for the case study purposes, as well as access to many people who were valuable in conducting the study. In other words, the author would not have been able to conduct the case study in the firm without top management commitment.

The second step of implementing the TQM implementation model is to formulate a TQM implementation team. In fact, during the whole process of conducting the case study, the author's role was like the "leader" of the "TQM implementation team". The "team"

consisted of three people: The author, one of the deputy general managers, and the coordinator. The coordinator was arranged by the firm in order to assist the author in conducting the study. The author generally asked the coordinator to arrange interviews with relevant interviewees. The coordinator also helped the author collect information needed for the study purposes.

The third step of implementing the TQM implementation model is to evaluate the firm's TQM implementation and overall business performance. To do so, the author interviewed relevant people in the firm using the assessment tools of TQM implementation practices and overall business performance. In order to have a better understanding of the firm's TQM implementation, the author also obtained many documents about the implementation, as well as overall business performance, over the past few years. Thus, the evaluation of the firm's TQM implementation and overall business performance was completed, the strengths and weaknesses of these areas were identified.

The fourth step is to formulate an improvement plan that can be implemented by the firm to improve its TQM implementation and overall business performance. This plan was formulated on the basis of the weaknesses of the firm's TQM implementation and overall business performance. The guidance for formulating an improvement plan, presented in the TQM implementation model, was used in this study. Through the evaluation, many weaknesses were identified and further categorized in terms of the four improvement possibilities: Structurally impossible, temporary barrier, ineffective, and feasible. Only feasible improvement possibilities were used in formulating the improvement plan. In fact, the firm could not implement these feasible improvement possibilities at one time; they had to be further analyzed and prioritized in terms of their potential contributions to the firm's targeted improvement areas of overall business performance. A firm's available resources should also be taken into account when formulating the improvement plan. In fact, in this study, the improvement plan consisted of a number of feasible improvement possibilities that could be implemented by the firm. In order to make the plan practical, a time schedule and major responsible departments involved in implementing the plan had to be determined. Naturally, the deputy manager was asked to be involved in formulating the improvement plan so it would better fit the firm. Finally, this improvement plan had to be accepted by the top management team. Otherwise, it would be nothing.

According to the TQM implementation processes presented in the TQM implementation model, there are another three steps to implementing the model. Due to the time limitation, this case study did not cover the practical implementation of the improvement plan formulated in the fourth step as it was beyond the scope of the study. Thus, after the four steps of implementing the TQM implementation model were complete, the case study was terminated.

8.3 A Brief Introduction of the Firm

The case study was conducted in a state-owned large-sized machinery firm that had been established in 1958. It is located in Shenyang, Liaoning Province, P.R.China, and was a key and backbone firm of the country in manufacturing rubber belt conveyers. Its market share ranked third in China. Its products involved various kinds, varieties, and specifications and had not only been sold across the country but also enjoyed a high reputation in Southeast Asia. The firm had been implementing TQM for a long time and obtained ISO 9001 certification in 1998. Due to its good quality management, the firm was awarded the "Quality Management Prize" by the Ministry of Machinery Building and the Liaoning Provincial People's Government a number of years ago. In 1998, the firm was conferred "Shenyang Advanced Management Enterprise". It had fixed assets (original value) RMB 118 million and occupied a piece of land with an area of 170,000 square meters. The firm had more than 400 various production machines and approximately 759 employees. In 1985, the firm imported foreign technologies from a German firm (KOCH) and an Italian firm (RULMECA). Its products can be used for mine exploration, coal industry, chemical industry, light industry, textile industry, and port construction and operation. The firm's organizational structure and numbers of people working in different functional departments and workshops are displayed in Figure 8.1. Figure 8.2 displays the structure of workshops.

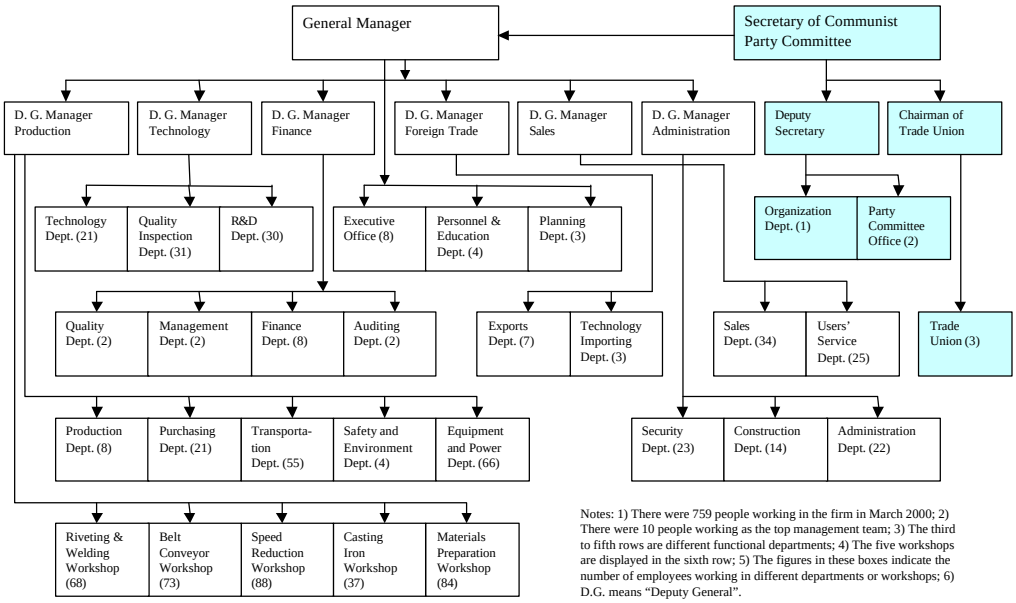


Figure 8.1 Organizational Structure

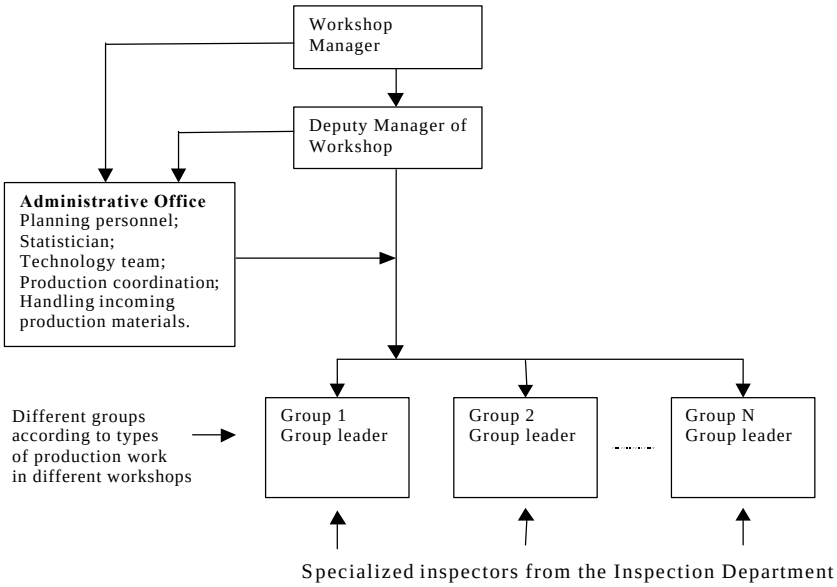


Figure 8.2 Workshop Structure

8.4 Evaluation of TQM Implementation and Overall Business Performance

The TQM implementation model was used in evaluating the firm's TQM implementation practices and overall business performance. The author conducted the evaluation guided by the assessment tools (see Appendix 5). The job titles of interviewees are listed in Appendix 6, though to preserve anonymity they are not referred to by name. Based on the evaluation, the current situations of the firm's TQM implementation and overall business performance were obtained. Appendix 5 presents the evaluation results, which were translated into scores according to the scoring methods, as well as the strengths and weaknesses of TQM implementation practices and overall business performance. In this section, only weak areas of the firm's TQM implementation and overall business performance are presented due to the text limitation. These weak areas can be used as possibilities for the firm to improve its TQM implementation and overall business performance, however, it should be noted that even its strong areas are not at all perfect. They still have room for improvement. Strong and average areas are just a relative sense compared with the firm's weak areas, though weak areas should receive more attention.

8.4.1 TQM Implementation

This subsection presents the weak areas of the firm's TQM implementation and the reasons leading to these weak areas. The assessment tool (see Appendix 5) was used to evaluate the firm's TQM implementation. The weak areas identified could be used by the firm to further improve its TQM implementation; they were regarded as potential improvement possibilities. Note that the identification of these weak areas was on the basis of unbiased, honest, and fact-based judgements.

Leadership

There was strong evidence that top management empowerment had not yet been implemented. The firm was centralized and hierarchical, and there was a strong tendency for employees to do things according to what they were told. They tended to wait for guidance from top managers or supervisors at all times. Thus, employees did not take any risk or responsibility if things went wrong; otherwise, they would be punished or fined. If things went wrong, employees tried to seek excuses to protect themselves in order to avoid being fined or criticized. Employees did not want to take any risk by doing things without permission.

Top management did not pursue long-term business success but focused instead on annual business success, which was their most important goal. Top management still viewed product quality as less important than cost. In addition, top managers often organized discussion meetings after quality problems had happened; how to prevent problems from happening was not given sufficient attention. Top managers were reluctant to accept or implement employee suggestions if money was needed for their implementation. The firm's many problems occurred due to its focus on immediate profits or short-term benefits.

Supplier Quality Management

Long-term partnership between the firm and its suppliers had not yet been established. The firm had a special policy of rewarding purchasing personnel who could purchase products without immediate payment or less immediate payment. This was due to the shortage of capital. Otherwise, the firm could not have sufficient materials to maintain normal production. Such practices caused the problem that the firm would have to pay more in the future. In China, many firms have such policies that a buyer can purchase products at a lower price if the buyer can pay immediately. If the buyer can not pay immediately, the purchasing price is always higher. One interviewee said that it was very difficult for the firm to organize production. For example, after a contract was signed, the customer generally paid approximately 20% of the product's selling price in advance. After receiving the product, the customer would pay another 70% of the payment[26]. The remaining 10% was used as a quality guarantee deposit. If the product had quality problems, the customer would use the deposit for repairing, changing parts, and so on. Thus, the firm did not have much money available to purchase products from suppliers. In total, the firm owed its suppliers

[26] In most cases, the firm's customers did not pay immediately after they received the firm's delivered products.

approximately RMB 10 million. The firm always received complaints from its suppliers. Due to the lack of partnership with suppliers and as well as mutual trust, the firm had to implement strict non-value added incoming inspection.

Purchasing price was the most important factor in selecting suppliers, with product quality falling behind the price. Such a practice indicated that the firm selected such a supplier that could provide the lowest price for technically accepted products. In a few cases, purchased products could not be accepted technically. For example, qualified suppliers could provide carburization for gears at a price of RMB 16 per kilogram, provided that the buyer pay immediately. However, the firm selected a supplier that could provide the service at the price of RMB 3.5 per kilogram and did not ask the firm to pay immediately. Thus, it is not difficult to imagine what would happen to the firm's product quality. Since it considered price the first priority in selecting suppliers, quality problems inevitably happened during the process of production and in the operation of the final products. In fact, many of the firm's quality problems occurred due to poor purchased products.

Vision and Plan Statement

The firm had a long-term vision statement that had been drawn up several years ago. However, many employees were not clear as to what the vision statement was. In fact, the firm did not use it as a guide in formulating its business strategies. In this regard, the general manager did not have a clear long-term vision. The reason for this was that the general manager had been appointed by the administrative bureau to run the firm on a short-term basis, based on a contract. If he performed well, he would stay in the position longer. The decision made by the bureau in this regard was highly dependent on the firm's annual business performance. Therefore, the general manager focused on annual business performance rather than long-term business success. His target was to accomplish the annual business performance indices assigned by the administrative bureau. To do so, the firm had an annual policy statement to guide the firm in doing business. These annual policies varied year to year depending on the firm's internal and external environments. Before these policies were in force, they had to be approved by the workers' congress. The annual policies were well communicated to employees at different levels.

The firm did not have long-term overall business performance plans. Instead, it had only annual strategic business performance indices and product quality goals, which were formulated based on the assignments set up by the administrative bureau. This was because top management placed too much emphasis on short-term objectives. Although these plans were also presented to the workers' congress for discussion, they would not be changed since they had been set up by the bureau. The firm did not have specific plans regarding which levels of employee and customer satisfaction should be reached.

The firm actually drew up its quality improvement plans in terms of quality problems that it had. The information used in making the plans was mainly from customers' complaints and the firm's different departments or workshops. It was evident that quality improvement plans were easily implemented if little money was required; it would be problematic if much money were needed. In this regard, the firm did not provide sufficient resources for implementing quality improvement plans. The primary reason for this was that the firm tried

to achieve cost reductions to maintain the firm's profits. Thus, the firm's general manager could survive.

Evaluation

Although the firm tried to improve a number of job-related facets that might affect employee satisfaction, the employee satisfaction level as a whole remained unclear to some extent. In fact, the firm did not evaluate its employee satisfaction and did not have employee satisfaction data. In this regard, the issue of employee satisfaction did not receive much attention from the firm. This was because it was easy to recruit new employees from the labor market. Furthermore, the firm already had a redundant workforce, which it was considered a heavy burden.

Competitive benchmarking with its major competitors was not conducted by the firm. Thus, TQM implementation and overall business performance of its main competitors remained unclear to a certain extent. Thus, the firm lost opportunities for further improvement of its quality of products and services. In fact, this practice had actually not caught top management's attention.

The data on appraisal costs and prevention costs were not available. The firm mixed these two types of quality costs with the firm's normal overhead expenses. Thus, it was not clear as to how much money was spent on appraisal and prevention. It is no doubt that the firm spent a great deal of money on various inspection activities, as it had approximately 30 specialized inspectors. Many inspection activities were actually non-value added. In fact, the availability of appraisal costs and prevention costs was valuable to the firm in formulating effective improvement actions so as to reduce these costs.

The firm did not have an integrated computerized information system for collecting, processing, analyzing, disseminating, and storing relevant information. Information technology remained at a primitive level. Thus, it was difficult for different departments and workshops to share their information. The firm's major information flow was through handwritten documents. Therefore, working efficiency was low and some problems occurred due to the poor information system. The firm did not have such a computerized information system in place due to its pursuit of immediate profits and short-term benefits.

Process Control and Improvement

The firm did not pay sufficient attention to determining an appropriate temperature range, lighting intensity, noise level, and air quality. During the process of conducting the case study, the author observed that several windows were broken and a number of lights and electric fans were turned off. Such practices were due to the fact that these workshops wanted to reduce costs in order to increase profits. It was evident that various workshops tried their best to reduce any cost that they could[27].

[27] Each workshop had its quota of production costs, which had been set up by the firm. Thus, workshops had to reduce various costs.

The firm did not calculate its process capability index in order to understand whether a process was stable. Designers determined design specifications according to their previous experiences. If problems occurred during an inspection stage, then necessary actions would be taken. In this regard, the firm did not focus on preventing problems.

Effective equipment maintenance and innovation were not conducted by the firm. Every year it invested only RMB 0.1 million in equipment maintenance, which was not sufficient. If equipment had problems, then it would be maintained or repaired. Due to insufficient equipment maintenance, a number of components could not be produced precisely. Thus, product quality was difficult to ensure. Every month there were a number of equipment problems that affected normal production. Concerning equipment innovation, some equipment was obsolete and could not meet production requirements. For example, the problem of welding quality had never been thoroughly solved because the firm did not have good welding equipment.

The firm did not pay sufficient attention to reducing various inspection activities. Instead, inspection was emphasized more than ever before. Every year the firm spent many resources (e.g., human and capital) on conducting various inspection activities. For example, there were approximately 30 specialized inspectors engaged in inspections. In fact, many inspection activities were non-value added. High product quality could not be manufactured by after-event inspection.

The seven new QC tools had never been used by the firm due to a lack of understanding. Occasionally, the firm used the seven QC tools and statistical process control to solve quality problems, however, it did not use them extensively.

Product Design

Concurrent engineering for product design was not effectively implemented by the firm. Designing products through cooperation among different people from various functional departments, suppliers, or customers had not been achieved. Generally, only the R&D department was involved in product design and the technology department was in charge of auditing various drawings of product design. Contract review and design review were not sufficiently implemented. Thus, a number of quality problems occurred during production and with products in the field.

The firm did not focus on modular design in order to make the product more producible. Designers tended to change product design drawings constantly. Thus, it was inevitable that more problems would occur during production or with products on the customer's site. Because the firm did not adopt modular design, it also took a long time to design products. Designers tried to continually change their design to lower production costs.

The technique of experimental design for new product development was not used by the firm. Designers developed products based mainly on their previous experiences. In fact, the optimal design of the firm's products was not achieved; there was still much room for the firm to further improve its product design. Experimental design was not used because the designers did not understand how to use it.

Quality System Improvement

During the process of implementing its quality system documents, the firm sometimes did not follow these documents very well. For example, it was clearly written in the documents that the firm should calculate process capability and use experimental design. In reality, the firm did not use these quality tools. In this, the firm did not implement the quality system documents very well or they did not draw up the quality system documents according to their actual requirements.

Employee Participation

The firm did not have QC circles because it did not provide necessary rewards to employees to conduct QC circle activities, or a good environment to support them in doing so. The firm used within-functional teams instead of QC circles. According to one interviewee, the firm had a number of QC circles several years ago. Their effects were not as expected, therefore the firm terminated QC circle activities.

Employees did not have any intention of reporting their own working problems because they were afraid of being fined or laid off. As a result, the firm lost many opportunities for quality improvement. In fact, employee working performance was highly related to monthly pay. If employees had their own working problems, they would be penalized according to the firm's penalty rule.

The firm did not implement the system of job rotation as many working posts required operators with special qualification certification to do the work. Such regulations were stipulated by relevant governmental agencies. For example, lathe operators cannot operate cranes without qualification certification. Due to the money limitation, it was impossible for the firm to send many employees to different special job training activities. Therefore, employees lacked multi-disciplinary skills.

Recognition and Reward

In fact, the firm had already adopted the principle of "more work more pay". However, the pay gaps among different employees were not very large. During the period of the author's conducting of the case study, the salary list (February 2000) of employees working at the speed reductor workshop was checked. It was found that the lowest pay (salary plus bonus) was RMB 250 and the highest was RMB 656.50. It was clear that the pay gap was not big enough. Thus, employees' initiatives and potential could not be brought into full play. Due to the reason of low pay, more and more highly qualified employees left the firm. For example, the previous quality departmental manager had left the firm in 1999.

Education and Training

Sufficient resources for employee education and training were not provided by the firm. Every year it spent only approximately RMB 0.2 million in this area. That amount of money was not enough; sometimes, employees had to pay the tuition fee themselves if they attended training courses. The firm also did not provide subsidies for employees attending formal

education promotion programs. The firm regarded employees' self development as their own personal business.

Team learning in the firm was not effective. Members of within-functional teams or different production groups were reluctant to share their ideas, information, and knowledge. There was a strong tendency for these members to be on their guard against their colleagues. The reason for this was that members within one team or production group had competitive relations among themselves. They had a strong sense of crisis and were afraid of being laid off if they did not have unique skills. If everyone can do your work, then you are not valuable. There is a Chinese proverb: The master will die of hunger because his apprentices can do his work.

Quality awareness education was not sufficiently conducted even though top and middle managers often emphasized the importance of quality in various meetings. It is true that the firm already conducted many quality awareness education programs, however, employees' quality awareness was still at a relatively low level. A number of employees still lacked of a strong sense of responsibility.

Training for quality management knowledge was not sufficient. The firm did not train employees on how to use the seven QC tools, the seven new QC tools, or statistical process control; nor did it train designers on how to use tools such as experimental design. Due to the lack of sufficient knowledge, these quality tools were not effectively used in solving quality problems.

Employees were deficient in work skills due to insufficient job training. For example, a number of designers lacked the knowledge of technology, production, marketing, and shop floor experience. Therefore, a number of problems occurred during production and assembly. During newly recruited university graduates' first year, it was arranged that they do practical work in workshops. However, the firm did not arrange for them to do practical work in different workshops. Therefore, they did not have a good command of the whole situation of the firm's production activities, equipment performance, and various drawings. Thus, it was unavoidable that design problems would occur after these new graduates began working in the departments of R&D or technology.

Customer Focus

The firm did not fully conduct market investigation. For example, designers hardly went out to collect information for improving product design due to the lack of money. Designers also rarely visited customers in order to understand the performance of their products on site. Thus, information sources used for product design were very limited. Designers only made use of customer complaint information and customer requirements specified in contracts for designing products. Customer expectations, future requirements, and competitors' offerings remained unclear to a certain extent for designers. How to delight customers was not the focus of designing products.

The firm did not have customer satisfaction information on the quality of products and services from its competitors. Thus, customers' views on the firm's competitors were

unclear. In fact, such information would have been valuable to the firm in further improving its quality of products and services.

8.4.2 Overall Business Performance

The assessment tool presented in Appendix 5 was used to evaluate the firm's overall business performance. In fact, this performance reflected the effects of the firm's TQM implementation. The data of the firm's overall business performance could be used as input for formulating an effective improvement plan. Therefore, evaluating overall business performance was also an important part of TQM implementation.

Employee Satisfaction

The firm did not conduct employee satisfaction surveys in order to understand employee satisfaction levels. Thus, employee satisfaction as a whole remained unclear to a certain extent. During the process of conducting the case study, relevant interviewees were asked about their perceptions of employee satisfaction in the firm. The author presented these interviewees with facets that might affect employee satisfaction level. After these interviews were conducted, the author transferred these interviewees' perceptions into scores, which are listed in Appendix 5. These interviews indicated that employee pay was the most important factor affecting employee satisfaction. Currently, many Chinese firms, especially state-owned firms in the Liaoning region, had difficulties paying their employees due to various reasons. Although employees in the firm did not earn a great deal they could, however, have their salaries and bonuses per month. If the whole of China's machinery sector were taken into account, the investigated firm was doing well. In this regard, employees were satisfied. If compared with other industrial sectors or foreign-funded firms, the employees in the firm were not satisfied due to their relatively low pay. As a result, more and more qualified employees had left the firm to find well-paid jobs. It was very difficult for the firm to keep well qualified employees, which was a serious problem it faced. Table 8.1 lists the average annual pay between 1993 and 1999. The second most important factor affecting employee satisfaction was job security. Due to the long history of the planning economy in China, the firm employed a huge reservoir of surplus labor power. During that time, the firm was not permitted to dismiss employees. With the establishment of the socialist marketing economy in China, the firm now had the right to lay off surplus employees. For example, it implemented a "lay-off project" in 1999. As a consequence, 259 employees were laid off. The firm planned to lay off further redundant employees in the future. Thus, employees were not very satisfied with their job security.

Table 8.1 People's Pay Between 1993 and 1999

Pay	1993	1994	1995	1996	1997	1998	1999
Annual average pay per person (RMB)	3,846	6,420	7,236	7,865	7,657	8,004	9,931

Product Quality

The firm did regularly measure various product quality indices, such as conformity rate for finished products, internal defect rate for processing parts and casting iron, internal failure costs, and external failure costs. Products manufactured by this firm had their own specific standards in which technical specifications (e.g., welding quality, paining quality, quality requirements for different parts) and the parameters of performance, reliability, and durability were specified. Before finished products were delivered, their performance had to be examined; otherwise, they could not be delivered to customers. If finished products met the requirements of their technical specifications and performance indices, then the conformity rate for these products was 100%. Generally, the indices of reliability and durability could not be checked in advance but could be examined through practical application of products on site. In fact, the firm did get a number of complaints from customers about the reliability of their products, though rarely about its product durability. The internal defect rate for processing parts was measured in terms of processing time (time used to process defective components divided by time used to process all components). The internal defect rate for casting iron was measured in terms of weight (weight of defective casting iron divided by whole weight of casting iron). Internal failure costs included those of defects and rework. External failure costs involved those such as changing or repairing components, transporting components to customers, and travelling expenses for service personnel. Table 8.2 lists four of the seven product quality indices since 1996. From this table, it is evident that the indices of product quality were getting increasing better from year to year.

Table 8.2 Product Quality Indices Between 1996 and 1999

Indices	1996	1997	1998	1999
Conformity rate for final products (%)	100	100	100	100
Internal defective rate for processing parts (%)	0.4	0.2	0.19	0.094
Internal defective rate for casting iron (%)	5.0	5.1	4.39	4.14
Internal failure costs (Unit: RMB 10,000)	15.60	8.26	8.89	4.56
Annual output value (Unit: RMB 10,000)	6,045	6,076	7,110	5,307
Percentage (%)	0.258	0.136	0.125	0.086
External failure costs (Unit: RMB 10,000)	49.03	52.04	40.24	29.45
Annual sales (Unit: RMB 10,000)	4,713	6,732	6,848	5,315
Percentage (%)	1.040	0.773	0.588	0.554

In fact, the firm was one of the best in its industrial sector in China. Its product quality enjoyed high reputation in the country. Therefore, its relative product quality was very high compared with that other firms (see Appendix 5). However, this does indicate that the firm's product quality was superior. Actually, there was still room for the firm to improve its product quality. A number of interviewees admitted that the performance, reliability, and durability of their products fell behind the advanced world-level products. Through the assessment of the firm's product quality, a number of areas that led to product quality problems were identified. These areas could be used by the firm to formulate an

improvement plan in order to improve the firm's TQM implementation and product quality. These weak areas are presented below.

Top managers did not pursue long-term business success. Instead, reducing immediate production costs and increasing immediate profits were their major concern. Improving product quality fell behind costs and profits.

Products purchased from suppliers occasionally had quality problems that could not be completely detected by incoming inspection. Such defects would cause quality problems during production or operations in customers' fields. This was due partly to the fact that the firm selected its suppliers based mainly on price rather than quality.

Management means was backward. From time to time, employees read handwritten documents incorrectly because different people had different styles of handwriting. A number of product quality problems occurred due to handwritten documents.

Employees' quality awareness was not very high and employees still lacked a strong sense of responsibility. In addition, a number of employees were short of sufficient skills needed to perform their jobs well.

Some production equipment was obsolete and could not meet production requirements. The firm did not innovate its production equipment since it was short of capital and did not pursue long-term business success.

Customer Satisfaction

Customer satisfaction surveys were regularly conducted to understand customers' views on the firm's quality of products and services. The firm conducted the survey mainly through customer feedback forms, personal interviews, telephone surveys, and seminars. The information obtained from customer feedback forms and the number of customer complaints received were the major sources for the firm in understanding customer satisfaction level (see Appendix 5). Through conducting the assessment of customer satisfaction, the firm's quality problems of products and services were identified. Such information could be used in formulating an improvement plan to improve product and service quality. Customer complaints about product and service quality were identified as follows:

Customers had complaints about product quality related to painting, welding, and other outside appearances; oil leakage from speed reductors; broken axles of belt conveyors; vibration, and noise. Concerning customer complaints about service quality, the firm had the following problems: Necessary parts were not packed for delivery; a number of small parts were not fixed in packing boxes; electric motors were not protected against water and moisture; packing lists were not complete; packing materials had quality problems; and packing quality was not good enough. The major reasons leading to these problems of products and services were recognized as: Low quality raw materials from suppliers, obsolete production equipment, and employees' low sense of responsibility.

Strategic Business Performance

The firm regularly measured its annual sales, sales growth, profits, market share, and exports. These indices between 1996 and 1999 are listed in Table 8.3. Of the five indicators of overall business performance, only market share increased continuously. The other four indicators decreased almost year by year. Such information could be used by the firm to take appropriate actions in order to increase its strategic business performance. The reasons leading to decreased annual sales (annual sales growth), profits, and exports are presented below.

Table 8.3 Strategic Business Performance Between 1996 and 1999

Indices	1996	1997	1998	1999
Annual sales (million yuan)	47.13	67.32	68.48	53.15
Sales growth (%)	-19.9	42.8	1.7	-22.4
Profits (million yuan)	1.2	1.3	1.0	0.5
Market share (%)	25.6	31.5	35.92	38.2
Exports (million yuan)	4.81	6.19	4.35	0.88
Exports rate by annual sales (%)	10.21	9.19	6.35	1.66

Note: Market share was calculated by the firm's output volume divided by the whole output volume in Liaoning Province.

In recent years, due to the problem of the "Triangle debt" in China, the customers of the firm did not want to pay their purchases immediately. Thus, it was not easy to collect money from the customers for products sold. Before July 1999, customers owed the firm RMB 30 million. As a result, the firm suffered severe shortages of money. In order to maintain normal production, it had to borrow more money from banks. In return, the firm had to pay more interest back. As a consequence, production costs were pushed up. Due to keen market competition, the selling price for different products also fell in recent years. For example, the selling price for speed reductors reduced 30% compared with the price in 1993. The price for all kinds of assembled parts was also reduced by 15% compared with the price in 1993. Due to the price war in China, some small firms could make profits if they sold products at a relatively low price. For the investigated firm, it was impossible to make profits if the selling price was low. The firm's burden was heavy because it had approximately 300 retired workers, who still received their pensions from the firm. Currently, product price was the most important factor in attracting customers because many industrial firms did not have sufficient money to buy products. The firm's customers were also faced with a capital shortage. In order to achieve annual sales volume, the firm from time to time had to produce products even though it could not make a profit. Some contracts could only bring annual sales volume rather than profits. Sometimes the firm had to sell products, suffering losses to maintain sales growth. In order to achieve the profit index set up by the bureau, the firm had to lower production costs, cut money expenditures, and avoid all unnecessary expenses.

The firm also experienced difficulties in exporting products to foreign countries. In fact, the firm's products were exported mainly to Southeast Asian countries. Due to the financial crisis in this area in 1998, the exports volume had declined very rapidly over the past two years.

8.5 Four Categories of Improvement Possibilities

Through the assessment of the firm's TQM implementation and overall business performance, its weak areas of TQM implementation were identified. These weaknesses could be used as improvement possibilities for further improving the firm's TQM implementation. Based on a thorough investigation of these improvement possibilities, they can be categorized into four improvement possibilities: Structurally impossible, temporary barrier, ineffective, and feasible. The deputy general manager was involved in assisting the author to categorize these four improvement possibilities. The detailed explanations and analyses of these four categories are described below:

Structurally Impossible Improvement Possibilities

Structurally impossible improvement possibilities are very difficult for the firm to implement under the current situation. The major reason causing structurally impossible improvement possibilities was that the firm's top managers did not pursue long-term business success; immediate short-term profits were their major concern. Due to the institutional system, the general manager was contracted to run the firm under the contract system. The firm's administrative bureau behaves as the principal representing state ownership. The top managers were assumed to have some delegated rights in their operations, but should represent the owner's interest. Every year, the administrative bureau assigned indices of overall business performance to the firm. Profit was the most important index in evaluating the performance of the general manager, whereas annual sales volume was the second. In fact, profit was the veto index, which played a 40% role in evaluating top management performance. As a result, the general manager had to try his best to accomplish these indices. If he did, he could be financially rewarded by the administrative bureau. If he could not achieve these indices, he would be financially punished or would risk being dismissed by the bureau. Under such a system, it was impossible for the general manager to pursue long-term business success. His major focus was to concentrate on annual business success. Profits and annual sales volume were the primary targets. However, to reach these targets was not an easy task under the current situation. Due to the slack market in China, the firm did have some difficulties in achieving the target of annual sales. In order to realize this index, the firm had to sell products at lower price, sometimes suffering losses. As a consequence, the firm had difficulties in realizing its profit target. In order to make profits, the firm had to cut money expenditures. As a result, further development of the firm was hindered. Thus, it was not difficult to understand why some improvement possibilities were very difficult to implement currently. Of the previously identified improvement possibilities, structurally impossible improvement possibilities are listed as follows:

- Pursuit of long-term business success;
- Long-term partnership with suppliers;
- Long-term vision statement;
- Long-term overall business performance plan;
- Implementation of improvement plans;
- Computerized information system;
- Improvement of working environment on shop floor;
- Equipment maintenance and innovation;

- Sufficient resources for employee training.

However, with the deep reform of state-owned firms in China, such structurally impossible improvement possibilities would be implemented if top managers would pursue long-term business success.

Temporary Barrier Improvement Possibilities

There were a number of improvement possibilities that could be implemented in the near future adopting step-by-step approach. First, employee empowerment could be implemented. Currently, the firm organized all activities according to the firm's various rules, regulations, and quality system documents. Every employee had his or her functions and duties, having to do things according to such regulations and procedures. Otherwise, the firm would have trouble. However, with the continuous improvement of employee education, employee commitment and employee skills, employee empowerment would be implemented in the future, though it would take some time to fully implement it. Second, China's present situation was uncertain, with much turbulence. Employees had a strong crisis awareness for their future-they were truly afraid of being laid off. At present, more and more employees were being laid off due to the fact that many firms adopted the policy of laying off redundant employees to increase profits. Thus, employees had a strong consciousness for protecting themselves. As a result, they declined to report their own working problems that were caused by themselves. However, after all redundant employees were laid off and the firm's business went well, employees would be more willing to report their working problems. They would also have more chances to learn different skills for performing different jobs. Third, it was possible that the firm would try to reduce various inspection activities in the future. The approach to reducing inspection activities should be undertaken step by step. Fourth, the deputy general manager did not have confidence in using the seven new QC tools in practice, as he felt they were too complicated to be used at this moment. The seven new QC tools should be implemented in the future after employees accept sufficient training in their use.

Ineffective Improvement Possibilities

It was ineffective for the firm to organize QC circle activities. In fact, the firm's different departments and workshops had already formulated a number of within-functional teams. These teams, instead of QC circles, were used to solve quality management problems. In addition, production employees had their own working tasks according to their job descriptions. If they could not finish these tasks, they would have less pay. Therefore, employees only paid sufficient attention to producing more yields. In such an environment, it was ineffective to organize QC circle activities.

Feasible Improvement Possibilities

Concerning other improvement possibilities, the general deputy manager admitted that these did not receive much attention from the top management team. It is better to say that these improvement possibilities were ignored by the firm. Such improvement possibilities could

be implemented by the firm under the current situation. These feasible improvement possibilities are listed as follows:

1. Supplier selection criteria should be changed in order to ensure that purchased materials have less (or no) quality problems. The quality of purchased products should be regarded as the most important factor in selecting suppliers. Total costs (e.g., incoming inspection, internal failure costs, external failure costs, and late delivery) should be taken into account in selecting suppliers.
2. Data on appraisal costs and prevention costs should be collected and analyzed in order to understand how much money was spent on appraisal and prevention. Such information can be used in seeking solutions to reducing unnecessary costs.
3. Various internal job training courses should be effectively organized in order to make employees perform their jobs better. Experienced employees from different departments or workshops can be training lecturers.
4. Team learning should be further improved by arranging for skillful employees to report their working experiences, rotating team members to present their good ideas during the process of team activities, and rewarding team members who are willing to share their knowledge with other members.
5. Quality awareness education should be further emphasized in order to increase employees' quality awareness and sense of responsibility.
6. The pay gap should be further widened in order to improve the initiatives of well performing employees, well qualified employees, and sales personnel. Employees who make large contributions to the firm deserve to earn more.
7. Competitive benchmarking should be conducted in order to understand competitors' offerings. Such information will be valuable for the firm in improving product design, product quality, and service quality.
8. In-depth market investigations should be conducted in order to obtain customers' real expectations and potential needs. It is valuable to obtain customer satisfaction information on the quality of products and services from the firm's competitors. Such information can be used for product design and quality improvement.
9. Employees should accept training on how to use the seven QC tools and statistical process control in practice. Designers should accept training on how to use experimental design in product design.
10. The seven QC tools should be used extensively in analyzing and solving quality-related problems.
11. Experimental design, concurrent engineering, and modular design should be used in improving product design.
12. The evaluation of employee satisfaction should be conducted regularly. Such information can be used by the firm to further improve its employee satisfaction.
13. Statistical process control should be used in order to control the production process. In addition, process capability should be calculated in order to provide sufficient information for designers to determine design specifications.
14. Quality system documents should be further improved according to the firm's current practices and the ISO 9001 requirements. The firm should change its quality system documents in order to ensure "write what they do and do what they write".

8.6 Formulation of Improvement Plan

The 14 improvement possibilities mentioned above could be used by the firm to formulate its improvement plan. Due to its limited resources, the firm could not implement these improvement possibilities at the same time but had to choose some critical improvement possibilities essential to the firm. More importantly, the firm could implement them in practice. Which improvement possibilities to be implemented should be based on a thorough analysis of these feasible improvement possibilities and the firm's available resources. In addition, time schedules and major responsible departments involved in implementing the improvement plan should also be determined. Thus, the plan might be more practical and its implementation easily ensured. In order to reach this aim, the author consulted with the deputy general manager[28] concerning how to formulate a more effective improvement plan.

Based on the guidance in formulating an improvement plan presented in the TQM implementation model, the targeted improvement areas of the firm's overall business performance were used in ranking all the feasible improvement possibilities. In this firm, it was obvious that the first priority was given to increasing profits. Thus, increasing the firm's profits was used to prioritize the 14 feasible improvement possibilities. Note that the deputy general manager was involved in ranking these improvement possibilities in terms of their potential effects of these feasible improvement possibilities on improving the firm's profits. The ranking was based on the deputy general manager's perception and understanding of these feasible improvement possibilities. The ranked order is presented in Section 8.5. Note that the research findings obtained from the questionnaire survey could not be used in ranking these improvement possibilities, as they only showed whether TQM elements have effects on overall business performance. In addition, the questionnaire findings did not indicate the amount of contribution each TQM element makes. Furthermore, the questionnaire survey findings showed that a number of hypotheses were not confirmed by the data. Actually, these TQM elements do have effects on overall business performance if implemented effectively.

In terms of the firm's available resources, it was better to implement the first five ranked improvement possibilities. The other nine would be left for the next stage of improvement. These five possibilities were then transferred into three programs. Thus, the formulated improvement plan is composed of three programs: Employee learning, analysis of quality costs, and supplier selection based on total costs. The first two programs will start at the same time; the third will start three months later. Figure 8.3 displays the time dimension and major responsible departments involved in implementing this improvement plan, which was formulated on a yearly basis. In other words, within one year's period, implementing this improvement plan is the firm's focus of TQM implementation. After the three programs are practically implemented, their effects and immediate results should be periodically monitored and checked. Immediate actions will be taken to ensure that the improvement plan

[28] The general manager of the firm was dismissed by the administrative bureau on March 13, 2000. At that moment, the author was conducting the case study in the firm. Thus, the author missed the opportunity to discuss with him these improvement possibilities. The author also missed the opportunity to present him with the final improvement plan.

can be effectively implemented. After one year of implementing the improvement plan, the firm should formulate another improvement plan for the next year's implementation. The lessons learned and experiences gained from this year will be used in formulating the next year's plan. It is a never-ending process. It is worthy to note that having a better understanding of these feasible improvement possibilities and the firm's available resources are the primary determinants in formulating a more effective improvement plan. The detailed explanations of this improvement plan are presented in the following paragraphs.

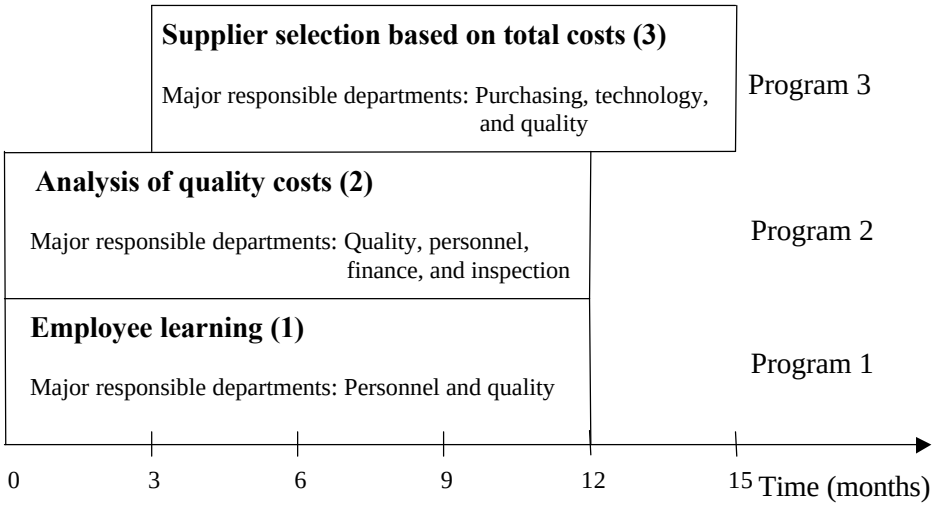


Figure 8.3 Three Programs of the Improvement Plan

Employee Learning (Program 1)

This program consists of three activities: Quality awareness education, internal job training, and team learning, which are explained as follows:

First, quality awareness education will be conducted in order to improve employees' quality awareness and sense of responsibility. It should be conducted on a regular basis (e.g., one time per month). All employees should accept such education. It can be expected that employees' sense of responsibilities will be improved; consequently, fewer quality problems will occur. Note that the contents of quality awareness education are essential to the success of this activity. It will be more effective to use facts to teach employees rather than only words. For example, the fact that money is lost each year due to employees' low quality awareness and lack of a sense of responsibility is a good example to teach employees. The effects of quality awareness education should be regularly monitored in order to continually improve the effectiveness of this activity.

Second, various internal job training courses will be organized to improve employees' skills. Competent employees from different departments or workshops can be asked to give training lectures. Thus, training costs will be reduced enormously. It is not always the case that

external job training is better than internal job training, or that external lecturers are better than internal ones. If qualified lecturers cannot be found within the firm in some cases, external trainers can be invited to give training lectures. Before conducting internal job training, it is essential to understand employees' skill levels. Note that different employees performing different jobs with different skill levels should accept different training. In this regard, internal job training courses should be well developed; otherwise, the training cannot be effective.

Third, the effectiveness of team learning will be further improved by arranging for skillful employees to report their working experiences, rotating team members to present their good ideas during the process of team activities, and rewarding team members who are willing to share their knowledge with other members. Such kinds of "compulsory" sharing ideas will be very effective.

To ensure the success of Program 1, two departments (personnel and quality) are mainly responsible for its implementation. Other departments or workshops should cooperate with these two major responsible departments. The personnel department is in charge of making the detailed time plan for conducting this program and drawing up reward policies to encourage team members to share their knowledge with other members. The quality department is responsible for selecting suitable personnel to give training lectures or present their working experiences. Program 1 will be initially conducted for one year. During the process of one year's implementation, the firm should monitor immediate results so as to take suitable action to ensure the success of this program. If Program 1 produces the expected results, the firm should integrate it into the firm's existing management systems. Thus, the system can ensure that employee learning can be continuously implemented. If this program does not produce the expected effect, then a new improvement program will be formulated on the basis of a careful examination of the one year's implementation of Program 1. Thus, the new improvement program will be more effective.

Analysis of Quality Costs (Program 2)

Various data related to quality costs will be collected and analyzed. Actually, there are four categories of quality-related costs: Internal failure, external failure, appraisal, and prevention. Internal failure costs are associated with defects found prior to transfer of products to the customer. Internal failure costs include, for example, scrap, spoilage, defectives, waste, rework, failure analysis, scrap and rework supplies. External failure costs are related to defects found after products are shipped to the customer, such as warranty charges, complaint handling, returned materials, and allowances. Appraisal costs are incurred in determining the degree of conformity to quality requirements. These costs include those caused by incoming inspection, in-process inspection, final inspection, and maintenance of testing equipment. Prevention costs are associated with those caused by quality planning, process control, quality audit, supplier quality assessment, and training. Note that to have data on quality-related costs is not enough to improve quality and reduce costs. Without carefully investigating the real causes leading to quality costs, actions cannot be effective and chronic deficiencies cannot be reduced. There are two ways of analyzing the data of quality costs. The first is to identify different segments of quality costs and rank these segments in terms of their sizes (amounts of money). In fact, the costs of quality do not exist

as a homogeneous mass. These segments are unequal in size, and a relative few account for the bulk of the quality costs. The second way to analyze the data is to investigate all reasons leading to quality costs and rank these in terms of their contributions to quality costs. Each segment of quality costs can be traceable to specific causes. Thus, different reasons leading to quality costs can be identified, especially those vital few reasons. In order to analyze data efficiently, Pareto analysis and cause-and-effect diagram should be used. It is worth noting that the largest segment of quality costs and the reason leading to the largest proportion of quality costs should be used as the primary input in formulating an improvement action. Such an action can be implemented in order to effectively reduce quality costs. Thus, it can be expected that the firm's profits will be improved. To ensure the success of this program, the departments of quality, personnel, finance, and inspection are mainly responsible for implementing this program. Other departments or workshops should cooperate with these major responsible departments. This program is designed for one year. After one year's trial, the firm should standardize its procedures through establishing a formal quality costing system to ensure that collection and analysis of quality costs is the normal life of the firm's evaluation activities.

Supplier Selection Based on Total Costs (Program 3)

The firm's many quality problems and losses were incurred by poor quality of purchased materials due to the fact that the firm selected suppliers based mainly on purchasing price rather than product quality. Of course, it is normal practice to balance between price and quality in order to pursue optimal purchasing. It is impossible for the firm to select its suppliers in terms of only one factor-quality. The firm's primary goal is to achieve the profit target set by the administrative bureau. Thus, supplier selection based on total costs should be adopted by the firm. From the analysis of quality costs (Program 2), the amount of quality costs caused by poor purchased products can be identified. This information can be used in optimizing supplier selection by balancing between quality and price. To do so, the firm can reduce total costs by selecting suitable suppliers. As a consequence, the firm's profits will be enhanced. In fact, it will take some time to collect and analyze the data of quality costs. Therefore, the program of supplier selection based on total costs will start three months later than that of analysis of quality costs. This program will be initially implemented for one year. Then, its effects on improving profits will be evaluated. If this program produces good results, the firm should continually implement it. If it does not have the expected effect, reason analysis should be conducted. A new improvement program concerning selecting suppliers will then be formulated, on the basis of the information obtained from the one year's implementation of supplier selection based on total costs. Note that external quality losses may not be identified in one year, but are most probably identified after that time. Therefore, the yearly evaluation of the effects of implementing this program should take this factor into account. The departments of purchasing, technology, and quality will be mainly responsible for implementing this program. Other departments or workshops should cooperate with these three major responsible departments.

During the process of formulating this improvement plan, the deputy general manager was personally involved. In fact, he agreed that this improvement plan would be implemented by the firm in practice. It should be noted that this plan was formulated on the basis of the 14

feasible improvement possibilities, the targeted improvement area of the firm's overall business performance (profits in this case), and the firm's available resources.

8.7 Discussion and Conclusions

Based on the evaluation, the strengths and weaknesses of the firm's TQM implementation and overall business performance were identified. The firm's current TQM implementation practices showed that it did not implement the full package of the TQM implementation model. It is better to say that this firm only implemented part of TQM, or that it was on the journey to full-fledged implementation of TQM. The weaknesses of the firm's TQM implementation and overall business performance provided opportunities for the firm to improve its TQM implementation. Based on these weaknesses, the firm's targeted improvement area of overall business performance, and the firm's available resources, an improvement plan was formulated. The firm's deputy general manager agreed that the firm would implement this improvement plan in practice. Thus, it can be concluded that this TQM implementation model can be used to evaluate the firm's TQM implementation and overall business performance, identify strengths and weaknesses therein, and assist the firm in formulating the improvement plan. Therefore, the TQM implementation model developed in this study is applicable to this firm.

Can this TQM implementation model be used in other Chinese manufacturing firms? In fact, the case study was conducted in only one Chinese state-owned manufacturing firm. Strictly speaking, the generalization was limited. However, it was safe to assume that no firms have implemented the full package of the TQM implementation model in practice. Firms' weak areas of TQM implementation and overall business performance can always be identified by comparison with this TQM implementation model. Weak areas can be used by firms to further improve their TQM implementation. Thus, the conclusion obtained from the case study can be generalized to other manufacturing firms in China. Therefore, the TQM implementation model developed in this study is applicable to all Chinese manufacturing firms.

The case study further shows that this TQM implementation model can be used to benchmark firms' continuous improvement, self-assess their quality improvement efforts, and measure their progress over time. Through using this model, firms can quickly identify which areas urgently need improvement. Thus, resources can be allocated more wisely. In fact, TQM implementation is a systematic approach. Different firms have different characteristics, histories, and backgrounds; adopt different technologies; have different TQM implementation maturity; serve different markets with different products; and employ people from different education levels. Different firms should adopt different approaches to TQM implementation on the basis of their own situations. No universal standard of TQM implementation exists. Firms should not follow the practices presented in this TQM implementation model strictly; when they start using it, they should combine their uniqueness with the practices of this model and consequently develop their own models and ways to excellence. Thus, firms can optimize the use of this model by blending with it and applying it to their own situations. Through this, their own models can suit their situations better. It is very important that firms adopt TQM practices that are valuable to their own

specific requirements. Additionally, firms need to develop their own measurement systems that can better measure employee satisfaction, product quality, customer satisfaction, and strategic business performance. Their own measurement systems can better fit their situations.

This case study also provides an example of how to use this TQM implementation model in practice. Firms that want to use this model can take this case study as an example. It should be noted that top management commitment is the most important prerequisite; without it, it is impossible to successfully implement this model in practice. To ensure the success of using the TQM implementation model, firms should understand their TQM implementation and overall business performance. Otherwise, weaknesses in these areas cannot be identified and effective improvement plans cannot be formulated. After improvement plans have been formulated, firms should implement them in practice, observe and check results, investigate and analyze the results, formulate new improvement plans again, and restart implementing new plans. In fact, implementing TQM is a continuous improvement process. It is a never-ending journey. Implementing this model does require patience, tenacity, and commitment from people at every level in firms. It is worth noting that there are no quick fixes. It will take some time to see the effects of implementing this model.

Chapter 9 Summary and Conclusions

9.1 Introduction

This chapter provides the summary of this thesis, research conclusions obtained from conducting this study, and a brief research evaluation. Section 9.2 presents a brief summary of this study. Section 9.3 provides conclusions obtained from conducting this research. Section 9.4 focuses on a brief research evaluation, such as research limitations and future research perspectives.

9.2 Brief Summary

In the field of total quality management, confusion was raised worldwide with the TQM concept and the effects of TQM implementation. In fact, much research dealing with the concept of TQM has been conducted. Different researchers have adopted different definitions of TQM; thus far, it has come to mean different things to different people. Concerning the effects of TQM implementation, different researchers have different findings. A number of researchers concluded that TQM implementation has effects on firms' business performance, whereas others stated that it does not lead to improvements in firms' business performance. Conflicting research findings have thus been reported surrounding the effects of TQM implementation. Similarly, conflicting results concerning the effects of TQM implementation on firms' business performance were also found in Chinese manufacturing firms. After the literature related to TQM implementation in Chinese manufacturing firms was studied, it became evident that no large-scale empirical research dealing with the effects of TQM implementation on firms' overall business performance had been systematically conducted. In addition, no research has been conducted for developing a TQM implementation model that can be used by Chinese manufacturing firms to improve their TQM implementation efforts. The lack of sufficient guidelines to assist firms' TQM implementation has led to a number of unsuccessful TQM implementations in China. Thus, the major objectives of this study are:

- To obtain the effects of TQM implementation on overall business performance in Chinese manufacturing firms;
- To obtain a TQM implementation model for Chinese manufacturing firms.

In order to achieve the two research objectives, five research questions were proposed as follows:

- *What is TQM?*
- *What is overall business performance within TQM?*
- *What are the effects of TQM implementation on overall business performance in Chinese manufacturing firms?*
- *What kind of TQM implementation model should be developed in order to guide Chinese manufacturing firms in implementing TQM?*

- *How can this TQM implementation model be demonstrated in practice?*

This study started with an extensive review of TQM literature from quality gurus (Deming, Juran, Crosby, Feigenbaum, and Ishikawa), the three quality award models (the Deming Prize, the European Quality Award, and the American Malcolm Baldrige National Quality Award), and the others conducting research in the field of TQM. Thus, the concept of TQM adopted in this study was defined as: 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. In this study, TQM consists of 11 constructs. To implement TQM is merely to implement these 11 TQM constructs through a set of practices such as using relevant tools or techniques. The extensive review of the TQM literature provided a solid foundation for conducting this research.

The extensive literature review on overall business performance within TQM suggested that four constructs of overall business performance were considered important by firms: Employee satisfaction, product quality, customer satisfaction, and strategic business performance (annual sales, sales growth, profits, market share, and exports). Thus, a model of TQM implementation and overall business performance was formulated on the basis of the existing research results. This model consists of nine hypotheses. TQM implementation is an independent variable and the four constructs of overall business performance are dependent variables. TQM implementation is the combination of its 11 constructs. The links between TQM implementation and employee satisfaction, product quality, customer satisfaction, and strategic business performance are incorporated in a single model. Furthermore, in order to explore the effects of the 11 different TQM constructs, a model of TQM implementation constructs and overall business performance was developed on the basis of the existing research findings. In this model, the 11 TQM implementation constructs are independent variables. Similarly, the four constructs of overall business performance are dependent variables. This model is composed of 17 hypotheses. The links between the 11 TQM implementation constructs and the four constructs of overall business performance are incorporated in a single model. In order to empirically test the two theoretical models hypothesized in this study, the operationalization of the 11 constructs of TQM implementation and the four constructs of overall business performance was conducted on the basis of the literature review, the existing measurement instruments, and the specific characteristics of Chinese manufacturing firms. Finally, 79, 1, 7, 2, and 5 items were developed to measure TQM implementation, employee satisfaction, product quality, customer satisfaction, and strategic business performance, respectively.

In order to reach the research objectives and answer the research questions, the following strategies for collecting data were adopted: A questionnaire survey, structured interviews, and a case study. Three Liaoning provincial governmental agencies and the Liaoning Provincial Quality Control Association sent questionnaires to 900 manufacturing firms in the Liaoning region in China. Only firms with annual sales greater than RMB 10 million were selected to receive questionnaires; these 900 firms were randomly selected from 2,929 firms with this level of sales in the year 1997. Finally, 212 questionnaires were returned, with a response rate of approximately 23%. The information obtained from the questionnaire survey was used mainly in testing the two models hypothesized in this study.

Ten structured interviews were conducted in ten different manufacturing firms. The information obtained from these interviews was used in developing the TQM implementation model and interpreting the findings from the questionnaire survey. The case study was conducted in a state-owned machinery firm in order to demonstrate how to use this TQM implementation model in practice. In this study, all investigated firms were from Liaoning province due to practicality.

In order to empirically test the two theoretical models, the two measurement instruments measuring TQM implementation and overall business performance for Chinese manufacturing firms were evaluated for reliability and validity. Only based on reliable and valid measurement instruments could model testing be conducted. The measurement instruments were empirically evaluated using the data from 212 Chinese manufacturing firms. Reliability analysis (internal consistency), item analysis, and validity analysis (construct analysis) were used for instrument evaluation. Finally, it was concluded that the instruments for measuring TQM implementation and overall business performance are reliable and valid. The data obtained using the two instruments can be used in testing the two theoretical models hypothesized in this study. Note that one item measuring TQM implementation was deleted after the evaluation. Thus, 78 items were used to measure TQM implementation.

Data from 212 Chinese manufacturing firms were used to test the two theoretical models. The LISREL technique was used for data analysis. The Pearson correlation matrix was selected as the input matrix for LISREL. The maximum likelihood was employed for model estimation. One-tailed significance levels were used to estimate structural model fit. The Chi-square, goodness-of-fit index, adjusted goodness-of-fit index, root mean square error of approximation, and root mean square residual were selected for estimating overall model fit. Contrary to what was hypothesized in the two models, some hypotheses were not confirmed by the data. The results obtained from the ten structured interviews were used to interpret the research findings obtained from the questionnaire survey, which have a number of practical implications. First, TQM implementation has positive effects on overall business performance and implementing TQM does payoff. Second, leadership is the decisive factor in determining the success of organizational overall business performance. In other words, without strong leadership, it is impossible for the firm to achieve good overall business performance. Third, the research findings can imply that it is not necessary for all TQM elements to be present to ensure the success of the TQM programs and overall business performance. In order words, even if a few elements are not present, it is still possible to obtain the required level of overall business performance. Finally, in this study, several hypotheses were not confirmed by the questionnaire survey data. This disconfirmation does not imply that these constructs are unimportant or useless. Instead, firms should identify the problem areas of these constructs and implement them more effectively.

Based on the existing TQM literature, the ten structured interviews, and the findings from the questionnaire survey, a TQM implementation model was developed for Chinese manufacturing firms. The model consists of a framework of TQM, a set of implementation practices, a set of indicators of overall business performance, processes of using this model in practice, and practical guidance to assist users in formulating the most effective TQM implementation plans. This model shows that the application of these TQM practices in combination can lead to improvements in overall business performance. Please note that

there is no single or best way of implementing this TQM implementation model. Firms are different in terms of their people, culture, history, goals, structure, products, services, technologies, processes, and operating environments. Therefore, they should combine their uniqueness with this model and consequently develop their own ways to excellence. Thus, firms can optimize the use of this model by blending with it and applying it to their own situations. Thus, their own methods can better suit their situations. Implementing TQM is a never-ending process. Investing in TQM implementation often implies a choice for a long-term effort that requires a great deal of energy, management attention, money, patience, and tenacity. Although this model was initially developed for manufacturing firms in China, firms in other countries also can use it as reference, since the existing quality management knowledge was used extensively to develop this model. Therefore, many principles and practices presented in this model can be used for firms in other countries. However, some practices are particularly applicable to Chinese manufacturing firms, and may not be so to firms in other countries. It should be noted that there are many types of firms in terms of ownership in China. Additionally, different firms are involved in different businesses. Some practices presented in the model cannot be applicable to all kinds of Chinese firms. Therefore, they must tailor some practices to meet their own requirements. Although this model was initially developed for Chinese manufacturing firms, it is hoped that it can also be helpful for service and public organizations in China. This is due to the fact that the basic philosophy of TQM is applicable to any type of organization. It is not surprising that some principles and practices presented in the model are key to the success of any organization. That is not to say, however, that they are a panacea or can be implemented without attention to specific circumstances and characteristics.

In order to provide an example of using this TQM implementation model in practice, a case study was conducted in a state-owned Chinese machinery firm. The firm's current TQM implementation and overall business performance were compared with the TQM implementation model. The strengths and weaknesses of the firm's TQM implementation and overall business performance were identified, the weak areas being used in formulating the improvement plan. Finally, it was concluded that the TQM implementation model developed in this study is applicable in practice. It can be used by Chinese manufacturing firms at the different stages of TQM implementation. For Chinese manufacturing firms that are implementing TQM or have had a TQM process, the model can provide additional ideas on how to improve their implementation efforts. For firms that are planning TQM, the model can provide detailed information on the elements and practices of TQM, and indicators of overall business performance. For firms that have not decided whether to implement TQM, the model can provide specific benefits of a number of TQM practices, positively encouraging them in implementing TQM.

Finally, it is necessary to review this study in light of the five research questions. The first question, "What is TQM?" was answered on the basis of the extensive literature review. The defined concept of TQM was used throughout this study, which laid a solid foundation for conducting this research. The second question, "What is overall business performance within TQM?", was also answered on the basis of the extensive literature review. The third question, "What are the effects of TQM implementation on overall business performance in Chinese manufacturing firms?", was answered using the data from 212 Chinese manufacturing firms in the Liaoning region. The effects of TQM implementation and different TQM constructs were identified. The fourth question, "What kind of TQM

implementation model should be developed in order to guide Chinese manufacturing firms in implementing TQM?", was answered by developing a TQM implementation model, which combined the existing TQM theory, the questionnaire survey findings, and the ten structured interviews in Chinese manufacturing firms. The fifth question, "How can this TQM implementation model be demonstrated in practice?", was answered by conducting a case study in a Chinese state-owned manufacturing firm. The case study showed that the TQM implementation model developed in this study is applicable to this typical Chinese manufacturing firm. In summary, the five research questions were answered and the two research objectives achieved through conducting this study.

9.3 Conclusions

A number of conclusions have been obtained from this research. Thus, a quality management theory related to Chinese manufacturing firms has been developed.

First, the instruments for measuring TQM implementation and overall business performance are reliable and valid, and can be used by other researchers to test the effects of TQM implementation on overall business performance. The reliable and valid instruments can also be used in testing the time dimension of TQM implementation.

Second, several conclusions have been obtained from testing the two theoretical models, which are listed as follows: (1) TQM implementation has positive effects on employee satisfaction, product quality, customer satisfaction, and strategic business performance; (2) Leadership has positive effects on employee satisfaction and strategic business performance; (3) Employee participation, recognition and reward have positive effects on employee satisfaction; (4) Education and training does not have a positive effect on employee satisfaction; (5) Supplier quality management, evaluation, product design, and quality system improvement do not have positive effects on product quality; (6) Vision and plan statement, process control and improvement have positive effects on product quality; (7) Quality system improvement has a positive effect on strategic business performance; (8) Customer focus has a positive effect on customer satisfaction; (9) Employee satisfaction has positive effects on product quality and customer satisfaction; (10) Product quality has positive effects on customer satisfaction and strategic business performance; and (11) Customer satisfaction does not have a positive effect on strategic business performance.

Third, the case study reveals that the TQM implementation model developed in this study is applicable in practice. This model can be used by Chinese manufacturing firms to improve their TQM implementation efforts. The case study further shows that this TQM implementation model can be used to self-assess firms' quality improvement efforts and measure their progress over time. Through using this model, firms can quickly identify which areas urgently need improvement. Thus, the resources can be allocated more wisely and more effective improvement plans can be formulated.

9.4 Research Evaluation

Research Limitations

The research has been completed. It is necessary to evaluate this study in the context of its limitations. First, data used to test the theoretical models came from only 212 manufacturing firms with annual sales more than RMB 10 million in the Liaoning region. One of the potential disadvantages was their relatively high degree of commitment to quality. In particular, the variances of the variables were reduced. Strictly speaking, the generalization is limited. Second, the measure of perceived employee satisfaction in particular is relatively weak, because it asked respondents for their general perception of employee satisfaction in their respective firms. Due to the secondary nature of the data, it cannot conclude that asking alternative sources is equivalent to asking the individuals directly about their job satisfaction. Thus, research findings might have been biased. Third, customer satisfaction data were obtained from respondents rather than customers. Due to the secondary nature of the customer satisfaction data used in this study, the data would not be very reliable and the research findings might have been biased to a certain degree. Finally, another weakness of this research was the issue of the common method variance. In each firm, only one respondent filled in the questionnaire.

Future Research Perspectives

In an exploratory study such as this, recommendations for future research would address the issues generated from this study. Based on these findings, future research may start from a relatively higher level of knowledge. First, a replication of this study would be helpful in re-examining the validity of its findings. Further empirical studies using larger sample sizes, greater geographical diversity, and firm type diversity would be helpful in validating specific parts of the theoretical models proposed in this study. Second, subsequent research needs to be engaged in the development of more valid and reliable operational definitions for the proposed constructs, overcoming the limitations posed by the data source used in this study. For example, more categories could be developed in order to score the responses for strategic business performance. The data of employee and customer satisfaction would be obtained from employees and customers, respectively, rather than from respondents. Third, the relationships found in this study would be investigated in different countries to test whether they go in the same or different directions. Fourth, a set of longitudinal studies would be very valuable in studying the time dimension of TQM implementation. Fifth, more structured interviews would be conducted in different kinds of Chinese manufacturing firms in order to continuously improve the TQM implementation model. Thus, model could better meet the requirements of different Chinese industries. Sixth, an in-depth case study would be conducted in a Chinese manufacturing firm to gain more insight into using this TQM implementation model in practice. Finally, the influence of external environment could be studied in order to explore how external environment affects firms' TQM implementation.

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Appendices

Appendix 1 TQM Implementation Instrument

A 5-Likert scale (1: Strongly disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly agree) was used to ask the respondents to state how much they agreed with these statements.

Scale 1: Leadership
(1) Top management actively participates in quality management activities.
(2) Top management learns quality-related concepts and skills.
(3) Top management strongly encourages employee involvement in quality management activities.
(4) Top management empowers employees to solve quality problems.
(5) Top management arranges adequate resources for employee education and training.
(6) Top management discusses many quality-related issues in top management meetings.
(7) Top management focuses on product quality rather than yields.
(8) Top management pursues long-term business success.

Scale 2: Supplier Quality Management
(1) Our firm has established long-term cooperative relations with suppliers.
(2) Our firm regards product quality as the most important factor in selecting suppliers.
(3) Our firm always participates in supplier activities related to quality.
(4) Our firm always gives feedback on the performance of suppliers' products.
(5) Our firm has detailed information about supplier performance.
(6) Our firm regularly conducts supplier quality audit.

Scale 3: Vision and Plan Statement
(1) Our firm has a clear long-term vision statement.
(2) The vision effectively encourages employees' commitment to quality management.
(3) Our firm has a clear short-term business performance plan.
(4) Our firm has a clear quality policy.
(5) Our firm has a detailed quality goal.
(6) Our firm has effective quality improvement plans.
(7) Various policies and plans are well communicated to the employees.
(8) Employees from different levels are involved in making policies and plans.

Scale 4: Evaluation
(1) Our firm regularly audits various business strategies.
(2) Our firm regularly conducts quality audits.
(3) Benchmarking is used extensively in our firm.
(4) Our firm uses quality-related costs extensively.
(5) Our firm has detailed quality-related data such as defect rates and scraps.*

(6) Quality-related data are used to evaluate the management of our firm.*
(7) Quality-related data are used to evaluate the performance of all departments.*
(8) Quality-related data are used to evaluate the performance of employees.*
(9) Quality-related information is displayed at the shop floor.
(10) The aim of evaluation is improvement, not criticism.

Scale 5: Process Control and Improvement
(1) Our firm is kept neat and clean at all times.
(2) Process capability can meet production requirements.
(3) Production equipment is well maintained according to the maintenance plan.
(4) Our firm implements various inspections effectively (e.g., incoming, process, and final products).
(5)# Our processes are designed to be "foolproof" in order to minimize the chance of employee error.
(6) Our firm uses the Seven QC tools extensively for process control and improvement.*
(7) Our firm uses SPC extensively for process control and improvement.*
(8) Our firm uses PDCA cycle extensively for process control and improvement.*

Scale 6: Product Design
(1) The design engineers are required to have some shop floor experience.
(2) The design engineers are required to have some marketing experience.
(3) The customer requirements are thoroughly considered in new product design.
(4) Various departments participate in new product development.
(5) New product designs are thoroughly reviewed before production.
(6) Cost is emphasized in the product design process.
(7) Experimental design is used extensively in product design.
(8) Quality function deployment (QFD) is used extensively in product design.

Scale 7: Quality System Improvement
(1) The quality system in our firm is continuously being improved.
(2) Our firm uses ISO 9000 as a guideline for establishing our quality system.
(3) Our firm has a clear quality manual.
(4) Our firm has clear procedure documents.
(5) Our firm has clear working instructions.

Scale 8: Employee Participation
(1) Our firm has cross-functional teams.
(2) Our firm has several QC circles (within one function).
(3) Employees are actively involved in quality-related activities.
(4) Our firm implements suggestion activities extensively.
(5) Most employees' suggestions are implemented after an evaluation.
(6) Employees are very committed to the success of our firm.
(7) Employees are encouraged to fix problems they find.
(8) Reporting work problems is encouraged in our firm.

Scale 9: Recognition and Reward
(1) Our firm improves working conditions in order to recognize employee quality

management efforts.
(2) Our firm has a salary promotion scheme to encourage employee participation in quality management.
(3) Position promotions are based on work quality in our firm.
(4) Excellent suggestions are financially rewarded.
(5) Employees' rewards and penalties are clear.
(6) Recognition and reward activities effectively stimulate employee commitment to quality management.

Scale 10: Education and Training

(1) Employees are encouraged to accept education and training in our firm.
(2) Resources are available for employee education and training in our firm.
(3) Most employees in our firm are trained on how to use quality management methods (tools).
(4) Quality awareness education is given to employees.
(5) Specific work-skills training is given to all employees.
(6) Employees are regarded as valuable, long-term resources worthy of receiving education and training throughout their career.

Scale 11: Customer Focus

(1) Our firm collects extensive complaint information from customers.
(2) Quality-related customer complaints are treated with top priority.
(3) Our firm conducts a customer satisfaction survey every year.
(4) Our firm always conducts market research in order to collect suggestions for improving our products.
(5) Our firm provides warranty on our sold products to customers.
(6) Our firm has been customer focused for a long time.

Notes*:* *# means that this item was deleted after factor analysis.*
******* *means that these items in that scale formed one factor and the other items in that scale formed another.*

Appendix 2 Overall Business Performance Instrument

Scale 1: Employee Satisfaction
Please state the perceived overall employee satisfaction level in your firm (Choose a number between "0" and "10" to 1 decimal place. 0: Extremely unsatisfied; 5.0: Middle; 1.0: Extremely satisfied).

(1) The employee satisfaction level in your firm

Scale 2: Product Quality
Compared with the other firms within the same industry in China, please state the situation of your primary products (1: Worst in the industry; 2: Below average; 3: Average; 4: Above average; 5: Best in the industry).

(1) The performance of your primary products
(2) The conformity rates of your primary products
(3) The reliability of your primary products
(4) The durability of your primary products
(5) The defect rates of your primary products*
(6) The internal failure costs as a percentage of annual output value*
(7) The external failure costs as a percentage of annual sales*

Scale 3: Customer Satisfaction
Please state the customer satisfaction level for your firm (1: Extremely unsatisfied; 2: Unsatisfied; 3: Middle; 4: Satisfied; 5: Extremely satisfied).

(1) The customer satisfaction level for product quality provided by your firm
(2) The customer satisfaction level for service quality provided by your firm

Scale 4: Strategic Business Performance
1. What were the approximate annual sales achieved by your firm in the last financial year (Unit million RMB)?

(1) Less than 13 (2) 13.1 - 22 (3) 22.1 - 50
(4) 50.1 - 150 (5) More than 150

2. Compared with the previous year, do you think your annual sales:*

(1) Decreased a great deal (2) Decreased slightly (3) Stayed almost the same
(4) Increased slightly (5) Increased a great deal

3. Do you think your firm was:*

(1) Losing money badly (2) Losing money slightly (3) Breaking even
(4) Making some profits (5) Very profitable

4. Compared with the firm that had the biggest local market share (regarded as 100%) within the same industry in China, what was the relative local market share of your products (your firm's output divided by the output of the biggest firm in the same industrial sector in China)?

(1) 0% - 20.0%	(2) 20.1% - 40%	(3) 40.1% - 60%
(4) 60.1% - 80%	(5) 80.1% - 100%	

5. Approximately what percentage of total annual sales by value was exported?

(1) 0%	(2) 0.1% - 8%	(3) 8.1% - 14%
(4) 14.1% - 35%	(5) More than 35%	

Note: ** means that these items in that scale formed one factor, and the other items in that scale formed another.*

Appendix 3 Frequency Distributions and Means of Respondents' Responses to Measurement Items

Table A Items Measuring TQM Implementation Constructs

			Response category					
Scales	Items	Means	1	2	3	4	5	Total
Leadership (Scale 1)	1	4.03	3	10	34	95	70	212
	2	3.57	4	32	59	73	44	212
	3	4.22	0	3	33	90	86	212
	4	3.61	6	24	57	85	40	212
	5	3.50	8	34	63	59	48	212
	6	4.32	0	2	21	97	92	212
	7	4.03	0	3	49	99	61	212
	8	3.95	3	12	55	65	77	212
Supplier quality management (Scale 2)	1	3.64	2	19	68	87	36	212
	2	4.16	1	4	31	100	76	212
	3	3.03	14	52	72	62	12	212
	4	4.08	0	6	43	90	73	212
	5	3.64	2	20	65	91	34	212
	6	3.53	2	36	60	76	38	212
Vision and plan statement (Scale 3)	1	3.96	2	12	52	72	74	212
	2	3.55	6	24	67	77	38	212
	3	4.19	1	5	28	97	81	212
	4	4.22	1	2	37	82	90	212
	5	4.04	2	13	42	73	82	212
	6	3.70	1	27	50	91	43	212
	7	3.92	2	13	44	93	60	212
	8	3.03	22	45	69	57	19	212
Evaluation (Scale 4)	1	3.47	5	26	73	81	27	212
	2	3.82	2	30	37	79	64	212
	3	3.60	8	29	56	66	53	212
	4	3.51	2	26	73	84	27	212
	5	4.20	0	3	38	84	87	212
	6	3.83	0	7	65	97	43	212
	7	3.66	0	18	72	87	35	212
	8	3.72	0	8	78	91	35	212
	9	3.17	13	39	79	61	20	212
	10	3.85	4	8	55	94	51	212

Continued

Scales	Items	Means	Response category 1	2	3	4	5	Total
Process control and improvement (Scale 5)	1	3.81	2	11	62	87	50	212
	2	3.98	0	8	41	110	53	212
	3	3.95	1	9	52	87	63	212
	4	4.24	0	6	30	84	92	212
	5#	*2.83*	*22*	*54*	*82*	*45*	*9*	*212*
	6	3.33	6	28	86	73	19	212
	7	2.95	22	39	94	41	16	212
	8	3.43	5	20	88	76	23	212
Product design (Scale 6)	1	4.02	0	6	43	104	59	212
	2	3.97	0	9	43	105	55	212
	3	4.23	0	3	26	102	81	212
	4	2.96	15	55	80	48	14	212
	5	3.89	0	7	59	96	50	212
	6	3.96	0	4	50	108	50	212
	7	3.11	17	45	65	67	18	212
	8	2.93	22	46	82	48	14	212
Quality system improvement (Scale 7)	1	3.94	0	12	55	78	67	212
	2	3.55	14	36	47	49	66	212
	3	3.61	23	19	45	55	70	212
	4	3.70	8	25	55	59	65	212
	5	3.86	3	18	48	79	64	212
Employee participation (Scale 8)	1	3.33	8	30	79	75	20	212
	2	3.47	8	30	63	76	35	212
	3	3.63	0	17	80	80	35	212
	4	4.05	0	4	50	89	69	212
	5	3.61	0	13	83	89	27	212
	6	3.71	1	19	62	89	41	212
	7	3.88	0	9	56	99	48	212
	8	3.76	1	10	62	104	35	212
Recognition and reward (Scale 9)	1	3.82	0	15	56	93	48	212
	2	3.62	4	19	68	84	37	212
	3	3.44	3	31	77	71	30	212
	4	3.84	0	10	59	97	46	212
	5	3.94	0	9	59	80	64	212
	6	3.51	1	25	78	81	27	212

Continued

Scales	Items	Means	Response category 1	2	3	4	5	Total
Education and training (Scale 10)	1	3.83	0	14	52	101	45	212
	2	3.36	1	52	55	77	27	212
	3	3.37	0	39	77	75	21	212
	4	4.00	0	6	53	89	64	212
	5	4.07	0	0	39	119	54	212
	6	3.42	6	33	63	86	24	212
Customer focus (Scale 11)	1	3.82	0	10	58	104	40	212
	2	4.18	0	4	25	111	72	212
	3	3.65	3	21	70	71	47	212
	4	3.80	2	18	49	94	49	212
	5	4.44	0	2	14	84	112	212
	6	4.09	0	8	39	91	74	212

Notes: # means that this item was deleted after the factor analysis.
The item order in this table is the same as in the instrument.

Table B Items Measuring Overall Business Performance

			Response category					
Scales	Items	Means	1	2	3	4	5	Total
Employee satisfaction (Scale 1)	1	7.51	--	--	--	--	--	212
Product quality performance (Scale 2)	1	3.97	2	10	46	89	65	212
	2	3.99	1	9	50	84	68	212
	3	4.02	1	5	44	100	62	212
	4	4.01	0	7	46	97	62	212
	5	3.61	4	20	71	76	41	212
	6	3.57	3	19	79	76	35	212
	7	3.61	3	20	73	77	39	212
Customer Satisfaction (Scale 3)	1	3.97	1	6	40	116	49	212
	2	4.11	1	7	34	95	75	212
Strategic business performance (Scale 4)	1	3.00	47	38	41	40	46	212
	2	2.96	48	47	16	67	34	212
	3	3.16	43	27	18	101	23	212
	4	2.30	98	36	23	26	29	212
	5	2.20	110	26	25	25	26	212

Notes: Scale 1 was ranged between 0 and 10 to 1 decimal place. The mean is 7.51; the minimum value is 0.5 (one time); the maximum value is 10.0 (23 times).
The item order in this table is the same as in the instrument.

Appendix 4 Item to Scale Correlation Matrix for the Eleven TQM Implementation Scales (Pearson Correlation)

		Scales										
Scales	Item	1	2	3	4	5	6	7	8	9	10	11
1	1	**.784**	.581	.631	.587	.555	.560	.525	.559	.466	.540	.538
	2	**.810**	.543	.685	.572	.541	.559	.554	.600	.458	.588	.583
	3	**.709**	.548	.577	.566	.536	.462	.378	.551	.509	.539	.491
	4	**.702**	.465	.583	.494	.463	.587	.478	.530	.404	.512	.484
	5	**.851**	.665	.703	.637	.622	.647	.596	.645	.523	.694	.596
	6	**.624**	.485	.485	.514	.445	.409	.365	.446	.472	.483	.490
	7	**.751**	.586	.603	.602	.563	.505	.433	.542	.534	.560	.515
	8	**.816**	.673	.695	.637	.623	.567	.576	.650	.612	.626	.661
2	1	.677	**.741**	.678	.583	.589	.603	.645	.650	.483	.615	.622
	2	.585	**.787**	.598	.598	.591	.483	.524	.509	.568	.527	.571
	3	.721	**.816**	.764	.674	.620	.635	.661	.657	.566	.658	.624
	4	.517	**.690**	.548	.581	.556	.404	.407	.493	.494	.526	.512
	5	.391	**.683**	.460	.533	.532	.344	.453	.480	.528	.474	.443
	6	.453	**.753**	.524	.554	.472	.396	.442	.435	.515	.465	.415
3	1	.738	.694	**.844**	.722	.716	.649	.662	.696	.644	.722	.731
	2	.724	.685	**.861**	.704	.674	.631	.633	.676	.613	.682	.665
	3	.427	.432	**.553**	.443	.383	.391	.353	.399	.436	.459	.442
	4	.693	.720	**.861**	.759	.738	.669	.756	.722	.644	.731	.698
	5	.724	.669	**.859**	.708	.689	.673	.763	.698	.556	.671	.662
	6	.748	.712	**.863**	.752	.693	.703	.722	.726	.620	.695	.691
	7	.476	.576	**.652**	.597	.502	.446	.422	.519	.538	.549	.512
	8	.663	.592	**.823**	.706	.599	.658	.622	.669	.585	.625	.598
4	1	.579	.607	.659	**.741**	.618	.549	.564	.577	.573	.609	.557
	2	.536	.644	.611	**.738**	.601	.500	.609	.525	.527	.597	.517
	3	.663	.615	.729	**.768**	.708	.642	.594	.690	.553	.634	.676
	4	.527	.545	.616	**.703**	.615	.564	.490	.553	.590	.551	.530
	5	.437	.542	.508	**.656**	.518	.469	.479	.467	.449	.521	.472
	6	.557	.548	.597	**.772**	.594	.536	.482	.628	.631	.555	.528
	7	.524	.537	.596	**.769**	.540	.561	.445	.603	.569	.544	.540
	8	.416	.433	.425	**.627**	.431	.395	.334	.467	.499	.419	.397
	9	.506	.490	.612	**.653**	.544	.588	.502	.600	.485	.515	.524
	10	.604	.622	.664	**.692**	.636	.599	.559	.650	.532	.578	.587
5	1	.580	.599	.621	.621	**.725**	.593	.530	.586	.566	.636	.581
	2	.455	.474	.496	.562	**.666**	.492	.389	.463	.557	.484	.405
	3	.510	.619	.592	.623	**.755**	.565	.508	.585	.552	.587	.555
	4	.570	.570	.630	.626	**.713**	.548	.583	.596	.536	.622	.565
	5	.643	.644	.709	.667	**.800**	.676	.679	.671	.591	.674	.656
	6	.475	.530	.536	.593	**.754**	.547	.553	.597	.542	.529	.532
	7	.535	.505	.600	.602	**.790**	.654	.584	.641	.500	.575	.530
	8	.479	.508	.491	.590	**.721**	.497	.564	.625	.563	.569	.580

Continued

6	1	.515	.403	.529	.510	.518	**.688**	.447	.437	.401	.488	.484
	2	.424	.371	.460	.492	.478	**.649**	.353	.418	.403	.400	.433
	3	.414	.392	.455	.462	.453	**.642**	.461	.449	.437	.370	.457
	4	.520	.448	.610	.588	.532	**.726**	.491	.588	.504	.508	.508
	5	.538	.564	.578	.621	.599	**.636**	.480	.590	.576	.572	.563
	6	.361	.385	.352	.438	.436	**.570**	.232	.425	.418	.358	.311
	7	.586	.505	.621	.578	.633	**.802**	.552	.611	.489	.560	.563
	8	.554	.471	.564	.519	.592	**.765**	.563	.582	.448	.542	.488
7	1	.621	.674	.690	.710	.715	.650	**.782**	.696	.616	.700	.691
	2	.565	.621	.681	.623	.661	.544	**.913**	.637	.554	.648	.630
	3	.564	.591	.679	.590	.616	.572	**.914**	.574	.461	.625	.598
	4	.608	.658	.741	.667	.662	.614	**.939**	.652	.538	.677	.651
	5	.548	.581	.666	.613	.660	.561	**.844**	.638	.564	.637	.588
8	1	.654	.636	.730	.671	.672	.645	.695	**.765**	.561	.654	.647
	2	.562	.491	.601	.548	.628	.597	.663	**.760**	.495	.599	.612
	3	.607	.527	.652	.616	.652	.577	.549	**.804**	.575	.663	.614
	4	.502	.494	.501	.573	.534	.478	.367	**.698**	.621	.539	.493
	5	.556	.544	.591	.584	.562	.521	.494	**.741**	.605	.667	.679
	6	.591	.553	.639	.653	.626	.606	.546	**.777**	.602	.646	.639
	7	.379	.438	.446	.542	.466	.456	.373	**.639**	.615	.487	.476
	8	.589	.618	.629	.657	.638	.574	.514	**.761**	.666	.646	.611
9	1	.637	.672	.696	.691	.706	.612	.577	.697	**.756**	.710	.663
	2	.310	.455	.381	.456	.420	.354	.325	.419	**.718**	.404	.371
	3	.528	.529	.608	.630	.616	.580	.517	.621	**.801**	.592	.588
	4	.495	.560	.522	.571	.548	.498	.444	.625	**.766**	.569	.537
	5	.410	.455	.481	.506	.487	.411	.360	.560	**.745**	.590	.565
	6	.613	.569	.673	.625	.619	.600	.581	.713	**.800**	.652	.670
10	1	.636	.663	.666	.672	.661	.536	.566	.673	.672	**.828**	.669
	2	.736	.642	.736	.650	.673	.639	.689	.736	.623	**.863**	.695
	3	.652	.653	.714	.706	.710	.650	.697	.713	.619	**.846**	.690
	4	.374	.452	.443	.498	.454	.368	.371	.488	.561	**.680**	.509
	5	.433	.456	.479	.500	.536	.419	.436	.542	.538	**.703**	.530
	6	.707	.610	.782	.685	.716	.670	.720	.757	.646	**.854**	.783
11	1	.600	.543	.702	.638	.574	.561	.563	.650	.594	.686	**.813**
	2	.505	.519	.507	.571	.561	.522	.474	.561	.511	.574	**.737**
	3	.643	.653	.685	.664	.677	.619	.681	.734	.667	.745	**.838**
	4	.610	.623	.689	.685	.722	.660	.613	.723	.664	.675	**.849**
	5	.380	.394	.413	.400	.363	.310	.352	.404	.437	.490	**.649**
	6	.618	.576	.677	.560	.556	.547	.608	.658	.566	.645	**.813**

Appendix 5 Assessment Tools for TQM Implementation Practices and Overall Business Performance

1. Assessment Tool for TQM Implementation

This assessment tool can be used to assess TQM implementation in a firm. The first column lists the TQM implementation practices. The second column lists the addressed area(s) for each practice. These specifically addressed areas are presented in the form of positive statements. Thus, a user can rate the firm's TQM implementation practices using a score between "0" and "10". The number "0" means that the firm is extremely weak in this practice, while the "10" indicates that the firm is extremely strong. In order to help the user in rating each TQM implementation practice, scoring guidelines were developed on the basis of the European Model for Total Quality Management (1994) and the American Malcolm Baldrige National Quality Award (1999). Scoring results are listed in the third column. Lower scored practices (e.g., lower than or equal to 5) should be given more attention by the firm. During the process of assessment, the strengths and weaknesses of addressed areas should be pointed out. If the firm is neither strong nor weak in an addressed area, "Average" should be indicated. The strengths and weaknesses are listed in the fourth column. The weak areas of the firm's TQM implementation can be used by the firm to formulate improvement plans. If some TQM implementation practices are not applicable (e.g., the firm does not have product design activities), "Not applicable" should be indicated in the "Scores" column. It should be noted that scoring each TQM practice should be based on evidence rather than imagination.

Note that all information in the columns "Scores" and "Strengths and Weaknesses" is the evaluation result of the case firm's TQM implementation.

Scoring Guidelines for TQM Implementation

Scores	Criterion
0	- No evidence is available.
1-2	- Little required evidence is available; - A systematic approach to the basic purposes of the practice is just beginning; - Huge gaps exist in deployment, which inhibits progress in achieving the basic purposes of the practice.
3-4	- Some required evidence is available; - A systematic approach to the basic purposes of the practice has been in use for some time; - Some areas are in the early stage of deployment.
5-6	- Much required evidence is available; - An approach is soundly based and systematic, which is responsive to the overall purposes of the practice; - The approach is developed, although deployment may vary in some areas.
7-8	- All required evidence is available; - An approach is soundly based and systematic, which is responsive to the multiple requirements of the practice; - The approach is well deployed without significant gaps.
9-10	- A sound, systematic approach, fully responsive to all the requirements of the practice is fully developed; - The approach is fully deployed without significant weaknesses in any area.

Notes: Approach refers to how a firm addresses the practice requirement(s) – the method(s) used.

Deployment refers to the extent to which a firm's approach is applied to all requirements of the practice (Malcolm Baldrige National Quality Award, 1999).

Leadership

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Top management commitment	- Pursue continuous improvement in all business activities; - Demonstrate constant commitment to the vision statement; - Demonstrate commitment to quality through actions rather than words; - Establish an organization-wide quality culture.	6	Strong Average Average Average
Top management participation	- Lead TQM implementation standing from the front; - Participate in TQM implementation personally; - Communicate with and listen to employees; - Participate in assessing TQM implementation progress.	8	Strong Strong Average Strong
Top management learning	- Accept education and training in management knowledge; - Give training lectures to employees; - Be modest enough to learn from employees.	6	Strong Average Average
Top management empowerment	- Empower employees to solve quality problems; - Empower employees to make some urgent decisions; - Manage the firm in a humanistic manner.	3	Weak Weak Average
Top management encouragement	- Encourage employee involvement in quality management activities; - Attach great importance to employees' suggestions; - Show more enthusiasm about TQM implementation; - Trust employees and believe that they can do things better; - Encourage employees to list the firm's shortcomings.	7	Strong Strong Strong Average Strong
Top management's role model	- Act as role models leading by examples; - Handle matters impartially; - Observe the firm's various rules and regulations.	7	Strong Strong Strong
Pursuit of long-term business success	- Focus on quality of products and services rather than yields; - Pursue long-term overall business performance.	4	Average Weak
Management by fact	- Make decisions based on facts rather than by imagination; - Use various pieces of information for decision-making.	6	Strong Strong

Supplier Quality Management

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Partnership with suppliers	- Work together with suppliers for mutual benefits; - Pursue long-term stable business relationships with suppliers; - Treat suppliers as partners rather than adversaries.	3	Weak Weak Weak
Supplier selection criteria	- Obtain sufficient information about suppliers or potential suppliers; - Understand suppliers' facilities and production capabilities; - Select supplier based on the quality of products and services rather than price alone.	5	Strong Strong Weak
Participation in suppliers	- Provide training for suppliers; - Participate in supplier quality improvement projects.	6	Average Average
Supplier performance evaluation	- Evaluate the performance of products and services from suppliers; - Feed back the performance of products and services to suppliers; - Rate suppliers in terms of product quality and service quality; - Have supplier performance evaluation system for measuring suppliers' performance.	7	Strong Strong Strong Strong
Supplier quality audit	- Conduct supplier quality audits regularly; - Audit suppliers' quality of products and services and quality management systems; - Audit suppliers' manufacturing facilities.	7	Strong Strong Strong
Supplier communication	- Inform suppliers of any change in design and/or production immediately; - Establish multiple channels of communication with suppliers.	8	Strong Strong

Vision and Plan Statement

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Vision statement	- Have a long-term vision statement; - Communicate the vision statement to employees; - Use the vision statement as a guide to formulate business strategies.	4	Weak Weak Weak
Quality policy	- Have a written quality policy; - Communicate the quality policy to employees; - Use the quality policy as a guide to formulate quality goals.	6	Strong Strong Strong
Overall business performance plan	- Have a long-term overall business performance plan; - Have an annual overall business performance plan; - Set up a realistic overall business performance plan scientifically.	5	Weak Average Average
Product quality goal	- Have the goal of product performance, reliability, and durability; - Have the goal of conformity rate and internal defect rate; - Have the goal of internal losses; - Have the goal of external losses; - Establish realistic quality goal indices scientifically.	6	Average Strong Strong Strong Average
Quality improvement plan	- Formulate a quality improvement plan to target major problem areas; - Implement the quality improvement plan in practice.	5	Strong Weak
Formulation of vision and plan	- Formulate the vision and plans in a holistic and cross-functional approach; - Use sufficient information to formulate the vision and plans; - Formulate the vision and plans by employees from different levels; - Make the vision, plans, and practices in a consistent manner.	6	Average Average Average Average

Evaluation

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Evaluation of strategy	- Evaluate strategies at different levels; - Adjust strategies on the basis of the evaluation.	8	Strong Strong
Evaluation of overall business performance	- Have data on employee satisfaction and evaluate employee satisfaction; - Have data on product quality and evaluate product quality; - Have data on customer satisfaction and evaluate customer satisfaction; - Have data on strategic business performance and evaluate strategic business performance; - Formulate improvement actions on the basis of evaluations.	5	Weak Strong Strong Strong Average
Evaluation of departments' performance	- Have performance criteria for different departments; - Evaluate departments' performance regularly; - Use evaluation results for improvement, recognition, and reward.	7	Strong Strong Strong
Evaluation of employee performance	- Have performance criteria for different employees; - Evaluate employee performance against set targets; - Use evaluation results for employees' education and training, recognition and reward.	8	Strong Strong Strong
Quality audit	- Conduct quality audits regularly; - Identify problem areas and formulate action plans.	8	Strong Strong
Benchmarking	- Have relevant information from competitors and best-in-class organizations; - Benchmark the competitors; - Benchmark the best-in-class firms; - Formulate improvement actions on the basis of benchmarking.	5	Average Weak Average Average
Quality costs	- Have data on internal failure costs; - Have data on external failure costs; - Have data on appraisal costs; - Have data on prevention costs; - Use such information to formulate improvement actions.	5	Strong Strong Weak Weak Average
Information system	- Have a computer-based integrated information system; - Have sufficient information in the system; - Share information among different departments; - Use the information system extensively for various business activities.	4	Weak Average Average Average

Process Control and Improvement

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Shop floor control	- Keep the shop floor neat and clean at all times; - Assign employees the responsibility of cleaning their own working areas; - Determine an appropriate temperature range and lighting intensity; - Reduce noise level and improve air quality.	5	Strong Strong Weak Weak
Process capability	- Calculate a process capability index; - Control and improve process capability; - Use the process capability index for setting realistic specification limits.	2	Weak Weak Weak
Equipment maintenance and innovation	- Have equipment maintenance and innovation plan; - Conduct breakdown equipment maintenance; - Conduct preventive equipment maintenance; - Assign employees the responsibility for daily equipment maintenance; - Innovate production equipment to meet production requirements.	5	Strong Strong Weak Strong Weak
Inventory management	- Keep the amounts of inventories as low as possible; - Keep the warehouse neat and keep inventories in good order.	7	Strong Strong
Inspection	- Conduct effective incoming, in-process, and final inspection; - Assign employees responsibilities to perform self-inspection; - Conduct sampling inspection; - Use inspection information to seek quality improvement; - Try to reduce various inspection activities.	5	Strong Strong Strong Average Weak
Use of quality tools	- Use the PDCA cycle extensively, for different activities; - Use the seven QC tools extensively; - Use the seven new QC tools extensively; - Use statistical process control extensively.	4	Average Weak Weak Weak

Product Design

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Concurrent engineering	- Establish cooperative relationships during the whole product design process; - Design products through cooperation among people from various functional departments, suppliers, or customers.	4	Weak Weak
Reliability engineering	- Set overall reliability goals; - Identify critical parts and causes of failures; - Determine solutions for increasing failure resistance.	6	Average Average Average
Designing for manufacturability	- Simplify a design by reducing total number of parts; - Make parts more producible; - Focus on modular designs.	5	Strong Average Weak
Design of experiments	- Use experimental design extensively for new product development.	0	Weak
Quality function deployment	- Have sufficient information on customer needs and expectations; - Prioritize customer needs and expectations for product design; - Transfer customer needs and expectations into product specifications.	6	Average Average Strong
Value engineering	- Analyze the contribution of different parts to product quality; - Reduce product costs without decreasing product quality.	8	Strong Strong
Computer-aided design	- Design a new product with the help of a computer.	8	Strong

Quality System Improvement

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Quality manual	- Have a quality manual; - Formulate the quality manual by people from different departments; - Get the quality manual approved by the general manager.	8	Strong Strong Strong
Quality system procedures	- Define responsibilities and authorities of different functional departments; - Solve the interface issues among different departments; - Draw up quality system procedures by people from different departments.	7	Strong Strong Strong
Work instructions	- Integrate existing work documents into work instructions; - Draw up various work instructions referring to procedures; - Formulate work instructions by people from different departments.	7	Strong Strong Strong
ISO 9000 certification	- Implement all quality system documents in practice; - Modify quality system documents through quality audits and management review; - Select a registration body for ISO 9000 certification; - Improve quality system documents continuously.	5	Weak Strong Strong Strong

Employee Participation

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Cross-functional team	- Have some cross-functional teams; - Choose team members according to their potential contributions; - Use cross-functional teams to effectively solve cross-functional problems.	8	Strong Strong Strong
Quality control (QC) circle	- Have some QC circles; - Encourage employees to participate in QC circles; - Evaluate the effects of QC circles.	0	Weak Weak Weak
Within-functional team	- Have some within-functional teams; - Choose team members according to their potential contributions; - Evaluate the effects of within-functional teams.	8	Strong Strong Strong
Information communication	- Provide sufficient information to employees by means of regular meetings, posters, newsletters, videos, and broadcasting; - Have effective information communication among different departments; - Stimulate mutual communication among people at different levels.	7	Strong Strong Average
Employee suggestions	- Have effective employee suggestion systems; - Encourage employees to submit suggestions; - Evaluate employee suggestions promptly; - Feed back evaluation results to suggestion providers; - Implement some employee suggestions after evaluation; - Provide recognition and reward for employee suggestions.	8	Strong Strong Strong Average Average Strong
Improving employee commitment	- Care for employees in job- and career-related development; - Respect and trust employees; - Encourage employees to report their own working problems.	4	Average Average Weak
Job rotation	- Rotate employee jobs regularly; - Establish internal partnerships between employees.	4	Weak Average
Workers' congress	- Hold workers' congress meetings regularly; - Discuss important issues through the workers' congress; - Approve important decisions by the workers' congress; - Supervise the behavior and conducts of management personnel.	7	Strong Strong Strong Average
Trade union	- Improve labor-management relations; - Ensure the democratic rights of employees; - Care for employees' quality of working life; - Perform duties strictly according to the Trade Union Law.	7	Strong Strong Strong Average

Recognition and Reward

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Recognition and reward program	- Have recognition and reward plan; - Have objective and measurable criteria for recognition and reward; - Get recognition and reward program approved by the workers' congress.	8	Strong Strong Strong
Working environment improvement	- Improve working environment for recognizing employees' quality improvement efforts; - Pay sufficient attention to employee well-being, safety, morale, and growth; - Reduce employees' working strengths by providing suitable equipment, devices, or tools.	5	Average Average Average
Salary promotion	- Increase employees' salaries on the basis of employees' performance; - Increase employees' salaries fairly and rationally; - Widen salary differences between employees with different skill levels and different contributions.	5	Strong Strong Weak
Bonus scheme	- Set up targets for different employees (teams, departments, or business units); - Align targets with the overall organizational objectives; - Provide more bonuses to well performing employees (teams, departments, or business units).	5	Strong Strong Weak
Position promotion	- Promote employees based on their capabilities, skills, performance, and contributions to the firm; - Appoint and remove managerial personnel (e.g., middle management and supervisors) according to the principle of equal competition, fairness, and rationality.	8	Strong Strong
Moral award	- Provide moral awards to well-performing employees by means of a thank-you note, oral praise, a letter of praise, award certification, or award ceremony; - Reward employees fairly and rationally.	8	Strong Strong
Penalty	- Have an effective penalty criterion; - Penalize employees according to the criterion; - Implement penalty scheme strictly.	9	Strong Strong Strong

Education and Training

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Education and training plan	- Have an effective education and training plan; - Formulate the education and training plan on the basis of employees' requirements and the firm's resources; - Provide sufficient resources for implementing the education and training plan.	5	Strong Average Weak
Team learning	- Arrange for skillful employees to present their working experiences; - Encourage team members to present their ideas during the process of team activities; - Share knowledge among team members.	3	Weak Weak Weak
Quality awareness education	- Provide quality awareness education to employees regularly; - Provide extensive quality awareness education to newly recruited employees.	4	Weak Weak
Training for quality management knowledge	- Train employees on understanding the philosophy of TQM; - Train employees on understanding ISO 9000; - Train employees on using the seven QC tools, the seven new QC tools, and statistical process control; - Train designers on using design tools such as experimental design.	5	Strong Strong Weak Weak
Job training	- Provide job training for employees to perform their jobs better; - Provide different training to different employees according to their actual job requirements.	5	Weak Average
Formal education promotion	- Encourage employees to follow formal promotion education programs; - Arrange new positions for employees who have finished their promotion education programs.	8	Strong Strong

Customer Focus

TQM Implementation Practices	Addressed Areas	Scores	Strengths and Weaknesses
Customer complaint information	- Establish customer complaint registration system; - Collect customer complaint information extensively; - Treat customer complaints with top priorities; - Analyze customer complaint information to formulate further improvement actions.	8	Strong Strong Strong Strong
Market investigation	- Collect information about customers' needs and expectations through market investigation; - Obtain information about customers' potential needs and expectations; - Formulate effective actions for improving quality of products and services through market investigation.	4	Weak Weak Weak
Customer satisfaction survey	- Have effective customer satisfaction measurements; - Have customer satisfaction levels on the quality of products and services; - Have customer satisfaction information on the quality of products and services from your competitors; - Use the information from customer satisfaction surveys for quality improvements.	5	Average Strong Weak Strong
Quality warranty	- Provide a quality warranty on products sold to customers.	9	Strong
Customer services	- Provide necessary assistance for customers before purchasing, during the process of purchasing, and after purchasing; - Have service standards and implement their standards strictly; - Have skillful sales and service personnel.	8	Strong Strong Strong
Customer information system	- Have an effective customer information system; - Store various data related to customers (e.g., satisfaction surveys, their needs and expectations).	6	Average Strong

2. Assessment Tool for Overall Business Performance

Due to the features of the four elements of overall business performance, it is necessary to develop different scales to measure employee satisfaction, product quality, customer satisfaction, and strategic business performance.

Note that all information in the columns "Scores", "Results", and "Strengths and Weaknesses" is the evaluation result of the case firm's overall business performance.

Employee Satisfaction

The first column lists addressed areas that may affect employee satisfaction. A number between "0" and "10" is used to score employee satisfaction level. The number "0" means that employees are extremely unsatisfied with the area and the number "10" indicates they are extremely satisfied with the area. The scores are listed in the second column. During the process of assessment, the strength or weakness of each addressed area (which is listed in the third column) should be pointed out. If the firm is neither strong nor weak in an area, "Average" should be indicated. Through conducting assessment, areas needing improvement can be identified. Such areas can be used by the firm to formulate improvement plans in order to improve employee satisfaction. Note that if some areas are not applicable to the firm, "Not applicable" should be indicated in the column "Scores". Scoring each addressed area should be based on evidence rather than imagination.

Addressed Areas	**Scores**	**Strengths and Weaknesses**
- Annual income (e.g., salary, bonus);	4	Weak
- Equity, fairness, and equal opportunities;	8	Strong
- Recognition and reward schemes;	8	Strong
- Job security;	4	Weak
- Democratic management (e.g., involvement in setting the firm's policies, strategies, and plans);	6	Average
- Leadership style and ability;	6	Average
- Top managers' and supervisors' conduct;	6	Average
- Relationships with top managers and supervisors;	6	Average
- Relationships with coworkers;	7	Strong
- Promotion opportunities;	7	Strong
- Nature of jobs (e.g., work loads, job content);	7	Strong
- Career development (e.g., training, retraining, and target setting);	5	Average
- Working conditions (e.g., safety, noise, and pollution).	5	Average

Product Quality

The first way to measure product quality is to compare a firm's own product quality with that of other firms in the same industrial sector in China (see the first table). Each area can be measured by a number between "0" and "10". The number "0" means that this area is the worst compared with other firms within the same industrial sector in China, and the number "10" means that this area is the best in this comparison. Thus, information from other firms is essential to the comparative assessment. Of course, the firm should have its own data concerning these addressed areas; otherwise, the assessment is impossible. Even if the firm does not have external data, it can assess its product quality based on its own data over the past several years. This is the second way to assess the firm's product quality (see the second table). Through conducting assessment, areas needing improvement can be identified. Such identified areas can be used by the firm to formulate improvement plans. Note that if some areas are not applicable to the firm, "Not applicable" should be indicated in the column "Scores" or "Results". The first table measures relative product quality and the second table measures the firm's actual product quality.

Relative Product Quality

Addressed Areas	**Scores**	**Strengths and Weaknesses**
- Performance;	8	Strong
- Reliability;	8	Strong
- Durability;	8	Strong
- Conformity rates (finished products);	10	Strong
- *Internal defect rates (during manufacturing process);*	8	Strong
- *Internal failure costs as a percentage of annual output value;*	8	Strong
- *External failure costs as a percentage of annual sales (e.g., warranty costs and claims costs).*	8	Strong

Note: The three addressed areas in italics are not used for assessing customer satisfaction.

Actual Product Quality

Addressed Areas	**Results 1996**	**Results 1997**	**Results 1998**	**Results 1999**	**Strengths and Weaknesses**
- Performance;	*	*	*	*	Strong
- Reliability;	*	*	*	*	Strong
- Durability;	*	*	*	*	Strong
- Conformity rates (finished products);	100%	100%	100%	100%	Strong
- *Internal defect rates (during manufacturing process);*	0.40%[1] 5.0%[2]	0.20%[1] 5.1%[2]	0.19%[1] 4.4%[2]	0.09%[1] 4.1%[2]	Strong Strong
- *Internal failure costs as a percentage of annual output value;*	0.258%	0.136%	0.125%	0.086%	Strong
- *External failure costs as a percentage of annual sales (e.g., warranty costs and claims costs).*	1.040%	0.773%	0.588%	0.554%	Weak

Notes: 1 - These figures are internal defect rates for processing parts.
2 - These figures are internal defect rates for casting iron.
* - This symbol means that these three areas are stipulated in the product standard.

Customer Satisfaction

There are two dimensions that affect customer satisfaction: Product quality and service quality, which are listed in the first column. The second column lists the specific addressed areas. To measure customer satisfaction, a number between "0" and "10" is used to score customer satisfaction level. The number "0" means that customers are extremely unsatisfied and the number "10" indicates that they are extremely satisfied. The scores are listed in the third column. During the process of assessment, the strength and weakness of each addressed area (listed in the fourth column) should be pointed out. If the firm is neither strong nor weak in an area, "Average" should be indicated. Through conducting assessment, areas needing to be improved can be identified. Such identified areas can be used by the firm to formulate improvement plans. Note that if some areas are not applicable to the firm, "Not applicable" should be indicated in the column of "Scores". Scoring each addressed area should be based on evidence from customers rather than imagination. Three addressed areas (in italics, Section 7.4.2) for measuring product quality are not used for measuring customer satisfaction since they generally do not affect customer satisfaction.

Dimensions	**Addressed Areas**	**Scores**	**Strengths and Weaknesses**
Product quality	- Performance;	8	Strong
	- Reliability;	4	Weak
	- Durability;	9	Strong
	- Conformity rates (finished products).	9	Strong
Service quality	- Delivery (e.g., on-time delivery, delivery frequency, lead time);	7	Strong
	- Complaints (e.g., complaint response time, effective resolution, time to resolve complaints, percent of complaints resolved on first contact, complaint levels, total number of complaints);	8	Strong
	- Warranty and guarantee provisions;	9	Strong
	- Support (sales support, technical support, product training, spare part availability);	8	Strong
	- Transportation (e.g., logistics information, packing for delivery).	5	Weak

Strategic Business Performance

For measuring strategic business performance, the addressed areas are listed in the first column. The results are listed in the second to fifth columns. The strengths and weaknesses are listed in the sixth column. Concerning the results of strategic business performance, the data should be available for at least four years. Of course, it is much better to have more data on strategic business performance from a long time period.

Addressed Areas	**Results 1996**	**Results 1997**	**Results1 998**	**Results 1999**	**Strengths and Weaknesses**
- Annual sales (million yuan);	47.13	67.32	68.48	53.15	Weak
- Annual sales growth;	-19.9%	42.8%	1.7%	-22.4%	Weak
- Profits (million yuan);	1.2	1.3	1.0	0.5	Weak
- Market share;	25.6%	31.5%	35.92%	38.2%	Strong
- Exports (million yuan).	4.81	6.19	4.35	0.88	Weak

Note: Market share was calculated by the firm's output volumes divided by the total of output volumes in Liaoning Province.

Appendix 6 A List of the Major Interviewees in the Case Firm

Interviewees' working units	Positions
Top Management Team	Deputy general manager
Exporting Department	Manager
Planning Department	Economist
Management Department	Manager
Management Department	Engineer
Quality Management Department	Engineer
Production Department	Manager
Production Department	Production coordinator inside the firm
Production Department	Production coordinator outside the firm
R&D Department	Assistant manager
R&D Department	Engineer
R&D Department	Computer expert
Personnel and Education Department	Personnel manager
Personnel and Education Department	Salary manager
Users' Service Department	Manager
Purchasing Department	Deputy manager
Technology Department	Deputy manager
Technology Department	Engineer
Sales Department	Salesman
Quality Inspection Department	Inspection planner
Quality Inspection Department	Inspectors
Trade Union	Chairman
Trade Union	Deputy chairman
Auditing Department	Lawyer
Equipment & Power Department	Manager
Speed Reductor Workshop	Manager
Speed Reductor Workshop	Deputy manager
Speed Reductor Workshop	Planner
Speed Reductor Workshop	Production coordinator
Speed Reductor Workshop	Operators

Note: In order to conduct the case study conveniently the firm arranged a coordinator, who worked in the Exporting Department. For the reason of anonymity, the names of these interviewees are not presented here.

A List of Abbreviations

ACSI:	The American Customer Satisfaction Index
AGFI:	Adjusted goodness-of-fit index
CAD:	Computer-aided design
CSB:	The Customer Satisfaction Barometer
GFI:	Goodness-of-fit index
GLS:	Generalized least squares
ISO:	International Organization for Standardization
ISO 9000:	ISO 9000 series standards include three basic standards (ISO 9001, ISO 9002, and ISO 9003), which can be used in third party certification of quality management systems.
JDI:	The Job Descriptive Index
JDS:	The Job Diagnostic Survey
JIG:	The Job in General Scale
JSS:	The Job Satisfaction Survey
LISREL:	Structural equation modeling is simply known as LISREL analysis, which is the name of one of the more popular software packages.
ML:	Maximum likelihood
MOAQ:	The Michigan Organization Assessment Questionnaire Subscale
MSQ:	The Minnesota Satisfaction Questionnaire
PDCA:	Plan, do, check, and act.
PRELIS:	A preprocessor for LISREL - A program for multivariate data screening and data summarization
QC:	Quality control
QFD:	Quality function deployment
R&D:	Research and development
RMB:	The Chinese currency unit. USD 1 is approximately RMB 8.3.
RMR:	Root mean square residual
RMSEA:	Root mean square error
SPC:	Statistical process control
SPSS:	Statistical Packages for the Social Sciences
TQM:	Total quality management
WLS:	Generally weighted least squares

Samenvatting

Op het gebied van Total Quality Management is wereldwijd nogal wat verwarring ontstaan, met name waar het gaat om de exacte betekenis van het TQM-concept en de effecten van invoering van TQM. Er is vrij veel onderzoek verricht naar het TQM-concept. Daarbij hanteerden diverse onderzoekers vaak verschillende definities van TQM, waardoor TQM niet voor iedereen dezelfde betekenis heeft. Ook met betrekking tot de effecten van invoering van TQM komen verschillende onderzoekers tot verschillende onderzoeksresultaten. Een aantal onderzoekers concludeert dat invoering van TQM invloed heeft op de bedrijfsprestaties van de onderneming, terwijl anderen van mening zijn dat de invoering van TQM niet leidt tot verbetering van de bedrijfsprestaties. Over de effecten van de invoering van TQM zijn tegenstrijdige onderzoeksresultaten gepubliceerd. Ook voor Chinese productiebedrijven geldt dat tegenstrijdige resultaten werden gevonden met betrekking tot de effecten van de invoering van TQM op de bedrijfsresultaten. Uit een studie van de literatuur over de invoering van TQM in Chinese productiebedrijven blijkt zeer duidelijk dat er geen grootschalig systematisch empirisch onderzoek is verricht naar de effecten van invoering van TQM op de algemene bedrijfsprestaties. Ook is geen onderzoek verricht met het doel een invoeringsmodel te ontwikkelen dat Chinese productiebedrijven kunnen gebruiken om het TQM-invoeringsproces in hun bedrijf te verbeteren. Door het gebrek aan bruikbare richtlijnen ter ondersteuning van de TQM-invoering, is in China een aantal pogingen TQM in te voeren mislukt. De voornaamste doelstellingen van dit onderzoek luiden dan ook als volgt:

- de effecten vast te stellen van de invoering van TQM op de algemene bedrijfsprestaties van Chinese productiebedrijven;
- een model te ontwikkelen voor de invoering van TQM in Chinese productiebedrijven.

Om deze twee onderzoeksdoelen te bereiken, werden de volgende vijf onderzoeksvragen geformuleerd:

- *Wat is TQM?*
- *Wat wordt bedoeld met 'algemene bedrijfsprestaties' in het kader van TQM?*
- *Wat zijn de effecten van de invoering van TQM op de algemene bedrijfsprestaties van Chinese productiebedrijven?*
- *Welk model kan worden ontwikkeld voor de invoering van TQM om Chinese productiebedrijven te helpen bij de invoering van TQM?*
- *Hoe kan dit invoeringsmodel in de praktijk worden gedemonstreerd?*

Dit onderzoek werd gestart met een uitgebreid TQM-literatuuronderzoek aan de hand van publicaties van "kwaliteitsgoeroes" (Deming, Juran, Crosby, Feigenbaum en Ishikawa), drie modellen voor kwaliteitsonderscheidingen (de Deming Prize, de European Quality Award en de Amerikaanse Malcolm Baldridge National Quality Award), en van andere onderzoekers die werkzaam zijn op het gebied van TQM. Aan de hand daarvan is het concept van TQM zoals dat in dit onderzoek wordt gehanteerd, als volgt gedefinieerd: een managementfilosofie gericht op voortdurende verbetering van algemene bedrijfsprestaties

op basis van leiderschap, kwaliteitsmanagement van leveranciers, vastlegging van visie en planning, evaluatie, procesbeheersing en -verbetering, productontwerp, verbetering van het kwaliteitssysteem, werknemersparticipatie, erkenning en beloning, opleiding en training, en klantgerichtheid. Daarmee bestaat TQM in deze studie uit 11 constructen. Invoering van TQM houdt in: invoering van deze 11 constructen aan de hand van een verzameling werkwijzen, zoals het gebruik van relevante hulpmiddelen of technieken. Het uitgebreide TQM-literatuuronderzoek biedt een solide basis voor de uitvoering van deze studie.

Het literatuuronderzoek over algemene bedrijfsprestaties in het kader van TQM heeft uitgewezen dat door ondernemingen zelf vier constructen van algemene bedrijfsprestaties belangrijk worden gevonden: werknemerstevredenheid, productkwaliteit, klanttevredenheid en strategische bedrijfsprestaties (jaaromzet, omzetgroei, winst, marktaandeel en export). Zodoende werd een model voor de invoering van TQM en algemene bedrijfsprestaties geformuleerd op basis van bestaande onderzoeksresultaten. Dit model bestaat uit negen hypothesen. TQM-invoering is een onafhankelijke variabele en de vier constructen van algemene bedrijfsprestaties zijn afhankelijke variabelen. TQM-invoering is de combinatie van de 11 constructen. De onderlinge verbanden tussen TQM-invoering en werknemerstevredenheid, productiekwaliteit, klanttevredenheid en strategische bedrijfsprestaties zijn geïntegreerd in één model. Teneinde de effecten van de 11 verschillende TQM-constructen te onderzoeken, is daarnaast op basis van de bestaande onderzoeksresultaten een model ontwikkeld voor de constructen van TQM-invoering en algemene bedrijfsprestaties. In dit model zijn de 11 constructen van TQM-invoering onafhankelijke variabelen. De vier constructen van algemene bedrijfsprestaties zijn afhankelijke variabelen. Dit model bestaat uit 17 hypothesen. De verbanden tussen de 11 constructen voor TQM-invoering en de vier constructen voor algemene bedrijfsprestaties zijn in één model geïntegreerd. Om de twee theoretische modellen waarvoor in deze studie hypothesen worden gepresenteerd empirisch te testen, werd de operationalisering van de 11 constructen van TQM-invoering en de vier constructen van algemene bedrijfsprestaties uitgevoerd op basis van literatuuronderzoek, bestaande meetinstrumenten, en de specifieke eigenschappen van de Chinese productiebedrijven. Ten slotte werden voor het meten van TQM-invoering, werknemerstevredenheid, productkwaliteit, klanttevredenheid en strategische bedrijfsprestaties respectievelijk 79, 1, 7, 2 en 5 vragen ontwikkeld.

Om de onderzoeksdoelstellingen te bereiken en de onderzoeksvragen te beantwoorden, werden de volgende onderzoeksstrategieën voor het verzamelen van gegevens toegepast: onderzoek aan de hand van een questionnaire, gestructureerde interviews en een case study. Drie provinciale overheidsinstanties van de provincie Liaoning en de Liaoning Provincial Quality Control Association verstuurden 900 vragenlijsten naar 900 productiebedrijven in de provincie Liaoning, China. Alleen productiebedrijven met een jaaromzet van meer dan RMB 10 miljoen werd een vragenlijst toegestuurd. Deze 900 bedrijven werden willekeurig geselecteerd uit 2.929 bedrijven met een jaaromzet van meer dan RMB 10 miljoen in 1997. Uiteindelijk werden 212 vragenlijsten geretourneerd, waarmee de respons ongeveer 23 procent bedroeg. De gegevens die met de vragenlijst werden verzameld, werden voornamelijk gebruikt om de twee modellen die in dit onderzoek worden gepresenteerd te testen. Er werden tien gestructureerde interviews afgenomen in tien verschillende productiebedrijven. De gegevens die met deze tien interviews werden verkregen, werden gebruikt voor de ontwikkeling van het TQM-invoeringsmodel, en om de bevindingen van de enquête te interpreteren. De case study werd in een machinefabriek in staatseigendom

uitgevoerd, om te demonstreren hoe dit TQM-invoeringsmodel in de praktijk kan worden gebruikt. Voor dit onderzoek werden om praktische redenen alleen bedrijven uit de provincie Liaoning geselecteerd.

Om de twee theoretische modellen empirisch te kunnen testen, werden de twee meetinstrumenten waarmee de invoering van TQM en de algemene bedrijfsprestaties van de Chinese productiebedrijven worden gemeten op betrouwbaarheid en validiteit beoordeeld. Het model kan namelijk alleen worden beproefd met behulp van betrouwbare en valide meetinstrumenten. De meetinstrumenten werden empirisch beoordeeld aan de hand van de gegevens van de 212 Chinese productiebedrijven. Voor deze beoordeling werden een betrouwbaarheidsanalyse (interne consistentheid), een vragenanalyse en een validiteitsanalyse (deelaspect-analyse) gebruikt. De eindconclusie luidde dat de instrumenten waarmee TQM-invoering en de algemene bedrijfsprestaties werden gemeten, betrouwbaar en valide zijn. De gegevens die met deze twee instrumenten werden verkregen, kunnen inderdaad worden gebruikt om de twee theoretische modellen die in deze studie worden gepresenteerd te testen. Daarbij wordt opgemerkt dat na de beoordeling één vraag voor de TQM-invoering werd geschrapt, zodat 78 vragen werden gebruikt om de TQM-invoering te meten.

De gegevens van 212 Chinese productiebedrijven werden gebruikt om de twee theoretische modellen te testen. Voor de analyse van de gegevens werd de LISREL-techniek gebruikt. Als invoermatrix voor LISREL werd de Pearson-correlatiematrix gebruikt. Als schattingsmethode voor het model werd de methode van maximum likelihood toegepast. Er werden eenzijdige significantieniveaus gebruikt voor een schatting van de fit van het structurele model. De Chi-kwadraat, de goodness-of-fit-index, de bijgestelde goodness-of-fit-index, de gemiddelde kwadratische benaderingsfout (root mean square error of approximation) en de residuele kwadratensom (root mean square residual) werden geselecteerd voor een schatting van de algemene fit van het model. Enkele hypothesen die als onderdeel van de twee modellen werden geformuleerd, worden niet door de gegevens bevestigd. De resultaten die met de tien gestructureerde interviews werden verkregen, werden gebruikt om de onderzoeksresultaten die met de enquête werden verkregen te interpreteren. Uit de bevindingen van de enquête komen enkele praktische overwegingen naar voren. Ten eerste heeft invoering van TQM een positief effect op de algemene bedrijfsprestaties, en is de invoering van TQM inderdaad lonend. Ten tweede is leiderschap een beslissende factor voor het succes van de algemene bedrijfsprestaties in een organisatie. Met andere woorden, zonder goed leiderschap is het onmogelijk voor het bedrijf om goede algemene bedrijfsprestaties te realiseren. Ten derde impliceren de resultaten dat niet noodzakelijkerwijs alle TQM-elementen aanwezig hoeven te zijn om het succes van een TQM-programma en de algemene bedrijfsprestaties te garanderen. Met andere woorden, zelfs als enkele van de elementen niet aanwezig zijn is het nog steeds mogelijk het vereiste niveau van algemene bedrijfsprestaties te bereiken. Ten slotte werden in deze studie diverse hypothesen niet bevestigd door de resultaten van de enquête. Het uitblijven van bevestiging houdt echter niet in dat de constructen onbelangrijk of nutteloos zijn; bedrijven doen er goed aan de probleemgebieden voor deze constructen te identificeren om deze constructen effectiever te kunnen invoeren.

Op basis van de bestaande TQM-literatuur, de tien gestructureerde interviews en de bevindingen van de enquête werd een TQM-invoeringsmodel voor de Chinese

productiebedrijven ontwikkeld. Het TQM-invoeringsmodel bestaat uit een TQM-raamwerk, een verzameling werkwijzen voor de invoering, een verzameling indicators voor algemene bedrijfsprestaties, een proces voor het gebruik van dit model in de praktijk, en praktische richtlijnen om gebruikers van het model te helpen de TQM-invoering zo effectief mogelijk te plannen. Dit model geeft aan dat de gecombineerde toepassing van deze TQM-werkwijzen tot verbetering van de algemene bedrijfsprestaties kan leiden. Daarbij moet worden opgemerkt dat niet eenduidig 'de beste' methode voor invoering van het model kan worden aangegeven. Bedrijven verschillen nu eenmaal waar het gaat om mensen, cultuur, geschiedenis, doelen, structuur, producten, diensten, technologieën, processen en bedrijfsomstandigheden. Ondernemingen moeten daarom hun eigen unieke kenmerken in dit model inbrengen, waarna ze hun eigen methoden kunnen ontwikkelen voor het behalen van goede prestaties. Zodoende kunnen bedrijven het gebruik van dit model optimaliseren door diverse elementen ervan te combineren en op hun eigen situatie toe te passen. Daarbij kunnen hun eigen methoden beter zijn toegesneden op hun specifieke situatie. De invoering van TQM is een doorlopend proces. Investeren in de invoering van TQM houdt vaak een keuze in voor een inspanning op lange termijn die veel energie, aandacht van het management, financiële middelen, geduld en vasthoudendheid vereist. Hoewel het model aanvankelijk werd ontwikkeld voor productiebedrijven in China, kunnen ondernemingen in andere landen dit model als referentie gebruiken, omdat bij de ontwikkeling van dit model veel reeds bestaande kennis over kwaliteitsmanagement is toegepast. Hoewel veel van deze principes en werkwijzen dan ook op ondernemingen in andere landen van toepassing kunnen zijn, gelden enkele werkwijzen in het bijzonder voor Chinese productiebedrijven, en wellicht juist minder voor bedrijven in andere landen. Daarbij moet worden opgemerkt dat er met betrekking tot eigendom vele verschillende soorten bedrijven bestaan in China. Ook opereren verschillende bedrijven in verschillende bedrijfstakken. Sommige werkwijzen die in het model worden gepresenteerd zijn niet van toepassing op alle typen bedrijven in China. Chinese bedrijven zullen dan ook sommige werkwijzen aan hun specifieke wensen en behoeften moeten aanpassen. Hoewel het model aanvankelijk werd ontworpen voor Chinese productiebedrijven, is het te hopen dat het ook kan worden gebruikt in dienstverlenende organisaties en overheidsinstellingen in China. De basisfilosofie achter TQM is namelijk toepasbaar op elk type organisatie. Het is niet verrassend dat sommige principes en werkwijzen die in dit model worden beschreven essentieel zijn voor het succes van een organisatie. Maar dat betekent niet dat deze principes en werkwijzen een wondermiddel zijn, of kunnen worden ingevoerd zonder rekening te houden met specifieke omstandigheden en kenmerken.

Om een voorbeeld te kunnen geven van het gebruik van dit invoeringsmodel in de praktijk, werd een case study uitgevoerd in een Chinees staatsbedrijf, een machinefabriek. De huidige TQM-invoering en de algemene bedrijfsprestaties werden vergeleken met het TQM-invoeringsmodel. De sterke en zwakke punten van de invoering van TQM in het bedrijf en de algemene bedrijfsprestaties werden geïdentificeerd. Op basis van de zwakke punten werd een plan voor verbetering opgesteld. Ten slotte kon worden geconcludeerd dat het TQM-invoeringsmodel zoals dat in dit onderzoek is ontwikkeld inderdaad in de praktijk kan worden toegepast; Chinese productiebedrijven kunnen het model gebruiken in verschillende stadia van de TQM-invoering. Voor Chinese productiebedrijven die TQM invoeren of reeds een TQM-proces hebben ingevoerd, kan het model aanvullende ideeën aanreiken voor verbetering van hun inspanningen op het gebied van TQM. Voor bedrijven die van plan zijn een TQM-proces te starten, kan het model gedetailleerde informatie

bieden over de elementen van TQM, de werkwijzen voor de invoering van TQM en indicators voor algemene bedrijfsprestaties. Voor bedrijven die nog niet hebben besloten of ze TQM gaan invoeren, kan het model informatie leveren over de specifieke voordelen van een aantal TQM-werkwijzen, hetgeen tot een positief besluit voor de invoering van TQM kan leiden.

Ten slotte moet dit onderzoek worden beoordeeld aan de hand van de vijf onderzoeksvragen. De eerste onderzoeksvraag "Wat is TQM" werd beantwoord op basis van een uitgebreid literatuuronderzoek. Het gedefinieerde concept van TQM werd in alle stadia van het onderzoek toegepast, zodat een solide basis werd gelegd voor de uitvoering van dit onderzoek. De tweede onderzoeksvraag "Wat wordt bedoeld met 'algemene bedrijfsprestaties' in het kader van TQM?" werd ook beantwoord op basis van het intensieve literatuuronderzoek. De derde onderzoeksvraag "Wat zijn de effecten van de invoering van TQM op de algemene bedrijfsprestaties van Chinese productiebedrijven?" werd beantwoord aan de hand van de gegevens van 212 Chinese productiebedrijven in de provincie Liaoning. De effecten van de invoering van TQM en de effecten van verschillende TQM-constructen werden geïdentificeerd. De vierde onderzoeksvraag "Welk model kan worden ontwikkeld voor de invoering van TQM om Chinese productiebedrijven te helpen bij de invoering van TQM?" werd beantwoord met de ontwikkeling van een model voor de invoering van TQM, waarin bestaande TQM-theorie, de bevindingen van de enquête en de tien gestructureerde interviews in Chinese productiebedrijven werden verwerkt. De vijfde onderzoeksvraag "Hoe kan dit invoeringsmodel in de praktijk worden gedemonstreerd?" werd beantwoord met de uitvoering van een case study in een Chinese machinefabriek. Uit deze case study bleek dat het model voor de invoering van TQM dat in dit onderzoek werd ontwikkeld, toepasbaar is op dit typisch Chinese productiebedrijven. Samenvattend kan worden gesteld dat de vijf onderzoeksvragen werden beantwoord en de twee doelstellingen met de uitvoering van dit onderzoek werden bereikt.

Conclusies

Uit dit onderzoek kan een aantal conclusies worden getrokken, waarmee kan worden beschreven hoe de theorie van kwaliteitsmanagement zich verhoudt tot de praktijk in Chinese productiebedrijven.

Ten eerste zijn de instrumenten voor het meten van TQM-invoering en algemene bedrijfsprestaties betrouwbaar en valide; ze kunnen door andere onderzoekers worden gebruikt om de effecten van TQM-invoering op de algemene bedrijfsprestaties te testen. Deze betrouwbare en valide instrumenten kunnen ook worden gebruikt voor het beoordelen van de tijdsfactor bij de invoering van TQM.

Ten tweede kan een aantal conclusies worden getrokken uit de beproeving van de twee theoretische modellen, die als volgt worden omschreven: (1) De invoering van TQM heeft een positief effect op werknemerstevredenheid, productkwaliteit, klanttevredenheid en strategische bedrijfsprestaties. (2) Leiderschap heeft een positieve invloed op werknemerstevredenheid en strategische bedrijfsprestaties. (3) Werknemersparticipatie, erkenning en beloning hebben een positieve invloed op werknemerstevredenheid. (4) Opleiding en training hebben geen positief effect op werknemerstevredenheid. (5) Kwaliteitsmanagement bij leveranciers, evaluatie, productontwerp en verbetering van het kwaliteitssysteem hebben geen positieve invloed op de productkwaliteit. (6) Vaststelling

van visie en planning, procesbeheersing en –verbetering hebben een positieve invloed op de productkwaliteit. (7) Verbetering van het kwaliteitssysteem heeft een positief effect op de strategische bedrijfsprestaties. (8) Klantgericht werken heeft een positieve invloed op de klanttevredenheid. (9) Werknemerstevredenheid heeft een positieve invloed op de productkwaliteit en de klanttevredenheid. (10) Productkwaliteit heeft een positieve invloed op de klanttevredenheid en de strategische bedrijfsprestaties. (11) Klanttevredenheid heeft geen positief effect op de strategische bedrijfsprestaties.

Ten derde blijkt uit de case study dat het invoeringsmodel voor TQM dat in dit onderzoek is ontwikkeld, in de praktijk kan worden toegepast. Het model kan door Chinese productiebedrijven worden gebruikt om hun inspanningen voor de invoering van TQM te verbeteren. Verder geeft de case study aan dat bedrijven dit invoeringsmodel kunnen gebruiken voor een interne, eigen beoordeling van hun inspanningen op het gebied van kwaliteitsverbetering en voor meting van de voortgang na verloop van tijd. Met behulp van dit model kunnen bedrijven snel bepalen welke aspecten dringend verbetering behoeven. Zodoende kunnen de beschikbare bronnen zorgvuldiger worden aangewend en kunnen effectievere plannen voor verbetering worden geformuleerd.

Evaluatie van het onderzoek

Het onderzoek is afgerond. Dit onderzoek moet worden beoordeeld tegen het licht van de beperkingen ervan. Ten eerste zijn de gegevens aan de hand waarvan de theoretische modellen werden getest afkomstig van slechts 212 productiebedrijven, met een jaaromzet van meer dan RMB 10 miljoen in de provincie Liaoning. Een van de mogelijke nadelen is de relatief hoge graad van inzet voor kwaliteit bij deze bedrijven. In het bijzonder waren de varianties voor de variabelen gereduceerd. Strikt gesproken is de generalisatiegraad beperkt. Ten tweede is vooral de maat voor gepercipieerde werknemerstevredenheid relatief zwak, omdat respondenten werd gevraagd hun algemene perceptie van de werknemerstevredenheid in hun eigen bedrijf weer te geven. Vanwege de secundaire aard van de gegevens kan niet worden geconcludeerd dat alternatieve bronnen gelijkwaardig zijn aan rechtstreekse vragen aan werknemers omtrent hun mate van tevredenheid. Hierdoor kunnen de bevindingen tot op zekere hoogte een vertekend beeld geven. Ten derde werden gegevens over klanttevredenheid van respondenten verkregen, en niet van klanten. Vanwege de secundaire aard van de gegevens over klanttevredenheid die in dit onderzoek werden gebruikt, zijn de gegevens mogelijk niet erg betrouwbaar, waardoor ook in dit geval de onderzoeksbevindingen een vertekend beeld kunnen geven. Ten slotte kan een zwak punt in dit onderzoek worden aangeduid met betrekking tot de common method variance. Voor elk responderend bedrijf werd de vragenlijst slechts door één persoon ingevuld.

Een verkennend onderzoek als dit kan aanbevelingen opleveren voor toekomstig onderzoek naar de kwesties die in dit onderzoek worden aangesneden. Op basis van de bevindingen van dit onderzoek kan toekomstig onderzoek op een relatief hoger kennisniveau worden ingezet. In de eerste plaats zou herhaling van dit onderzoek nuttig zijn met het oog op een hernieuwde beoordeling van de validiteit van de bevindingen. Verder empirisch onderzoek, met omvangrijker steekproeven, een grotere geografische diversiteit en meer diversiteit in bedrijfstypen, zou nuttig kunnen zijn voor de validering van specifieke onderdelen van de theoretische modellen die in dit onderzoek worden voorgesteld. Ten tweede zou aanvullend onderzoek zich moeten richten op de ontwikkeling van meer valide en betrouwbare werkdefinities voor de voorgestelde constructen, om tegenwicht te geven aan de

beperkingen die de gegevensbron voor dit onderzoek met zich meebrengt. Er zouden bijvoorbeeld meer categorieën kunnen worden vastgesteld voor de waardering van de antwoorden over strategische bedrijfsprestaties. De gegevens over werknemerstevredenheid en klanttevredenheid zouden respectievelijk van werknemers en van klanten moeten worden verkregen in plaats van respondenten zoals in dit onderzoek. Ten derde zouden de relaties die bij dit onderzoek werden aangetroffen in verschillende landen moeten worden onderzocht, om te kunnen bepalen of deze zich in vergelijkbare of in verschillende richtingen ontwikkelen. Ten vierde zou een serie lange-termijnstudies zeer waardevol zijn om de tijdsdimensie van TQM-invoering te bestuderen. Ten vijfde kunnen meer gestructureerde interviews in verschillende typen Chinese productiebedrijven worden afgenomen, teneinde het TQM-invoeringsmodel voortdurend te verbeteren. Daardoor zou het TQM-invoeringsmodel beter kunnen voldoen aan de vereisten van verschillende industriële branches in China. Ten zesde zou een diepgaande case study in een Chinees bedrijf kunnen worden uitgevoerd om meer inzicht te verkrijgen in het gebruik van het invoeringsmodel in de praktijk. Ten slotte zou men kunnen bestuderen in hoeverre en op welke manier de invoering van TQM in het bedrijf wordt beïnvloed door de externe omgeving.

Curriculum Vitae

Zhihai Zhang was born on 12 December 1963 in a small village in Liaoning Province, the People's Republic of China. In 1981, he enrolled in the Department of Agricultural Engineering at Shenyang Agricultural University. In 1985, he finished his undergraduate studies and obtained a Bachelor Degree in engineering. The same year he continued to pursue postgraduate studies, in the same department. In 1988, he obtained a Master Degree in engineering. After graduation, he worked as a deputy departmental manager in the Liaoning Provincial Township Enterprises (Group) Corporation for three years. He then worked as a quality management consultant (engineer, governmental official) at the Technology and Quality Department of the Liaoning Provincial Township Enterprises Management Institute, which is a provincial governmental agency of the Liaoning Provincial People's Government. Between June and September 1993, he was sent by the Chinese government to Japan to systematically study Japanese TQM implementation and standardization activities. In September 1995, he came to the Faculty of Management and Organization at the University of Groningen in the Netherlands as a visiting scholar through the cultural exchange program between the Chinese and Dutch governments. In March 1997, he became a PhD candidate at this faculty. His research has focused on TQM, ISO 9000, product design, production management, and technology innovation. During the period of his PhD study he published a number of papers, which are listed as follows:

1. Zhang, Z.H. (1997a), Quality management efforts in China: State supervision and inspection of product quality, *SOM Research Report*, 970A20, University of Groningen, The Netherlands.
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