

TQM in Taiwan's computer and its peripheral industry

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Abstract

Total quality management (TQM) has been widely brought into action to improve the business's essence in industries. In Taiwan, the computer and its peripheral industry is becoming a real global business. Most of the companies are buying and selling goods and services all through the world's business community. The current progress toward TQM is one of the most noteworthy changes in Taiwan's computer and its peripheral industry. Uses questionnaires to survey the implementation issues of TQM in the computer and its peripheral industry in Taiwan. A total of 40 companies responded to the questionnaires in the survey. Observing the survey results, the quality performances of most Taiwan's computer and its peripheral companies are still vulnerable. Meanwhile, the training programs of related quality management techniques need further conduct to improve the quality management system.

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Introduction

The current progress toward quality awareness is one of the most noteworthy changes in international commerce. It is important to note that today less than 40 percent of the Taiwan workforce is involved in manufacturing. This fact reflects substantial improvements in productivity, and the computer and its peripheral industry has both contributed to and benefited from the increased efficiencies. Computer technology is pervasive in modern society, and the computer and its peripheral industry is vital to our economic progress. Since 1995, Taiwan's computer and its peripheral industry has been the third biggest one all over the world according to Taiwan Economic Research Institute's projection. Some products of this industry even dominate the global market. However, the global competition continues to escalate, particularly in the computer and its peripheral industry. Moreover, 90 percent of the computer related products manufactured in Taiwan are exported to the global business community. Scarce resources, fierce global competition and rapid technological advancement in the computer and its peripheral industry require continuous improvement in quality. Total quality management (TQM) promotes rapid development of high quality and low cost products through close cooperation among quality management disciplines.

The computer and its peripheral industry has truly become global in nature. Consumer demands for higher quality and lower cost products are creating opportunities for Taiwan's world-class companies to gain market share. Quality management is an essential part of internal corporate policy that not only determines product quality, but

also impacts on the corporation's future development. Therefore, all companies invest substantial effort into quality improvement to strengthen their competitive advantage. Ways to improve quality range from quality monitoring in the early days to most recent TQM. The quality management system develops a management style that satisfies customer needs. Even though an abundance of research in TQM has been conducted in the past, relatively little attention has been paid to investigating implementation of TQM in Taiwan's industry. This paper aims to fill this gap through four hypotheses.

The objective of this survey is to promote TQM in the computer and its peripheral industry by presenting some practical findings and suggestions for manufacturers of this industry in Taiwan. Comprehensive analysis will be followed by the discussion of TQM theory. Two issues are analyzed:

- 1 Detail the current use of TQM in the Taiwan's computer and its peripheral industry.
- 2 Explain the correlation between the implementation of TQM and quality performance in Taiwan's computer and its peripheral industry.

Literature review

TQM has received widespread attention from both researchers and practitioners since it has become an essential part of manufacturing and service organizations. Although TQM has been extensively studied, a universally accepted definition does not exist. According to the Department of Defense (1989), TQM integrates human resources and scientific methods to continuously improve an organization. Therefore, TQM can be viewed as a management operation philosophy.

Oakland (1994) defines TQM as "an approach to improving effectiveness and flexibility of business as a whole. It is an essential way of organizing and involving the

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whole organization, every department, every activity, every person at every level.” Most researchers believe that TQM emphasizes leadership, customer satisfaction, employee involvement, continuous improvement, supplier partnership and performance measures. Huq and Stolen (1998) developed a theoretical framework consisting of 19 key TQM dimensions by extending the suggestions made by the quality sages Crosby, Deming, Feigenbaum, Ishikawa, Juran and Taguchi. Their analysis confirmed the hypotheses on the management, control and implementation dimensions of TQM in manufacturing and service companies.

Several recent studies have examined TQM implementation. For instance, Chen and Lu (1998) identified Taiwan's cultural issues, particularly Confucian tenets, as important factors in the implementation of TQM in a single local company. Gunasekaran (1999) presented a framework for TQM implementation based on TQM implementation issues in a gas turbine company. Based on the literature and case experience, a framework for the implementation of TQM is presented. Krasachol and Tannock (1999) used case-study analysis to investigate how three Thai companies adopted TQM. Sun (1999) revealed that the components of a TQM program might vary from country to country. His study discovered that the TQM enablers such as quality leadership, human resource development, and quality information enhance customer satisfaction and business performance. However, none of these TQM enablers can guarantee better results. Sun's study also found that most of the sampled companies have not yet fully implemented TQM and it will be a long journey for them to continue the implementation. Longo and Cox (2000) investigated managers' perceptions of the TQM programs applied in their organizations. Interviews were conducted with the managers responsible for “quality initiatives” in the head offices of some of the largest companies in British financial services. Hides *et al.* (2000) investigated how certain projects are utilized to adopt total quality principles. Sohal and Terziovski (2000) discussed trends in the adoption of quality management practices in the Australian manufacturing industry and highlighted some of the barriers to the adoption of such practices. Furthermore, their paper discussed the factors that are considered to be critical to the adoption of TQM in Australian manufacturing.

Terziovski and Samson's (1999) examination of the strength of the relationship between TQM practice and

organizational performance discovered that TQM tends to have mixed results when covaried for company size and industry type. Significant differences exist in the relationship between TQM and organizational performance across industry sectors and different sized companies (particularly on the effect of defect rate, warranty costs and innovation of new products) since the relationship between TQM and organizational performance was unaffected when covaried for ISO 9000 certification status. Parzinger and Nath (2000) investigated the relationship between TQM implementation factors and measures of quality for software development.

Research methodology

For the purpose of this study, a survey was used. The questionnaire used herein was based on the TQM dimensions developed by Huq and Stolen (1998). It contains ten management dimensions and nine control and implementation dimensions: the management dimensions are:

- 1 quality mission statement;
- 2 customer focus;
- 3 management commitment;
- 4 work environment;
- 5 communications in company;
- 6 performance appraisal system;
- 7 statistical evidence of quality;
- 8 familiarity with TQM;
- 9 measures of quality; and
- 10 causes of quality variation.

While the control and implementation dimensions are:

- 1 customer feedback – vehicles used;
- 2 commitment for continual improvement;
- 3 problem solving approach;
- 4 activities to remove barriers for reaching consensus;
- 5 comparison of actual with planned performance;
- 6 education and training;
- 7 supplier development;
- 8 quality circles/quality improvement teams, etc.; and
- 9 application of advanced analysis techniques.

A five-point Likert type scale was used to quantify the responses relating to the TQM dimensions. The numbers represent the strength of agreement, correlation agreement, perception or opinion, concerning the question item. For example, if a question asks to what extent the company has trained the employees in TQM concepts and techniques, five represents the high end

of the scale while one stands for the least. In addition, each company was asked to assess its quality performance (i.e. the defect rate, rework rate, delay rate of delivery) over the past three years and to indicate whether it had won any quality awards (Deming Prize, National Quality Award of Taiwan, etc.). Other background information included the size of the company, number of employees, and company activities.

In this study, the survey population for the computer and its peripheral industry was selected from the Taiwan Manufacturing 500 and Hsinchu Science Park (Taiwan). A total of 150 firms were randomly selected from the computer and its peripheral manufacturers in Taiwan. The selected firms were contacted by telephone and mail while the question responses were obtained by repeat visits and interviews. Only the managers, supervisors, or senior engineers of the quality department were interviewed. The investigation was performed over a six-month period (from July to December 1999). Each company was visited between one to three times. In the end, a total of 42 firms participated in this study. Only 40 of the 42 questionnaires returned were deemed valid for further analysis. A variety of statistical methods, including SPSS and SAS, were utilized to analyze these data.

Results

Table I presents an analysis of the survey results on management dimensions while the control and implementation dimensions are illustrated in Table II. The following hypotheses are based on the questionnaire analysis:

H1. There should not be any significant difference in the ten management dimensions as practiced by Taiwan's computer and its peripheral manufacturers.

H2. There should not be any significant difference in the nine control and implementation dimensions as practiced by Taiwan's computer and its peripheral manufacturers.

On management dimensions, the research results indicate that the majority of respondents supported the statement that "the company's quality mission statement is adequate for the company to sustain and grow in the current environment" while "the company has trained most of the employees in TQM concepts and techniques" obtained least support. To realize whether these ten dimensions are significantly different, we use Friedman rank test and obtain $\chi^2_F(9) =$

25.398, $p < 0.05$. We conclude that these ten management dimensions are significantly different.

On control and implementation dimensions, research results indicate that most respondents agreed with the statement that "the company has in continual process control and improvement; the goal is zero defects through development of foolproof methods" while few concluded that the practice of "the company has used advanced quality techniques (such as the Taguchi method and experimental design) to solve various quality problems." To realize whether these nine dimensions are significantly different, we use Friedman rank test and obtain $\chi^2_F(8) = 61.715$, $p < 0.05$. We conclude that these nine control and implementation dimensions are significantly different.

On quality result, the defect rate of Taiwan's computer and its peripheral industry averages 4.2 percent, while the standard deviation is 7.6 percent. These data indicate that there is room for improvement in quality management system in Taiwan's computer and its peripheral industry. In this study, the impact of TQM implementation on the quality performance of an organization is investigated. A hypothesis regarding the relationship between TQM and quality performance is formulated as follows:

H3. TQM has an impact on quality performance (i.e. the defect rate, rework rate, delay rate of delivery).

This work utilized the Pearson correlation analysis to test *H3*. "Quality mission statement" (correlation coefficient = -0.320 , p -value < 0.05) and "customer feedback" (correlation coefficient = -0.330 , p -value < 0.05) can reduce the rework rate. Further, "commitment for continual improvement" (correlation coefficient = -0.332 , p -value < 0.05), "comparison of actual with planned performance" (correlation coefficient = -0.400 , p -value < 0.05) and "application of advanced analysis techniques" (correlation coefficient = -0.356 , p -value < 0.05) can reduce the delay rate of delivery. From the correlation analysis, no evidence indicates that TQM has an impact on defect rate.

Approximately 30 percent of Taiwan's computer and its peripheral companies have adopted TQM. This study further investigated the relationship between companies that have implemented or are implementing TQM and those that have obtained quality awards. The hypothesis is formulated as follows:

H4. Obtaining quality awards is directly related to implementing TQM.

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Using a ϕ correlation analysis, the research results indicated that there is conclusive relationship between companies implementing TQM and being awarded (correlation coefficient = 0.375, p -value < 0.05). Those companies implement TQM almost obtain a quality award at least. Moreover, one of them wins the Deming Prize, and five companies win the National Quality Award of Taiwan. Quality awards audit the quality management system thoroughly, and TQM is a continual quality improvement system, companies implementing TQM generally have better quality management system.

Suggestions

The concept of TQM is straightforward and its principles are ways to manage an organization. Observing from our investigation results, the introduction of TQM is not necessarily simple and straightforward, and the difficulties are likely to be experienced in Taiwan's computer and its peripheral industry.

Management aspects

From our observations, the companies' quality mission statements are only presented in the documents; there exist no top management comprehensive commitment and involvement in their mission statements. Recently, Taiwan's computer and its peripheral industry has been the third biggest one all over the world. The companies mainly focus on the product-related quality issues. Under this view of quality management, Taiwan's computer and its peripheral industry could not continue to be the leading edge in the global supply chains. Except controlling product quality, TQM involves many major management aspects to increase productivity and competitiveness. Under the economic attack from the other Asian developing countries, Taiwan's companies have to learn that quality is not only complying with design specifications, but also satisfying the customers' prospects far better than their competitors. Top management, which is directly responsible for the high-level processes, needs to get ahead of product-related quality subsystem to a whole-company TQM system.

Table I

Survey results (management dimensions)

Question type	Description	Mean rank
1. Quality mission statement	The company's quality mission statement is adequate for growth in the current environment	6.25
2. Customer focus	In addition to incorporating the external customer preferences in the products and services, the company believes that the internal must be satisfied	5.99
3. Management commitment	Top management is committed to implementing TQM by overhauling the company culture	5.20
4. Worker empowerment	The company has made employees responsible for quality, they are encouraged to make suggestions, and in many cases allowed to take action	5.35
5. Communications in company	The company believes in teamwork and making decisions based on consensus	6.07
6. Performance appraisal system	The reward system is based on team performance	4.80
7. Statistical evidence of quality	Process performance is monitored by the use of statistical tools, and suppliers are required to provide statistical evidence of quality	5.34
8. Familiarity with TQM	The company has trained most of its employees in TQM concepts and techniques	4.34
9. Measures of costs of quality	The company has developed measures of costs of prevention, inspections, appraisal (costs of conformance), and costs of scrap and rework, complaints, returns, etc. (costs of nonconformance)	5.21
10. Causes of quality variation	The company has identified the errors that are built into the system (common causes) and the errors that can be controlled by the workers (special causes)	6.45

Table II

Survey results (control and implementation dimensions)

Question type	Description	Mean rank
1. Customer feedback – vehicles used	The company uses questionnaires or interviews to obtain the external customer requirements to enhance products/services quality	4.78
2. Commitment for continual improvement	The company has continual process control and improvement; the goal is “zero defects” through development of foolproof methods	6.94
3. Problem solving approach	The company uses a team approach that entails idea generation, alternative evaluation and consensus building to solve problems	5.76
4. Activities to remove barriers to reaching consensus	The company solicited the opinions of employees to remove barriers to reaching consensus	5.36
5. Comparison of actual with planned performance	Cost is used to compare the actual and planned quality performance	5.51
6. Education and training	The company has spent an enormous amount of time educating employees	4.68
7. Supplier development	The number of suppliers has reduced since the company adopted TQM. The company works closely with them to develop long-term relationship	4.09
8. Quality circles, quality improvement teams, etc.	The company periodically implements quality activities such as quality circles, quality improvement teams, or suggestion systems	4.50
9. Application of advanced analysis techniques	The company has used advanced quality techniques (such as the Taguchi method, experimental design, and regression analysis) to solve various quality problems	3.40

Evaluation process of quality awards covers the whole-company management areas such as leadership systems, strategic planning, customer and market focus, information and analysis, human resource, process management, etc. There exist many important similarities between quality award criteria and TQM. Therefore, this study indicates that there is a conclusive relationship between implementing TQM and winning quality awards. Through the evaluation of quality awards, companies can identify the core of their business excellences, and can introduce TQM concepts to all employees.

Implementation and control aspects

For the three quality performance indices, implementation of TQM can reduce the rework rate and delay rate of delivery. However, there is no evidence in this study to demonstrate that implementation of TQM has a positive impact on the reduction of defect rate. Dissimilar to product-related quality subsystems, TQM covers the entire organization, processes and management system. Realization of TQM has a long-term influence on quality performance through the organization's improvement and culture change. Presuming TQM concepts only as slogans could bring about no progress in quality performance. Quality management

practices (QMPs) can be taken as the short-term act for improving the quality performance.

There are many research results regarding the implementation of ISO 9000, with contrasting views about the relationship between ISO 9000 and TQM (Sun and Palmer, 1999). Regardless of the contrasting views, some authors praise the ISO concept and view it as a primary form of quality management and believe it should not be used in isolation from TQM. It is believed that ISO 9001 is a positive step forward to incorporating fundamental customers' expectations. However, a TQM approach for organizational improvement can further help to attract and retain customers (Conti, 1999). Furthermore, the ISO 9000-2000 makes an effort (Conti, 1999) to extend its scope of the quality system to the whole organization view (e.g. TQM).

Generally, large-sized firms are more aware than small-sized firms about the value of the adoption of TQM. This situation is inevitable because small-sized firms do not gain as much from the TQM implementation. The small-sized firms can begin their TQM philosophies with the adoption of ISO 9000 and QMPs. ISO 9000 series is an advantageous interpersonal communication tool due to its documentation basis. The employees can improve on collecting and

mining information to support strategic investigation, marketing research, and contemporary technology launch. For gaining the short-term effects, ISO 9000 implementation and QMPs realization can both result in improvements in company performance and quality performance.

Observing the results of this survey, several important issues such as introduction of new concepts and techniques and suggestion of new quality system are seldom addressed. Moreover, companies have not trained most of their employees in TQM concepts and techniques. There is budget for training quality technologies. However, the advanced techniques such as the Taguchi method, experimental design, and regression analysis are seldom adopted to solve various quality problems. Researchers and practitioners agree well with the existing knowledge, and experience about the success of TQM is mostly established on the support of employees. Continuous provision of training maintains the employees' knowledge and skill levels for quality management.

For supply chains, the partnership is subjective, and an in-depth cooperation may put forward a better interaction. The companies can suggest improvement, training, new technology and expectation for those suppliers that perform beyond expectations. The number of suppliers is reduced and long-term relationship to suppliers is developed since the company knows how to work together with its suppliers.

Conclusions

Executive managers should be aware that the implementation of TQM needs changes in the company's culture and organization. It is a hard way to identify the changes, and much more difficult to implement the identified changes. Taiwan's computer and its peripheral companies must be as competitive as possible to win customers in a very aggressive global industry. Companies must gain competitive edge by improving the quality of their products. The implementation of ISO 9000 can be a step toward TQM. The year-2000 ISO 9000 series is expected to better commit to the TQM principles. This study does not address the relationship of ISO 9000 to TQM. Future researchers can compare the effectiveness of TQM and ISO 9000 to study their respective strengths and weaknesses and use this result as reference for quality improvement.

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