Total Quality Management for Information Systems : An Empirical Investigation

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ABSTRACT

In recent years, there has been an increasing interest by both academics and practitioners in improving the quality of information systems (IS). Past literature includes several conceptual frameworks and models proposing principles of applying TQM and other quality methodologies. In addition, case studies describing the experiences of individual companies have been published. Empirical evidence, however, on the effectiveness of TQM programs in the IS area is sparse. This paper attempts to provide a benchmark of current TQM practices for IS. A detailed exploratory analysis of survey responses from 142 Korean companies indicates the awareness, usage, length of experience, and the extent of top management support for IS TQM programs. The study also provides information on the realized benefits from TQM and tests their relationship to the implemented TQM principles. The relationship between the extent of top management support and the realized benefits from TQM in IS is also tested. Global applicability and implications are discussed.

KEY WORDS

Information Systems Management, Systems Quality, Total Quality Management

INTRODUCTION

Many corporations today are concerned with providing better products and services and gaining a sustainable competitive advantage. Total Quality Management (TQM) is a philosophy of management and a set of customer-centric practices for delivering quality. Capturing the competitive advantage offered by TQM is possible in all types of businesses, from manufacturing through service. Furthermore, the TQM principles, practices, and techniques can be applied to all functions within an organization, including information systems (IS), marketing, finance, and research and development (Godfrey, 1995; Tenner, 1991).

Quality management is a critical issue for information systems, as information is one of the most valuable assets of an organization. Many organizations rely on computer-based information systems for their day-to-day operation, managerial decision making, and strategic advantage (Ashmore, 1992). Because of this increased demand for information within the organization, IS professionals should expect a greater focus on the quality and business value of products and services provided by the IS function.

The transformation of a traditional IS organization to a quality-based one can be achieved only by IS managers who (1) understand the principles, practices, and techniques upon which TQM is based (i.e., understand the importance of top management commitment and leadership, customer focus, benchmarking, measurement, communication, and employee empowerment and training); (2) realize that TQM is a necessary operational strategy for future competitiveness; and (3) recognize the TQM opportunities in their own function and organization (Pearson et al., 1995).

However, of the IS organizations pursuing total quality, studies show that most have wasted vast amounts of time, energy, and resources and few organizations have had unqualified success with their quality management programs (Eckerson, 1991). Some reasons for the failures include: (1) launching dozens of activities all at once and at multiple locations; (2) making the assumption that quality activities will always yield quality results and subsequently focusing exclusively on activities; and (3) not spelling out step-by-step milestones or beginnings and ends (Schaffer, 1992). A large number of IS organizations have not adopted TQM for software engineering. A key reason for this, according to Zadrozny and Tumanic (1992), is that IS professionals misunderstand the key principles of TQM as applied within the IS environment.

TQM has a long tradition in Korea across most industries. Many Korean companies have implemented quality programs well ahead of their American and European competitors. Given this experience base, the purpose of this study is to explore and establish the extent to which IS organizations within Korean companies are aware, understand, use, support and benefit from TQM. We will argue that lessons learned from the Korean experience are generalizable and have global IT implications. The study also tests the relationship between the implemented TQM principles, the extent of top management support and the realized benefits from TQM in IS.

AN OVERVIEW OF TOTAL QUALITY MANAGEMENT

Total quality management (TQM) is a philosophy or an approach to management, characterized by principles, practices, and techniques that emphasize an organization's total commitment to the customer and to continuous improvement of every process through the use of data-driven, problem-solving approaches based on top management commitment and empowerment of employee groups (Dean and Bowen, 1994). TQM provides not only the foundation for any continuously improving organization, but also seeks to secure an organization's competitive position and long-term survival by continuously improving quality. Higher quality leads to higher productivity through reduced rework, rejects and waste, leading to lower costs and customer complaints, and ultimately increased market share (Deming, 1986). While there is no single definitive view of TQM, the TQM philosophy has five basic principles: top management commitment, customer focus, continuous improvement, structured problem-solving processes, and employee empowerment (Anderson et al., 1994; Dean and Bowen, 1994; Waldman, 1994).

First, top management commitment is the starting point for any major organizational change or quality improvement effort. Top managers are actively involved in promoting the importance of quality and customer satisfaction and they devote a substantial fraction of their time to quality-related issues. Top managers also have much involvement in goal setting, strategy formulation, and implementation of TQM. Similarly, top management commitment is also needed in setting up executive, division, and department TQM councils that are involved in the management of the quality improvement teams, suggestion systems, and recognition systems. Choi and Behling (1997) indicate that top managers' underlying orientations toward time, market, and customers affect the nature of their firm's TQM program. Furthermore, top management commitment to TQM and visionary leadership produce competitive advantage and drive TQM success (Morrow, 1997; Powell, 1995). Starting with top management, everyone in the organization needs to be aligned with the quality improvement effort.

Second, TQM has a customer focus. TQM emphasizes the improvement of processes for both internal and external customers. Internal customers include one's fellow employees. External customers include not only those who use the products and services but also one's suppliers and other groups operating in the larger environment. Quality-focused organizations must identify their customers (both internal and external), determine the specific needs of these customers, integrate all activities of the organization to satisfy the needs of these customers, and finally, follow up to ensure the customers have been satisfied (Pearson et al., 1995). Lengnick-Hall (1996) identifies the following key elements of customer orientation necessary to achieve sustainable competitive quality: (1) treating the customer as the focus of quality activities; (2) treating the customer is the final arbiter of quality; (3) the customer being actively involved in design and assessment of products and services; (4) placing emphasis on trust and development of effective relationships between the organization and customers; (5) using sophisticated measures of customer satisfaction and expectations; and (6) treating the customer as potential partner.

Third, TQM emphasizes continuous improvement. It advocates a culture in which people are not satisfied with meeting current standards but, rather, push to exceed those standards. TQM aims to continuously improve all products, processes, and people within an organization through steady incremental change rather than radical innovation. Lynch and Werner (1992) identify the keys to a successful continuous improvement process as follows: (1) top management's passionate conviction that change is necessary and valuable; (2) be ready to seek and accept honest self-assessment; (3) spend time communicating with customers and workers and learning skills and tools for continuous improvement; (4) develop and work within the organizational vision, mission, and principles; (5) work within the strategic plan, and specify the important results that should be achieved through the process of continuous improvement; (6) be prepared to deal with the fears and unreasonable expectations that change causes; (7) expect, understand, and use cynicism from employees; (8) remain focused on external customers; and (9) derive satisfaction from

the opportunity continuous quality improvement provides to learn from mistakes and experience.

Fourth, TQM involves structured, problem-solving processes for identifying and solving problems and finding opportunities for improvement. These processes may include such quality-adding techniques and tools as benchmarking, quality function deployment, pareto charts, statistical process control charts, cause-and-effect diagrams, and affinity diagrams (Hackman and Wageman, 1995; Zahedi, 1995). The common objective of these techniques and tools is to reduce systematic or common variance from quality standards. Once the process is brought under control, attention then focuses on reexamining the process to see if it can be further improved by developing even tighter standards.

Finally, TQM emphasizes employee empowerment. A major tenet of the TQM philosophy is that continuous improvement is most likely to occur with groups of individuals who are provided not only with knowledge, skills, and motivation but also with the authority to take action (Crosby, 1984). Empowered employees at all levels are charged to review and change their work processes in an effort to improve the overall quality of the finished product and service (Shrednick et al., 1992). Empowered employees are also responsible for monitoring the state of control within their processes. Once a process is in statistical control, then employees, with encouragement and coaching from managers, develop and implement process improvements to reduce the variation of the process continuously, thus improving the quality of the product or service. In general, while TQM can include many different policies and activities in different combinations, all TQM programs share the common objective of channeling the organization's energy toward the customer (Anderson et al., 1994).

APPLICATION OF TQM TO IS

TQM can be applied to an organization's information systems (IS) to improve quality of its products and services offered to both internal and external customers. Applying the lessons of TQM to the use of information technology (IT) promises to decelerate wasteful investments in technology for the sake of technology (Ayers, 1993). The TQM principles of top management commitment, customer focus, continuous improvement, benchmarking as a problem-solving technique, and employee empowerment can be applied to IS for quality improvement.

First, top management commitment is regarded as essential to the application of TQM to IS. "Quality programs that are successful are in most cases the result of visionary leadership willing to invest energy and resources and even more importantly committed to champion the process and lead the troops in the front line" (Stylianou and Kumar, 2000). Top management who can adopt a more visionary approach for how IS can streamline procedures and make information more accessible are the ones who truly reduce costs, eliminate bottlenecks, and respond most readily to customer needs (Reese, 1995). This means top management need to develop creativity for how

IS can be used to speed and improve certain processes and not simply think of IS as tools to make the old ways of doing things a little faster or a little cheaper. Top managers need to constantly reinforce customer focus, process improvement and involving others as a necessity. Top managers must use every possible opportunity to celebrate and recognize the success to encourage continued collective support (Landis and Knight, 1995).

Second, TQM is a commitment to the continuous improvement of work processes with the goal of satisfying internal and external customers. In implementing TQM in IS, IS professionals need to identify, measure, and design the product and service attributes that the customer cares about and continuously monitor customer satisfaction. To successfully apply TQM to an IS organization, IS professionals need to concentrate on the following aspects: (1) identifying all customers, both internal and external; (2) defining customer requirements and expectations; (3) delivering information products and services that meet, or exceed, defined requirements; and (4) increasing customer involvement throughout the IS development process (Carroll and Swatman, 1997; Tayntor, 1993; Stylianou and Kumar, 2000; Stylianou et al., 1997; Ward, 1994b).

Third, applying continuous improvement to improve the quality and productivity of processes is difficult, but it is also paramount to the ongoing success of mission-critical IS projects. The software development process remains one of the most uncontrolled and poorly managed functions in all of business (Dawson, 1994). About 60% of the errors reported during system testing and production can be traced to the analysis stage of development (Oates, 1992). According to Dawson (1994), the techniques and philosophies of continuous improvement are as important and as applicable to software development as they are in more traditional functions like manufacturing. Dawson also found that systematic improvement requires dedicated support from developers and managers, and that a formal development process pays for itself in improved quality and efficiency. Continuous process improvement involves documenting, analyzing, and measuring all activities performed by an IS organization. Processes are standardized and simplified to limit variability. The focus is always on the process, not on the product or on the individual performing the process (Kiely, 1993; Ward, 1994a).

Fourth, as a structured, problem-solving process, the practice of benchmarking is becoming more popular in IS because it helps ensure a company is as good as its competitors in what it does (Buckler, 1994; Kiely, 1993). Benchmarking can provide considerable insight into how IS maximizes the efficiency and effectiveness of its operations. One area in which IS organizations have been relatively aggressive in benchmarking is data-center efficiency and cost control (Criner, 1994; Freedman, 1992). A well-designed benchmark can help a computer professional make better purchase decisions and maximize returns. IS budget benchmarks are tools in TQM. By comparing the installation with comparable systems, the computer analyst gains insight into the quality and cost-effectiveness of information processing operations (Elms, 1993). To improve the quality of structured, problem-solving processes, IS

needs to adopt certain systems, priorities, and procedures right away. For example, IS employees must be continuously supported with quality-adding tools and techniques through quality-related education and training (Bedwell, 1993).

Finally, IS employee empowerment requires information, skills, and resources. It is the leader's task to empower the employees by adopting strategies appropriate for the given type of work and environment. Common ingredients of successful employee empowerment processes include employee education and training, team development, communication, recognition and award, organizational structure, organizational culture, and the personality and leadership style of the management team (Zahedi, 1995).

Critical success factors for implementing employee empowerment strategies in an IS organization include, according to Shrednick et al. (1992): starting with a vision and clear goals, ensuring management commitment, visible support, and willingness to take risks, paying particular attention to middle managers and supervisors, involving staff in all phases of the project, communicating, upward as well as downward, staying tuned to the business, educating and training everyone, and developing a reward system that recognizes both team and individual achievements.

Grosnick (1994) also identifies that the following three major changes usher in IS employee empowerment: creating literacy, changing management practices, and moving toward empowerment as the basic architecture of the organizational unit.

Furthermore, Prince (1993) emphasizes the following four basic rules that top managers should remember at all the times in implementing TQM in IS: (1) most employees do not absorb new ideas quickly and will resist them if they are pushed too hard; (2) employees only do well what they like to do; (3) tasks have to be matched closely with the personality of the person chosen to do them; and (4) the miracle of organizational change only works through teams, whether they are formal or informal.

The successful implementation of these TQM principles in IS potentially provides many significant benefits (Carroll and Swatman, 1997; Pearson et al., 1995). These benefits include:

- Improvements in quality and productivity (e.g., higher quality products; lower maintenance costs; reduced application development time);
- Improvements for staff and management (e.g., better utilization of human resources; better management control; increased morale, teamwork and job satisfaction);
- Improved relations with customers (e.g., increased customer focus, customer satisfaction, and awareness of the importance of service; increased flexibility in meeting customer demands); and
- Strategic benefits (e.g., increased alignment with corporate culture and organizational objectives and better targeting of business value).

Based on the described principles of TQM in IS and the success factors identified by prior studies, the specific objectives of this study are to explore the following areas: the awareness, usage, and length of experience of TQM in IS; the extent of top management support for TQM in IS; the extent of benefits realized by TQM; the extent the TQM philosophy is implemented in IS; the relationship between IS TQM benefits and top management support for TQM; and the relationship between IS TQM benefits realized and TQM principles implemented.

BACKGROUND ON KOREA

The Korean manufacturing and service industries have made a significant contribution to the spectacular economic growth in Korea during last three decades. Recently, however, most Korean companies have suffered from declining competitiveness in global markets. Foreign companies from the developed countries now provide high-quality products and services at reasonably low prices, presenting a serious strategic challenge to many Korean firms. Furthermore, Korean consumers are becoming more quality conscious. The new wave of quality awareness and emphasis has had a significant impact on business operations, forcing Korean companies to shift their strategy from being low-cost producers to being high-quality producers. It has become increasingly difficult for companies to compete solely on the basis of price. To meet the challenge, Korean firms have increased their investments in quality management significantly during the last decade. During this time period, the number of companies introducing and implementing the total quality management (TQM) approach to improve competitiveness has increased steadily. Investment in quality management is expected to increase as quality becomes more critical to survival in global markets (Lee, 1998).

METHODOLOGY

Data Collection

The data for the study were gathered via a mail survey questionnaire. The questionnaire for the study was partially adopted from a similar U.S.-based study (Pearson et al., 1995) and a TQM implementation constructs development study (Ahire et al., 1996) and then modified appropriately to apply to information systems (IS) departments. The survey method provides probability sampling, standardized measurement, and information available from no other sources (Fowler, 1988) and is an appropriate form for this stage of research in TQM for IS. The questionnaire items were written in the form of statements to which respondents responded using a 7-point Likert-type scale (ranging from strongly disagree to strongly agree).

The survey questionnaire was mailed to the 500 largest Korean companies (based on total sales). A follow-up questionnaire was mailed to those who had not responded about three weeks later. A third follow-up questionnaire was mailed to those who had not responded about six weeks later. The questionnaire was addressed to the top manager in charge of the IS department. Despite follow-up efforts, 15 questionnaires

were undeliverable because of bad addresses. 142 usable responses were received representing a response rate of 29%. Non-response bias was checked by comparing the answers provided by the first respondents with those provided by respondents following the second and third mailing (Fowler, 1988). Analysis indicated no statistically significant differences at the level of 0.05 among these three groups with respect to their total sales, number of employees, IS budgets, and number of IS employees, thus indicating non-response bias was not a problem in this research. This lack of non-response bias implies that the results from the study sample can be generalized to the larger population.

Responding Sample Characteristics

Although a variety of industries were represented in the responses (manufacturing, finance/insurance, retail/wholesale, construction, transportation/werehousing, technology/service, and other), a large proportion of these companies were manufacturers (38%) or involved in banking and insurance (21%). Further, the responding companies represent a wide variance in size, with 40 of 131 companies (28%) having annual sales of $650 million or above, and 12 (8.4%) having sales below $200 million. Also, 21 of 137 companies (14.7%) have 3,500 or more employees, and 19 (13.4%) have fewer than 500.

The IS departments in these companies exhibit similar variance. 71 of 126 companies have IS budgets of $2 million or less, and 25 have $6.5 million or above. Also, 27 of 133 companies have 45 or more IS employees, and 39 companies have fewer than 15.

RELIABILITY AND VALIDITY ANALYSES

Reliability

Reliability is the degree to which an instrument measures the same way each time it is used under the same conditions with the same subjects. That is, reliability refers to the accuracy (consistency and stability) of measurement by the instrument (Isaac and Michael, 1981) or repeatability of an assessment over a variety of conditions (Nunnally, 1978).

Variables with composite measures were evaluated for their internal consistency through the Cronbach's Alpha measure. The higher the Cronbach's Alpha value, the greater is the internal consistency of the items making up a composite measure. Nunnally (1978) suggests that a value of 0.6 or higher is acceptable. The Alpha's for the variables with composite measures ranged from 0.82 to 0.94. These scores are shown in Table 1.

Table 1: Reliability Analysis for Composite Measures

Construct Measured	Number of Items	Cronbach Alpha
TQM Benefits Realized	9	0.9234
Top Management	5	0.8842
Commitment	4	0.8159
Customer Focus	5	0.9448
Employee Training	5	0.8711
Employee Empowerment	5	0.9261
Benchmarking		

Validity

A construct is a mental or conceptual variable. Because a construct is conceptual, it is necessary to create an empirical definition of that construct; one which can be measured and recorded, before conducting research. Construct validity is the degree to which the empirical definition of a construct corresponds with a conceptual definition of the construct (Churchill, 1979; Kerlinger, 1986). It consists of two major validity concepts: convergent validity and discriminant validity.

Convergent validity is the degree to which multiple attempts to measure the same concept are in agreement (Campbell and Fiske, 1959). In this research, convergent validity is evaluated by measuring the correlation of each item representing the construct with the aggregate measure for that construct less the focal item (Ives et al., 1983; Kerlinger, 1986). This approach assumes the total score to be valid; thus the extent to which an item correlates with the total score is indicative of construct validity for the item. Nunnally (1978) suggests that a value of 0.35 or higher is acceptable. Based on this criterion, no items were excluded from further analysis. The correlation with total ranged from 0.39 to 0.90. These scores are shown in Table 2.

Table 2: Inter-Item Correlation of Research Variables

Deleted Items	Correlation with Total
TQM Benefits Realized (BENEFIT):	
Lower maintenance in developed applications	0.8105
Better IS management control	0.7428
Enhanced quality of services delivered	0.7295
Improved customer satisfaction	0.7813
Greater productivity of IS personnel	0.7404
Reduced product development time	0.5402
Enhanced quality of products delivered	0.8020

Better utilization of human resources	0.7507
Increased flexibility in meeting customer demands	0.6931
Top Management Commitment (TMC):	
Relative importance given by top management to quality versus cost	0.7710
Clarity of quality goals for the organization	0.7498
Performance evaluation of managers based on quality	0.6427
Allocation of adequate resources to quality improvement efforts	0.7265
Relative importance given by top management to quality as a strategic issue	0.7411
Customer Focus (CF):	
Extent of customer satisfaction survey feedback given to managers	0.7345
Availability of customer complaint information to managers	0.6434
Extent of the use of the customer feedback to improve product quality	0.8384
Overall customer focus in quality management	0.3948
Employee Training (ET):	
Availability of resources for training	0.7509
Frequency of training and retraining an employee	0.8465
Number of employee levels participating in the same training session	0.9018
Number of employees trained in basic quality concepts	0.8844
Satisfaction of employees with overall training	0.8786
Employee Empowerment (EE):	
Employees authorized to find and fix problems	0.4451
Employees encouraged to find and fix problems	0.7845
Employees given resources to fix problems	0.7952
Technical assistance given to employees for solving problems	0.7554
Supporting infrastructure for problem solving	0.7370
Benchmarking (BEN):	
Emphasis on benchmarking competitors' products and processes	0.8318
Effectiveness of benchmarking in product cost reduction	0.7571
Emphasis on benchmarking non-competitors' products and processes	0.8626
Effectiveness of benchmarking in product quality improvement	0.8029
Willingness of the organization to benchmark in the future	0.7901

Discriminant validity is the degree to which a construct differs from other constructs. This is usually verified through factor analysis (Kerlinger, 1986). Factor analyses for discriminant validity were performed with respect to each construct of this research. The cut-off for the number of factors is the widely accepted criterion of an eigenvalue of one. In each case, discriminant validity is confirmed if items for each variable load

onto a single factor. The significance of item loadings is chosen as at least 0.50 (Hair et al., 1984). Items with loadings of less than 0.50 on any factor or loadings of more than 0.50 on more than one factor are dropped from subsequent measures of the construct. Nine items are used to measure TQM benefits. Factor analysis with varimax rotation reveals only one factor as shown in Table 3.

Table 3: Factor Analysis of TQM Benefits Realized

Factor	Items	Factor loadings	Eigenvalue	Variance explained (%)
1	BENEFIT1	0.8632	5.7101	63.4
	BENEFIT7	0.8543		
	BENEFIT4	0.8393		
	BENEFIT8	0.8112		
	BENEFIT2	0.8028		
	BENEFIT3	0.7994		
	BENEFIT5	0.7975		
	BENEFIT9	0.7590		
	BENEFIT6	0.6140		

Twenty-four items are used to measure TQM principles. Factor analysis with varimax rotation provides five factors as shown in Table 4.

Table 4: Factor Analysis of TQM Principles Implemented

Factor #	Name	Items	Factor loadings	Eigenvalue	Variance explained (%)
1	IS employee training	ET3	0.8160	4.4857	18.7
		ET4	0.7674		
		ET5	0.6666		
		ET2	0.6223		
		ET1	0.5980		
2	Benchmarking	BEN3	0.8265	4.3742	18.2
		BEN5	0.7903		
		BEN4	0.7560		
		BEN1	0.7348		
		BEN2	0.7191		
3	Top management commitment	TCM1	0.8711	3.6558	15.2
		TCM2	0.8314		
		TCM5	0.7262		
		TCM4	0.6147		
4	Empowerment	EE3	0.8108	3.3510	14.0
		EE5	0.7155		
		EE4	0.6980		
		EE2	0.6621		
5	Customer focus	CF2	0.8265	2.8679	11.9
		CF3	0.7795		
		CF1	0.6021		

Legend to Table 4:

ET: Employee Training
BEN: Benchmarking
TMC: Top Management Commitment
EE: Employee Empowerment
CF: Customer Focus
One item of customer focus (overall customer focus in quality management) is dropped from subsequent measures of the construct, since it has a loading of less than 0.50. One item of top management commitment (performance evaluation of managers based on quality) and one item of employee empowerment (employees authorized to find and fix problems) are dropped from subsequent measures of each construct, since each item has loadings of more than 0.50 on more than one factor.

RESULTS AND DISCUSSION

IS Manager's TQM awareness

As indicated in Table 5, 86% of the IS managers had heard of TQM. Approximately one-half of these indicated that they understood a little or very little the philosophy and concepts associated with TQM. Almost 58% believed that TQM could have much or very much impact on the information systems (IS). Therefore, it is suggested that the IS managers need an opportunity of learning the TQM philosophy through TQM seminars or related education.

Table 5: IS Manager's TQM Awareness

Awareness		Frequency		Percent	
Heard of TQM	Yes	122	142	85.9	100
	No	20		14.1	
Understanding of TQM philosophy	Very Much	3	142	2.1	100
	Much	17		12	
	Somewhat	52		36.6	
	A little	41		28.9	
	Very Little	29		20.4	
Perception of TQM impact on IS	Very Much	19	142	13.4	100
	Much	63		44.4	
	Moderate	43		30.3	
	A little	6		4.2	
	Very Little	3		2.1	
	Unanswered	8		5.6	

Usage of TQM in IS

Of the 142 respondents, only 36 (25%) noted that their companies use TQM for information systems (IS). Interest among nonusers of TQM in IS is higher with 46 of

106 (43.3%) nonusers indicating that the potential use of TQM in IS was being considered at their companies.

Length of TQM in IS Experience

As shown in Table 6, of the 36 TQM for IS users, 15 (42%) have been implementing TQM for IS for between 1 and 3 years and 13 (36%) have been doing so between 3 and 5 years. Thus, the varied experience of these companies can provide insights for firms contemplating TQM for IS as well as firms already involved in IS TQM programs.

Table 6: Length of TQM Experience for IS

Length (year)	Frequency	Percent
Less than 1	6	16.7
1 to below 3	15	41.7
3 to below 5	13	36.1
5 and above	2	5.6
Total	36	100

Top Management Support for TQM for IS

Of the 36 respondents received, 20 (56%) noted that their top management supports strongly TQM for information systems. 16 (44%) noted that their TQM for IS has been supported by top management somewhat less or very little.

TQM Benefits for IS

Respondents were asked to rate realized benefits of TQM for IS using a 7-point Likert-type (strongly disagree to strongly agree). As shown in Table 7, the most common benefits were enhanced quality of services delivered, enhanced quality of products delivered, IS management control, and greater productivity of IS personnel.

Table 7: Benefits of TQM for IS

TQM Benefits Realized	Mean	Standard Deviation
Lower maintenance in developed applications	4.7777	1.3961
Better IS management control	5.3055	1.0907
Enhanced quality of services delivered	5.3611	1.1251
Improved customer satisfaction	5.1944	1.1166
Greater productivity of IS personnel	5.3055	1.0642
Reduced product development time	4.7777	1.2215
Enhanced quality of products delivered	5.3611	0.8992
Better utilization of human resources	5.1388	1.2224
Increased flexibility in meeting customer demands	5.1714	1.1753

Implemented TQM Principles

Respondents were asked to rate the TQM principles implemented in IS on a 7-point Likert-type scale (from strongly disagree to strongly agree). As shown in Table 8, the most commonly used TQM principles were customer focus and employee empowerment.

Table 8: Implemented TQM Principles

Implemented TQM Principle	Mean	Standard Deviation
Top Management Commitment	4.7083	1.0624
Customer Focus	5.1857	0.9555
Employee Training	4.6229	1.1301
Employee Empowerment	4.9829	0.828
Benchmarking	4.6914	1.2246

Relationship of Top Management Support and TQM Benefits

For the relationship analysis, the degree of top management support is subgrouped into two classes (high and low). High indicates that the degree of top management support was rated in the top two points on the scale (much or very much). Low indicates a rating in the lower two points on the scale (somewhat or less). As shown in Table 9, the relationship of top management support and TQM benefits indicates that there is a significant difference between high and low top management support. Therefore, the result indicates that top management support is a good determinant of an IS organization's TQM benefits.

Table 9: T-Test of Degree of Top Management Support on TQM Benefits

Variable	Top Management Support	Mean	T-value	p-value
TQM benefits	High (n=20) Low (n=16)	5.5528 4.6528	3.369	0.0019

Relationship between Implemented TQM Principles and TQM Benefits

According to Table 10 showing the relationship between the implemented TQM principles and TQM benefits, TQM benefits are significantly influenced by the implemented TQM principles. As the focus is a test of the individual relationship, the key concern is whether the simple linear equation is significant (Dowdy and Wearden, 1991). Analysis of simple regression is performed to test the significance of each relationship. As shown in Table 10, each equation is significant at the 0.05 level with R square ranging from 0.13 to 0.36.

Table 10: Simple Regression Analysis of TQM Principles on TQM Benefits

TQM Principles Implemented	TQM Benefits Realized		
	T for H0: Parameter=0	p-value	R^2
Top Management Commitment	4.392	0.0001	0.3619
Customer Focus	4.168	0.0002	0.3449
Employee Training	3.865	0.0005	0.3116
Employee Empowerment	4.199	0.0002	0.3483
Benchmarking	2.244	0.0316	0.1324

Although the individual relationships are significant, since there is a serious collinearity among the independent variables, a further multiple regression analysis is performed to identify the key exploratory variables among the five factors, (see correlation matrix of research variables in Table 11). Johnson (1984) indicates that biased results from multiple regression analysis begin to creep in at correlations above 0.5. The process of identifying key variables serves two major purposes: (1) obtaining a simpler relationship which may be subject to further testing with new sets of data; (2) enabling other researchers to build on this work by highlighting the most powerful exploratory variables. The results of all possible 31 regression analyses indicate that two independent variables (top management commitment and customer focus) provide key influence on TQM benefits for IS organizations, as shown in Table 12. Therefore, the successful implementation of TQM relies on these key components.

Table 11: Correlation Matrix of Research Variables

	BENEFIT	TMC	CF	ET	EE
TMC	0.602*				
CF	0.587*	0.410**			
ET	0.558*	0.669*	0.614*		
EE	0.590*	0.565*	0.675*	0.762*	
BEN	0.364**	0.512*	0.426**	0.573*	0.569*

* significance < 0.01
** significance < 0.05

Legend:
BENEFIT: TQM Benefits Realized
TMC: Top Management Commitment
CF: Customer Focus
ET: Employee Training
EE: Employee Empowerment
BEN: Benchmarking

According to Cortada (1995) several basic activities make up the practices of good commitment to TQM:

(1) Setting strategic visions and 'selling' them to employees;
(2) Preserving high standards of measurable quality;
(3) Modeling the way to customer end-user focus;
(4) Strengthening the heart by supporting teaming, employee initiatives, and individual accomplishments; and
(5) Fostering a world of continuous improvement (Cortada, 1995).

For customer focus, Pearson et al. (1996-1997) suggest the following steps:

(1) Identify who the "real" IS customers are;
(2) Understand the expectations of your customers; and
(3) Identify and commit the processes that are critical in the support of your customer's expectations.

Table 12: Multiple Regression Analysis of TQM Principles on TQM Benefits

TQM Principles Implemented	TQM Benefits Realized		
	T for H0: Parameter=0	p-value	R^2
Top Management Commitment	3.158	0.0035	0.47
Customer Focus	2.993	0.0053	

GLOBAL APPLICABILITY AND IMPLICATIONS

Although, the findings presented here are based on data from Korean organizations, they, nevertheless, have strong global applicability and implications. The study is generalizable to organizations in countries like Japan, Singapore, and Taiwan. These countries are all neighbors with similar cultures and work ethics and have similarities at least in terms of business traditions (Sohal, 1998). The quality practices in these countries are strongly influenced by the successes of the Japanese. Furthermore, our findings are in agreement with findings of studies conducted by Dahlgaard et al. (1998), Howard and Foster (1999), Hua et al. (2000), Rao and Raghunathan (1997), Sohal et al. (1998), and Pearson et al. (1995), suggesting much broader applicability of these findings to Western and other countries. Howard & Foster, for example, support the importance of employee empowerment (sample from USA), while Dahlgaard et al. find that the most important quality practices include a focus on customer needs, employee training, and top management commitment (sample from Korea, Taiwan, Denmark, Sweden, Finland, and Australia). Rao & Raghunathan, also find top management support to be a critical factor (sample from India, China, and Mexico). Although the above studies are not specifically in the area of information systems, their findings are consistent with the findings of this study. Our findings also agree with the results of the study conducted by Pearson et al. with regards to the

extent TQM awareness by IS managers and the TQM benefits realized by the IS department.

Furthermore, Dahlgaard et al. (1998) conclude that "although Western companies have made substantial improvements in quality management practices over the past ten years, a significant gap still remains between the East and the West," and they recommend additional emphasis on top management commitment and on-the-job education and training. Given such as gap, empirical findings about the practice of TQM in the IS area in Korea, should be useful globally. From a different perspective, comparison of our results with the results of these other studies, demonstrates that quality management practices and success factors in IS are not significantly different from those in other areas of organizations.

LIMITATIONS

This research deals with a relatively new phenomenon – the application of TQM in the IS function. While we feel that the study contributes to academic and practical areas, it also has some limitations that need to be mentioned. First, the study uses a questionnaire method for data collection that relies on a single respondent for each company. As a result, it does not capture the top management commitment of each company to the extent that a case study or a field study involving multiple respondents from each company would. Second, even though we made every effort to design a questionnaire that would reduce response bias, such a bias cannot be avoided entirely due to the post hoc nature of research. Finally, the instrument used in this research was not designed to determine the IS manager's understanding of the broad TQM principles, practices, and techniques of TQM. These limitations provide the foundation for future discussion and research. Additional useful lessons will be learned by replication of the study in IS organizations in other parts of the world and comparison with the Korean data.

CONCLUSIONS

The results of this survey indicate that 86% of the Korean top IS managers are aware of total quality management (TQM) and about 58% believed that TQM could have much impact on the information systems (IS). However, only 14% suggested that they understood well the TQM philosophy and concepts associated with TQM. The study also indicates that only 25% of respondents have implemented TQM for IS. However, interests among nonusers of TQM for IS is very high. Approximately 43% of the nonusers noted that the potential implementation of TQM for IS was being considered at their companies. Many of the companies implementing TQM for IS have been doing so for several years and have support from their top management.

IS managers reported several realized benefits from TQM for IS. The most common benefits are enhanced quality of IS services delivered, enhanced quality of IS products delivered, better IS management control, and greater productivity of IS personnel. IS managers also reported the specific TQM principles they have implemented. The

most commonly implemented principles are customer focus and employee empowerment.

The results of this study also indicated that there is a relationship between the extent of top management support and realized benefits from TQM for IS. The higher the top management support, the better TQM benefits. Therefore, top management support is a good determinant of an IS organization's success from TQM for IS. The study further indicated that there is a relationship between realized benefits from TQM for IS and the implemented TQM principles. Top management commitment and customer focus are good determinants of an IS organization's TQM benefits.

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