Discriminating factors of information systems function performance in Hong Kong firms practising TQM

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Abstract *This paper proposes an effective way to improve poor performance of ISF. The result finding was based on a questionnaire survey, and the selected respondents were asked to evaluate the adoption level of the TQM concept in governing their information systems function. Through the tests of reliability and validity, the proposed instrument was verified as a good measuring tool. The findings show that dissatisfying performers of ISF should pay more emphasis on the practices of user focus, IS top management support, and IS product/service design.*

Introduction

Effective decision making relies on relevant information. Information systems function (ISF) provides reliable and crucial information for management in a timely manner so that the outcomes permit an organization to reach a competitive edge over their competitors. Therefore, searching for an effective method to ensure a high quality service of ISF is highly emphasized in IS literature.

Research efforts contributing to an improvement of the ISF quality services are mainly based on a mixed form of the following criteria:

- user involvement (Tait and Vessey, 1998);
- user friendliness (Adams *et al.*, 1992);
- ease of use (Davis, 1989);
- top management involvement (Doll, 1985); and
- system performance (Saunders and Jones, 1992).

Recently, proposals of an integrative approach to manage ISF have escalated in the literature. For example, Braithwaite (1995) discussed the integration of total quality management (TQM) concept into IS management. Ward (1994b) converged their discussions on applying some forms of integrative principles or tools of TQM – such as the study of customer orientation, continuous process improvement, the use of quality function deployment, and CASE tools – to further improve the quality of software process management. In the area of software development, Ashrafi *et al.* (1995) recommended that an integrative quality system requires achieving a high quality in software development. Pearson *et al.* (1995) surveyed 500 IS managers and concluded that some TQM

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tools and concepts could have a positive impact on ISF, such as enhanced quality and improved customer satisfaction.

Although the integrative approach is claimed as a preferred method to govern ISF (Bartel and Finster, 1995), most of the literature reported so far is anecdotal in nature. Empirical results are lacking to support the claim. This paper attempts to remedy this deficiency by presenting an empirical model that applies an integrative quality service approach to improve the quality service of ISF. This paper proposes to adopt the TQM concept as a basis of measurement and to determine how the TQM concept can improve poor performers of ISF. The result of this paper was based on a discriminant model.

In order to ease the understanding of the proposed model development, a brief introduction of the concept and development of TQM is presented in the next section. Sections 3 and 4 elaborate the proposed model development and research methodology. The findings, conclusion, and discussion are discussed in the subsequent sections.

Research background of TQM

TQM is defined as a holistic management philosophy that emphasizes the involvement of every employee in an organization to achieve customer satisfaction through continuous process improvement (Bank, 1992). With the proper implementation, TQM can further enhance the ability of a firm become a time-based competitor that contributes to competitive advantage (Youssef *et al.*, 1996). According to Dotchin and Oakland (1992), the development of TQM is under the immense influence of Deming (1986), Juran (1989), Crosby (1979), and Feigenbaum (1991).

Accordingly, many studies have attempted to synthesize different TQM practices into a meaningful set of critical TQM factors to assist users to conceptualize the TQM concept more easily. It was not until recently that the empirical results of these critical TQM factors were revealed. For example, Saraph *et al.* (1989) synthesized the different TQM practices from the literature to form a set of eight TQM factors. Their findings were based on the following steps of investigations. First, a group of TQM practices was identified from an extensive literature review. Second, the components that were associated with the TQM practices were clustered into a group of eight TQM factors. These include:

(1) the role of management leadership and quality policy;

(2) role of quality department;

(3) training;

(4) product/service design;

(5) supplier quality management;

(6) process management;

(7) quality data and reporting; and

(8) employee relations.

Third, the purification of the TQM factors is achieved through detailed item analysis. The latter results were then verified through the tests of content validity, construct validity, and criterion-related validity. These TQM factors are claimed as a reliable measurement because their respective Cronbach alpha (α) values were ranging from 0.71 to 0.94. Black and Porter (1995) modified the former method by using the 1992 Malcolm Baldrige Award as a basis to form TQM practices. Ten TQM factors were identified from the result of an exploratory factor analysis:

(1) corporate quality culture;

(2) strategic quality management;

(3) quality improvement measurement systems,;

(4) people and customer management;

(5) operational quality planning;

(6) external interface management;

(7) supplier partnerships;

(8) teamwork structures;

(9) customer satisfaction orientation; and

(10) communication of improvement.

The Cronbach alpha reliability values related to later findings were reported from the range of 0.68 to 0.87.

Tamimi (1995) argued that the quality theory proposed by Deming was quite elusive and attempted to simplify that theory into a more structured form. Tamimi identified a total of 50 of Deming's quality practices from the literature review. Using exploratory factor analysis, the following eight TQM factors were identified:

(1) top management commitment;

(2) supervisory leadership;

(3) education;

(4) cross-functional communications;

(5) supplier management;

(6) training;

(7) product/service innovation; and

(8) providing assurance to employees.

Another study that related to the Deming theory was accredited to Anderson *et al.* (1995). In the latter study, a group of Deming's quality practices was first identified through a three-round Delphi study. The identified factors were then served as input variables to the path analysis method in which their relationships and significant levels were examined. A total of seven TQM factors were verified as valid indicators in their study: visionary leadership, internal and external co-operation, learning, process management, continuous improvement, employee fulfilment, and customer satisfaction. The study of Flynn *et al.* (1995b) was very similar to that of Anderson *et al.* (1995). The main difference was that the former paper concentrated on a wide variety of TQM practices found in the literature rather than just focusing on Deming's theory.

Research model development

The model of this paper was based on the nine TQM factors. The first eight factors were derived from the model of Saraph *et al.* (1989), and the last one was the customer focus that derived from the category of the Malcolm Baldrige National Quality Award. The measurement tool proposed by Saraph *et al.* (1989) was adopted mainly because:

- it provides a high value of external validity;
- their findings were comparable to many other empirical studies; and
- it is based on an aggregation of knowledge from many quality experts rather than just based on one particular theory, such as Deming.

The last factor was added because it was highly referred (Gale, 1994). The following section elaborates the contents of these nine factors.

Top management leadership and support (F1)

Top management leadership and support are essential elements for the successful deployment and implementation of TQM (Flynn *et al.*, 1995a). Top management needs to clearly define and to develop a long-term vision of its goals and objectives in improving its services and products (Anderson *et al.*, 1995). In addition, short-term objectives and business plans should be carefully outlined to realize the vision of the long-term planning (Mann and Kehoe, 1995). Apart from planning, top management must also demonstrate an irrevocable commitment to the TQM program through its daily involvement in relevant activities. The relevant activities include the participation in quality seminars, discussion of quality issues, and the prioritization of the quality versus the operations cost (Bossink *et al.*, 1992). The lack of top management involvement may lead to employees regarding the TQM practice as a gimmick or an agenda. In the IS setting, the IS top management leadership and support are similarly required to establish a vision of IS quality. Cortada (1996) further reiterated that such a vision can be rendered by clarifying the quality objectives and involvement in daily quality activities by the IS top management.

The role of the quality department (F2)

It was reviewed that the establishment of a quality council or quality improvement team can boost quality performance in organizations. The quality group actively directs and coordinates the whole organization in quality improvement. Another role of the quality group is to act as consultant to assist in quality improvement in organizations. The quality group should have sufficient autonomy to work on the critical quality issues (Cole, 1981; Juran, 1989). The quality group in ISF can be formed as the quality assurances team which performs the work of quality review and control in all IS-related activities. Often, members in this group are quite effective in solving various quality problems (Buckland *et al.*, 1991). A conspicuous example of the importance of the quality group in ISF can be referred to Hallmark Ltd, that created a separate IS quality assurance function to improve its software (Johnson, 1990).

Training (F3)
Employees can only participate and contribute to the quality improvement programs if they are equipped with sufficient knowledge. Employee training is considered as an effective way to elevate the educational standard of employees. Thus, training must be provided to all levels of employees (Juran, 1989). Training programs include the use of various quality tools or statistical techniques such as fishbone diagrams, and team building (Deming, 1986). Deephouse *et al.* (1995) reported that the availability of training in organizations positively affected the IS planning and budget control. Thus, management must ensure that sufficient resources and a high frequency of training sessions are provided for employees (Grahn, 1995). In addition, Cortada (1996) pointed out that management should develop a long-term training strategy that emphasizes company-wide quality improvement for IS professionals.

Product/service design (F4)
An effective design of operational processes is needed in the quality program so that errors found in the final products can be reduced to a minimal level (Feigenbaum, 1991). An IS product/service design is considered a good product if, and only if, it meets the needs of customers. A product/service design that only meets the requirement of budget cost and time schedule is simply inadequate (Mann and Kehoe, 1995). To develop a quality product, all relevant departments must participate in the design process so that the final product suits the needs of everyone (Juran, 1989). Proper product/service design is genuinely needed in ISF since many IS applications are complex in nature. User involvement in the design process allows ISF to gain a better understanding of user requirements and needs. Documentation like user requirement analysis and design specification can also be used (Laudon and Laudon, 1996).

Supplier quality management (F5)
The quality of products from suppliers plays a significant role in the success of a quality program. The reason is that output of our service will inherit the quality of products that are provided by suppliers. If suppliers provide inferior products, it is certainly confirmed that final products will fall below the acceptable level. In order to ensure adequate supplier quality, an effective

monitoring system for suppliers is required. The following are few examples of criteria for selecting quality suppliers. First, suppliers should be willing to commit the continuous improvement of their quality products (Deming, 1986, Dotchin and Oakland, 1992; Tamimi, 1995). Second, an organization should establish a long-term relationship with suppliers so that the use of different suppliers is minimized. The latter practice promises higher quality of services from suppliers (Richardson, 1993). The management team should regard the suppliers as their business partners. It should, therefore, establish a working relationship with suppliers and assist them to improve their quality continuously (Block and Porter, 1995; McLntyre, 1992). Schulmeyer amd McManus (1992) claimed that the above concept should be equally applied to ISF to guarantee the success of TQM implementation.

Process management (F6)

Errors detected in the output are usually associated with the improper control of work-in-process (Deming, 1986). One way to rectify this deficiency is to develop an effective process management system. Preventative maintenance and measures are samples of such a process management system. Cole (1981) claimed that a foolproof system of process management should first be established so that errors can be reduced to a minimal level. In ISF, the CASE tools were suggested as a foolproof device (Aggarwai and Lee, 1995; Buckland *et al.*, 1991). Other ways include the development of a standard procedure to ensure the quality practices (Pearson *et al.*, 1995). Lillestol (1991), Mohanty and Dahanayka (1989) and Barker (1990) reviewed other effective tools and statistical techniques that can be used for process management. One way to ensure that a proposed process management system remains as an error-free product is through continual testing and examining (Crosby, 1979).

Quality information reporting (F7)

To maintain the focus on customers' needs and keep track of our quality performance, a quality reporting system, like a cost of quality and customer satisfaction survey is required (Shepetuk, 1993). This information needs to be highly visible so that everyone is alert to the quality of their services or products (Grahn, 1995). Schatzberg (1992) reported that publicizing information such as type of data errors and number of customer complaints in ISF allows employees to pay more attention in seeking quality improvement of their services. In addition, these reports should be readily available to the concerned parties in a timely manner so that their quality performance can be actively monitored (Leonard and Sasser, 1982).

Employee relations (F8)

One way to further improve the quality of services or products is to involve all employees in the quality program (Oliver, 1988). The establishment of quality circles or employee involvement is highly encouraged (Kumar and Gupta, 1991). Employees should be adequately rewarded if they are actively contributing to a quality improvement program (Bowen and Lawler, 1992). Supervisors should repeatedly encourage their subordinates to participate in the program, and they should coach their subordinates rather than control their activity (Shrednick *et al.*, 1992). The latter practice allows management to break down the barriers and tensions between employees and supervisors. Other items which management could contribute to the elevation of use to employee relations include setting up clear goals, objectives and supervisory methods for their employees (Tobin, 1990).

Customer focus (F9)
Any business should understand and respond to the need of its customers (Kordupleski *et al.*, 1993). It is believed that the focus on the needs of customers is a key point in providing high quality products and services (Patel, 1995). In the IS setting, one way to satisfy customer needs is through the understanding of user orientation. A formal method which captures the latter element is, for example, set up a customer feedback system and conduct frequent meetings with customers (Griffin and Hauser, 1993). Several renowned quality awards such as the Malcolm Baldrige Award also place a great emphasis on customer satisfaction (Heaphy and Gruska, 1995). Ward (1994b) claimed that the direct interaction with users is a must in the IS profession so that users can be better served.

Methodology

Instrument development
The construction of the proposed instrument was based on the following two parts:

(1) the measurement items of the proposed nine TQM factors,; and

(2) the measurement items for customer satisfaction of ISF.

In the first part, the nine TQM factors were renamed into the following terms so that they are directly related to the ISF setting: IS top management support (F1), the role of the IS quality group (F2), training (F3), IS product/service design (F4), supplier quality management (F5), process management (F6), quality information reporting (F7), employee relations (F8), and user focus (F9). Operationalization of the first eight factors, F1 to F8, was based on the 66 measurement items developed by Saraph *et al.* (1989). The construction of measurement items for the last factor – user focus (F9) – was based on the eight measuring items of the category 7.0 of the 1995 Malcolm Baldrige Award elaborated by Heaphy and Gruska (1995).

The following filtering processes were used to improve the proposed measurement in the ISF setting:

- remove items in each factor that are not applicable to the ISF setting;
- add relevant items which advocate the integration of TQM in ISF from IS literature;

- reword items in such a way that they are directly related to the ISF environment; and
- extract examples from the literature that clearly describe each item so that they are better understood by our respondents.

As a result of process one, two items were removed from the process management factor (F6) because they were strictly production-oriented:

(1) the use of acceptance sampling to accept/reject lots or batches of work; and

(2) the stability of production schedule/work distribution.

In process two, the following three measurement items were added to the process management factor (F6):

(1) a continuous process improvement is sustained (Dawson, 1994);

(2) the thoroughness of documentation is achieved (Braithwaite, 1995; Pearson and Hagmann, 1996); and

(3) the timeliness of project schedule is committed (Arthur, 1993).

In conclusion, a total of 75 items were used for measuring the proposed nine TQM factors. All of these items were evaluated on a five-point Likert scale, with value "5" representing a very high frequency of practice, and value "1" representing a very low frequency of practice. The ISF managerial personnel of the selected firms evaluated this part of the questionnaire.

The second part related to the construction of measurement instrument for ISF user satisfaction. There are two main reasons for which the development of such an instrument is needed. First, the measurement of ISF user satisfaction allows one to cluster the selected respondents into the good and poor performers of ISF. Second, achieving a high level of user satisfaction is the key theme of TQM (Barker, 1990; Heaphy and Gruska, 1995). Three measurement items were adopted to evaluate the ISF user satisfaction:

(1) the perceived user satisfaction on IS products developed (Anderson *et al.*, 1995);

(2) the perceived user satisfaction on IS services rendered (Flynn *et al.*, 1995a); and

(3) the perceived overall ISF quality performance (Anderson *et al.*, 1995; Saraph et al., 1989).

A five-point Likert scale was also used to assess the ISF user satisfaction, with value "5" representing a very high satisfactory level, and value "1" representing a very low satisfactory level. The non-ISF managerial personnel of the selected firms evaluated this part of questionnaire. A full description of TQM measurement items is shown in the Appendix.

Sampling
Samples were randomly selected from the following two sources with firms that are practicing TQM:

(1) *1995 Dun's Top 2000 Foreign Enterprises in Hong Kong*; and

(2) *1994-1995 Dun's Guide to Hong Kong Businesses.*

Participants were initially contacted through telephone calls to obtain their names and positions, and then explaining the objective of the proposed study. Subsequently, a total of 628 samples were selected. Questionnaires, together with a covering letter, were mailed to all selected participants. In the questionnaire, a specific instruction stated that ISF managerial personnel were to evaluate the questionnaires in Part 1, and non-ISF personnel for Part 2. Two weeks later, the same questionnaire with a follow-up letter was sent to non-respondents.

A total of 225 questionnaires were collected. However, eight replies were unusable for the reasons of missing data. Thus, these eight questionnaires were discarded, leaving 217 usable responses. The response rate is 34.55 percent. All selected companies hire more 100 employees, out of which 44.7 percent of them have more than 300 employees. All replies were answered by managerial personnel. Of these companies, 38.7 percent are manufacturing firms and 61.3 percent are service firms.

Results

Reliability and validity
The reliability of the proposed instrument was tested. Reliability refers to the degree of consistency of a scale. If a scale possesses a high reliability the scale is homogeneous (Kerlinger, 1986). Cronbach alpha (α) coefficient is a widely adopted measure of reliability. An α value indicates the internal consistency of a scale and it tells us how much correlation we expect between the scale and its corresponding measurement items. A high α value (close to 1) demonstrates a high reliability of the instrument. According to Nunnally's (1978) suggestion, α values equal to or greater than 0.70 are considered to be a sufficient condition. Further, this paper followed the instruction of Norusis (1993) that the final instrument should be based on a maximum effect from the consideration of each item that is deleted. Items that were deleted from that factor were excluded for subsequent data analysis. As a result, three measurement items were deleted from the proposed interment: 2d, 7h, and 8c. Since all α values relating to each TQM factor are greater than 0.7 (see Table I), the proposed measurement instrument exhibited sufficient reliability.

The second evaluation of our instrument related to the convergent validity of each TQM factor. Convergent validity refers to all items measuring a construct actually loading on a single construct (Campbell and Fiske, 1959). Convergent validity of each TQM factor was assessed by the within-scale factor analysis. All but only one of our TQM factors demonstrates unidimensionality. The factor dubbed as "Supplier quality management" (F5) loaded into two factors (see Table II). In assessing the meanings of the two factors and their Pearson

Table I.
Reliability of the factors constructed

Name of factor	Items deleted	No. of items used	Maximum Cronbach alpha value
IS top management support (F1)		13	0.9489
Role of IS quality group (F2)	2d	4	0.9329
Training (F3)		8	0.9220
IS product/service design (F4)		6	0.8924
Supplier quality management (F5)		8	0.8409
Process management (F6)		11	0.9142
Quality information reporting (F7)	7h	7	0.9202
Employee relations (F8)	8c	7	0.8888
User focus (F9)		8	0.9148
ISF user satisfaction		3	0.8557

Table II.
Convergent validity of factor "Supplier of quality management" (F5)

	Supplier quality assurance (F5a)	Supplier relationship (F5b)
5a	0.80	
5b	0.79	
5c	0.73	
5d		0.78
5e		0.86
5f		0.80
5g	0.60	0.47
5h	0.63	0.38
Reliability	0.7503	0.8079

Note: Supplier quality management is finally split into two factors and named as supplier quality assurance and supplier relationship after convergent validity testing; in addition, two items (5g and 5h) are not included into the two new factors because of indistinctive loading (factor loading > 0.35 in both factors)

correlation with the perceived ISF quality performance ($r =$ 0.55, for the first one, and $r = 0.31$ for the other, at significant p-value < 0.0001), it was decided to divide "Supplier quality management" (F5) into two new factors called "Supplier quality assurance" (F5a) and "Supplier relationship" (F5b) hereafter. The result is shown in Table II. Two items, items 5g and 5h, were excluded from Table II so that the above two new factors can be distinctly formed. The α values of the two newly-formed factors were computed and presented in Table III. After the test, our proposed nine TQM factors have become ten TQM factors. The two new factors passed the within-scale factor analysis and demonstrated unidimensionality. The final factor loading of each item to its corresponding TQM factors is shown in Table IV.

Next, discriminant validity of the proposed instrument was executed. Discriminant validity refers to the extent to which measures of two different constructs are relatively distinctive, that their correlation values were neither absolute value of 0 nor 1 (Campbell and Fiske, 1959). Table V shows that correlation between the ten TQM factors range between values of 0 and 1. Hence, they are not perfectly correlated. Moreover, we further followed a more stringent rule proposed by Smith *et al.* (1996). That is, if the average amount of variance extracted of a factor is greater than the squared correlation between that and every other factor, the factor exhibits discriminant validity. Table V shows that the ten TQM factors exhibit dicriminant validity because the average amount of variance extracted by each factor is greater than the associated square correlations.

Content validity refers to the extent to which an instrument covers the meanings included in the concept (Babbie, 1992). Researchers, rather than proving by statistical testing, subjectively judge content validity. The content validity of the proposed instrument is at least sufficient because the instrument is carefully refined from a proven instrument with an exhaustive literature review process.

Criterion related validity refers to the extent to which the factors measured are related to pre-specified criteria (Saraph *et al.*, 1989). In this study, if our TQM factors are highly correlated to the ISF quality performance, our TQM factors demonstrate a criterion-related validity. Table VI shows the computed Pearson correlation carries all positive values with the significant level at p-value < 0.0001. In addition, the multiple correlation coefficient computed for the ten TQM factors is 0.8214, which further indicates that the ten factors are related to ISF user satisfaction. Hence, the ten factors exhibit the criterion-related validity.

Discriminant analysis

Table VI shows that the ten TQM factors have a moderate to strong positively significant correlation with ISF user satisfaction (r value ranges from 0.31 to 0.76, p-value < 0.0001). It shows evidence that the proposed TQM factors have a positive relationship with ISF quality performance. Next, a test was conducted to examine if the ten proposed TQM factors can be used to discriminate the performance between good quality performers (GQP) and poor quality performers (PQP).

Two-factor discriminant analysis was employed to achieve the purpose. Two-factor discriminat analysis requires a categorical dependent variable and one or more metric independent variable(s). Hence, we divided our respondents into two groups which, based on the average, perceived IS user satisfaction

Name of factor	Items deleted	Items included	Maximum Cronbach alpha value
Supplier quality assurance (F5a)	–	5a, 5b and 5c	0.7503
Supplier relationship (F5b)	–	5d, 5e and 5f	0.8079

Table III. Reliability of the two new factors constructed

Items	F1	F2	F3	F4	F5a	F5b	F6	F7	F8	F9
1a	0.79									
1b	0.80									
1c	0.82									
1d	0.82									
1e	0.67									
1f	0.82									
1g	0.83									
1h	0.80									
1i	0.82									
1j	0.76									
1k	0.72									
1l	0.79									
1m	0.78									
2a		0.90								
2b		0.92								
2c		0.92								
2e		0.92								
3a			0.70							
3b			0.87							
3c			0.88							
3d			0.81							
3e			0.79							
3f			0.75							
3g			0.84							
3h			0.80							
4a				0.83						
4b				0.75						
4c				0.76						
4d				0.86						
4e				0.85						
4f				0.81						
5a					0.86					
5b					0.80					
5c					0.78					
5d						0.77				
5e						0.90				
5f						0.88				
6a							0.69			
6b							0.71			
6c							0.77			
6d							0.79			
6e							0.74			
6f							0.70			
6g							0.66			

(*Continued*)

Table IV.
Factor loading of the ten TQM factors

Items	F1	F2	F3	F4	F5a	F5b	F6	F7	F8	F9
6h							0.73			
6i							0.78			
6j							0.77			
6k							0.76			
7a								0.80		
7b								0.87		
7c								0.89		
7d								0.85		
7e								0.77		
7f								0.85		
7g								0.75		
8a									0.81	
8b									0.82	
8d									0.77	
8e									0.76	
8f									0.82	
8g									0.78	
8h									0.66	
9a										0.71
9b										0.75
9c										0.82
9d										0.74
9e										0.82
9f										0.86
9g										0.85
9h										0.77

Notes: Where F1 = IS top management support; F2 = role of IS quality group; F3 = training; F4 = IS product/service design; F5a = supplier quality assurance; F5b = supplier relationship; F6 = process management; F7 = quality information reporting; F8 = employee relations; F9 = user focus

Table IV.

scores. Those respondents who obtained a mean score value of ISF user satisfaction higher than three were classified into the GQP grouping. Those obtained a score lower than three are grouped into the PQP group. All samples that scored a scale of three for user satisfaction were excluded because their perceived views of ISF user satisfaction were simply impartially difference. Based on this rule, a total of 104 respondents were grouped as GQP and 78 respondents were grouped as PQP. Therefore, a total of 182 observations were analyzed by the stepwise discriminant procedure in the SPSS program. The stepwise procedure continuously evaluates all variables at each step and selects the variable with the greatest discriminating power to enter into the predictive model based on the Wilks' Lambda value (Norusis, 1993). To examine the relative discriminating power of each variable, discriminant

Average	F1 (0.622)	F2 (0.788)	F3 (0.650)	F4 (0.655)	F5a (0.667)	F5b (0.723)	F6 (0.542)	F7 (0.685)	F8 (0.604)	F9 (0.628)
F2	0.602									
SC	(0.362)									
F3	0.747	0.557								
SC	(0.558)	(0.310)								
F4	0.588	0.495	0.611							
SC	(0.345)	(0.245)	(0.373)							
F5a	0.597	0.416	0.578	0.589						
SC	(0.356)	(0.173)	(0.334)	(0.347)						
F5b	0.326	0.363	0.346	0.399	0.390					
SC	(0.106)	(0.132)	(0.120)	(0.159)	(0.152)					
F6	0.585	0.524	0.651	0.736	0.572	0.408				
SC	(0.342)	(0.275)	(0.423)	(0.542)	(0.327)	(0.166)				
F7	0.617	0.534	0.629	0.636	0.543	0.320	0.736			
SC	(0.381)	(0.285)	(0.396)	(0.404)	(0.295)	(0.102)	(0.542)			
F8	0.631	0.503	0.665	0.563	0.534	0.273	0.727	0.699		
SC	(0.398)	(0.253)	(0.442)	(0.317)	(0.285)	(0.075)	(0.529)	(0.489)		
F9	0.651	0.586	0.665	0.654	0.538	0.345	0.732	0.755	0.760	
SC	(0.423)	(0.343)	(0.442)	(0.428)	(0.289)	(0.119)	(0.535)	(0.570)	(0.578)	

Notes: all correlations are significant at *p* value > 0.0001; where average = average of variance extracted; SC = squared correlation; F1 = IS top management support; F2 = role of IS quality group; F3 = training; F4 = IS product/service design; F5a = supplier quality assurance; F5b = supplier relationship management; F6 = process management; F7 = quality information reporting; F8 = employee relations; F9 = user focus

Table V.
Result of discriminant validity

loadings, sometimes called structural correlation, was scrutinized because it is regarded as a better measure than discriminant coefficient (Grover, 1993). The larger the discriminant loadings, the stronger the relationship between the factor and the discriminant function. The sign attached to the loading shows a positive or negative relationship with the discriminant function (Hair *et al.*, 1995). In our research, a positive sign indicates the factor is contributing to good performance, and vice versa. Percentage of variance that can be explained by the discriminant function is denoted by the value of canonical squared

	F1	F2	F3	F4	F5a	F5b	F6	F7	F8	F9
QP	0.63	0.53	0.54	0.66	0.55	0.31	0.68	0.71	0.67	0.76

Notes: multiple correlation coefficient = 0.821; where, F1 = IS top management support; F2 = role of IS quality group; F3 = training, F4 = IS product/service design;
F5a = supplier quality assurance; F5b = supplier relationship; F6 = process management; F7 = quality information reporting; F8 = employee relations; F9 = user focus,
QP= perceived ISF user satisfaction

Table VI.
Correlations between the ten TQM factors with the perceived ISF quality performance

correlation. The overall fit of a discriminating model can be assessed by the percentage of samples that can be correctly classified, or collectively called the hit ratio. If the value of hit ratio is larger than a pre-specified cutting score, the model is said to be effective. Several methods can be used to determine a cutting score. One of them is called maximum chance criterion (Hair *et al.*, 1995). According to this method, the cutting score is the ratio of sample size of the largest group to the total sample size, that is 104/182 = 0.57, or 57 percent in this study.

Table VII summarizes the result of stepwise discriminant analysis. It shows that three TQM factors were discriminated from the behavior of GQP and PQP: user satisfaction (F9), IS top management support (F1), and IS product/service design (F4). From the discriminant loadings, user focus (F9) has the highest discriminating power ($r = 0.85$), IS top management support (F1) is second ($r = 0.74$), and IS product/service design (F4) is in third place ($r = 0.72$). The discriminant function has a canonical squared correlation equal to 0.54 and is statistically significant with Wilks' Lambda = 0.46, *P* value = 0.0000. The discriminating model has a hit ratio about 84.15 percent, much higher than that of maximum chance criterion, i.e. 57.14 percent. Hence, the proposed model is an effective model in classifying the two measuring group, GQP and PQP. The remaining seven TQM factors have discriminant loadings ranging from 0.37 to 0.71. Although the discriminant loadings of the remaining seven factors were high, they were not selected as significant discriminant factors.

It further noted that the discriminant loadings of the three significant TQM factors all carried a positive value. This observation indicates that the GQP

Name of factor	Discriminant loadings
User focus (F9)	0.85[a]
IS top management support (F1)	0.74[a]
IS product/service design (F4)	0.72[a]
Training (F3)	0.71
Process management (F6)	0.67
Quality information reporting (F7)	0.64
Employee relations (F8)	0.61
Supplier quality assurance (F5a)	0.54
Role of IS quality group (F2)	0.51
Supplier relationship (F5b)	0.37
Group centroid for GQP	0.93
Group centroid for PQP	–1.25
Wilks' Lambda	0.46
P-value	0.0000
Canonical squared correlation	0.54
Hit ratio	84.15

Note: [a] factors entered into the stepwise model

Table VII. Result of the discriminant analysis group viewed the user focus (F9), IS top management support (F1), and IS product/service design (F4) as more frequently adopted practices than did the PQP group. Since there is no negative significant discriminant loadings revealed in the findings, no conclusion can be drawn as to any particular type of TQM factors that the group of PQP emphasized.

Discussion

Three TQM factors were singled out as a high frequency of TQM practices for the GQP group rather than the PQP group: user focus (F9), IS top management support (F1), and IS product/service design (F4). The discriminant loadings of three TQM factors were reported as positive values, which implied that these TQM factors enhance a higher satisfactory level of ISF user satisfaction. The PQP group paid less attention to these three TQM factors, therefore a lower satisfactory level of quality performance is thus revealed.

User focus (F9) has the highest discriminant loadings, $r = 0.85$. This result revealed that the GQP group emphasizes this factor more than the PQP group. A high emphasis on user focus allows the PQP group to understand of users' needs better, therefore their user satisfaction level displays a high success rate. This finding upholds the main theme of TQM practices. Satisfying customers' needs is to emphasize customers, of their needs and the shift of their focus of direction. Thus user focus is the most important element revealed here. It is thus advised that the PQP group should take steps to remedy the negligence of this factor.

IS top management support (F1) was ranked as the second highest significant discriminant loading ($r = 0.74$). This result implied factor (F1) permits the GQP group to gain a higher user satisfaction level than the PQP group. The IS top management of the PQP group should take an active role in participating in the TQM practices in the ISF setting so that integrative benefits of TQM can be enhanced in this department. Top management support and participation are imperative for any organization that claims quality product as a slogan (Daily, 1992).

IS product/service design (F4) was ranked as the third highest significant discriminant loading ($r = 0.72$). The GQP group paid more attention to the IS product design than the PQP group. It is generally believed that a high emphasis on factor (F4) would facilitate the lesser-detected errors of IS products and thus contribute to a high level of user satisfaction. Therefore, the PQP group should again not neglect this TQM factor.

Although the remaining seven TQM factors revealed insignificantly discriminant ISF factors in this study, one should not ignore their important contributions in TQM practice. The reason was that this paper dealt only with the different TQM practices between GQP and PQP groups, the significance and contribution of TQM factors in ISF were not discussed here.

Conclusion

This study extended past research efforts in searching for effective management methods to govern ISF. This study was based on a questionnaire survey that evaluates the difference between the satisfying and dissatisfying groups of quality services rendered by ISF. Respondents were asked to evaluate the level of adoption of TQM concept in the ISF. A total of ten TQM factors were used for evaluation. Through tests of reliability and validity, the proposed instrument was determined to be a good measurement tool. The results revealed that the effective ISF performers exercise the following three TQM practices more than the less effective group of TQM practitioners: user focus (F9), IS top management support (F1) and IS product/service design (F4).

Although the remaining seven factors revealed no significant difference between the two groups of study, these factors may remain as relevant factors to a good performance for ISF. It is claimed that the dissatisfying group should pay much more attention to the adoption of the three significant TQM factors so that the level of qualify performance can be improved.

For practitioners, the results of this paper promote the use of TQM. However, a careful study of effective ways to implement each TQM factor is significantly important. The success of strategic use of TQM is very much dependent on the way in which factors are enforced. This paper particularly shows that TQM factors of user focus, IS top management support, and IS product/service design are the areas that require the special attention of managers. It is, however, not implied that practitioners should pay less attention to the remaining seven TQM factors. This is because each TQM factor is, to a certain degree, correlated to one and another, and managers are thus required to play an active role in coordinating these events so that a fruitful result can be readily enhanced.

For academics, there is much verification work needed to be done in evaluating the applicability of TQM in organizations. Although it is claimed in the literature that TQM is mainly beneficial to a company as a whole, we are not sure if the TQM concept is equally applicable to all functional units. For example, we need to examine further if the remaining seven TQM factors are significantly relevant when appled to functional units such as information system function, human resource function, and accounting function. Some of these questions will be examined thoroughly in an expanded version of this paper.

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Appendix. Operationalized items of TQM factors

Factor 1. Role of ISF top management (F1)

(1a) Our top ISF executives (responsible for ISF profit and loss) assume responsibility for quality performance.

(1b) Acceptance of responsibility for quality by major department heads/project leaders/ supervisors within our ISF.

(1c) Our ISF top management is evaluated for quality performance.

(1d) Our ISF top management supports long term quality improvement process.

(1e) Participation by major department heads/project leaders/supervisors supports long term quality improvement process of ISF.

(1f) Our ISF top management has objectives for quality performance.

(1g) Specificity of quality goals within our ISF.

(1h) Comprehensiveness of the goal-setting process for quality within our ISF.

(1i) Quality goals and policies are understood within our ISF.

(1j) Importance attached to quality by our ISF top management in relation to cost and schedule objectives.

(1k) Review of quality issues in our ISF top management meetings.

(1l) Our ISF top management considers quality improvement as a way to increase effectiveness and efficiency.

(1m) Comprehensiveness of the quality plan within Our ISF.

Factor 2. Role of the IS quality group (F2)

(2a) Visibility of the group.

(2b) The group's access to our ISF top management.

(2c) Degree of autonomy of the group.

(2d) Amount of coordination between the group and other ISF department/personnel.

(2e) Effectiveness of the group in improving quality.

Factor 3. Training (F3)

(3a) Specific work-skills training (technical and vocational) given to employees throughout our ISF.

(3b) Quality-related training given to employees throughout our ISF.

(3c) Quality-related training given to managers and supervisors throughout our ISF.

(3d) Training in the "total quality concept" (i.e. philosophy of company-wide responsibility for quality) throughout our ISF.

(3e) Training in the basic statistical techniques (such as histogram and control charts) in our ISF as a whole.

(3f) Training in advanced statistical techniques (such as design of experiments and regression analysis) in our ISF as a whole.

(3g) Commitment of our ISF top management to employee training.

(3h) Availability of resources for employee training in our ISF.

Factor 4. IS product/service design (F4)

(4a) Thoroughness of new IS product/service design reviews before the IS product/service is produced, and operationalized.

(4b) Coordination among affected departments in the IS product/service development process.

(4c) Quality of new IS products/services emphasized in relation to cost or schedule objectives.

(4d) Clarity of product/service specifications and procedures (e.g. user requirement specification, user training procedures).

(4e) Extent to which implementation/producibility is considered in the IS product/service design process.

(4f) Quality emphasis by our ISF staff.

Factor 5. Supplier quality management (F5)

(5a) Suppliers are selected based on quality rather than price or schedule.

(5b) Thoroughness of the supplier rating system.

(5c) Reliance on reasonably few dependable suppliers.

(5d) Amount of education of supplier by ISF.

(5e) Technical assistance provided to the suppliers.

(5f) Involvement of the supplier in the IS product development process.

(5g) Extent to which longer term relationships are offered to suppliers.

(5h) Clarity of specifications provided to suppliers.

Factor 6. Process management (F6)

(6a) Amount of preventative equipment maintenance.

(6b) Inspection, review, or checking of work is automated.

(6c) Amount of testing incoming products.

(6d) Amount of testing intermediate products within our ISF.

(6e) Amount of testing final products within our ISF.

(6f) Timeliness of project schedule.

(6g) Degree of automation of the process (e.g. use of CASE tools in system development process).

(6h) Extent to which IS related process design is "fool-proof" and minimizes the chances of employee errors.

(6i) Clarity of work or process instructions given to employees.

(6j) Continuous process improvement is sustained to achieve zero defect.

(6k) Thoroughness of documentation is done (e.g. user requirement specification, design specification, operation procedures) .

Factor 7. Quality information reporting (F7)

(7a) Availability of cost of quality data/information in our ISF.

(7b) Availability of quality data/information.

(7c) Timeliness of the quality data/information.

(7d) Quality data/information are used as tools to manage quality.

(7e) Quality data/information are available to employees.

(7f) Quality data/information are available to managers and supervisors.

(7g) Quality data/information are used to evaluate supervisory and managerial performance.

(7h) Quality data/information, control charts, etc. are displayed at employee work places.

Factor 8. Employee relations (F8)

(8a) Quality circle or employee involvement type programs are implemented in our ISF.

(8b) Effectiveness of quality circle or employee involvement type programs in our ISF.

(8c) IS employees are held responsible for error-free output.

(8d) Amount of feedback provided to IS employees on their quality performance.

(8e) Participation in quality decisions by non-supervisory IS employees.

(8f) Quality awareness building among employees is ongoing.

(8g) IS employees are recognized for superior quality performance.

(8h) Effectiveness of IS supervisors in solving problems/issues.

Factor 9. User focus (F9)

(9a) Near and long term customer expectations and requirements are determined by our ISF.

(9b) Strategies to understand and anticipate customer needs are developed and used by our ISF (e.g. user involvement).

(9c) Effective management system in response to and follow up with users' need is existed in our ISF.

(9d) Good relationships with our users is built by our ISF.

(9e) Formal process to determine user satisfaction is existing in our ISF.

(9f) Processes for determining user satisfaction are evaluated and improved.

(9g) Our user satisfaction and dissatisfaction results using key measures and/or indicators in our ISF.

(9h) Our user satisfaction results with the best practices inside/outside company is compared by our ISF.