Total Quality Management

A conceptual framework for managing end-user computing by the total quality management strategy

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Abstract *As organizations face diverse changes, staff members require increasing amounts of information to manage task uncertainty and complexity. Information technology continues to improve. End-users using, developing and establishing application systems—referred to as end-user computing (EUC)—have grown rapidly in organizations. Although EUC can improve an organization's effectiveness, its resistance to control keeps it from bringing the expected benefits and often results in wasted investment. Organizations implementing total quality management (TQM) objectives are those which are boosting quality and effectiveness throughout the organization. The essence of TQM is a convergence management process, while EUC's essence is that of diverging innovation. This paper proposes a framework for managing EUC under TQM, thinking that the TQM strategy can solve the problems and risks produced in EUC. In view of the need for high quality information, implementation of TQM can contribute continuous improvement to EUC activity. Applying the EUC empowerment concept can enforce autonomy and responsibility in EUC activity and increase the satisfaction of the organization's internal and external customers. The result is that EUC retains its inherent freedom and flexibility, alongside the quality culture and high quality information produced under TQM.*

Introduction

From the end of the 1970s, business has faced a rapidly changing environment; hence, organization members need more information to manage task uncertainty and complexity. This has required information systems departments to hire more systems analysts and programmers to develop and maintain application systems for end-users. This is a very time-consuming process, resulting in the information systems department not keeping up with users' requirements, or in systems which do not actually provide what the user really wants to manage the ever-changing, large quantity of information demanding attention (Alavi, 1985; Alavi & Weiss, 1985–6; Alavi *et al.*, 1987–8; Amoroso, 1988; Pyburn, 1986–7). However, information technology (IT) has made a lot of advances; workstations and personal computers are commonplace. Commercial software which is easy to use and offers user-friendly interfaces is plentiful. Decentralized organizational management has resulted in users

being able to use, develop and control appropriate applications systems. Researchers have come up with the term 'end-user computing' (EUC) to describe this phenomenon in organizations (Alavi, 1985; Brancheau & Brown, 1993; Canning, 1983; Davis & Olson, 1985; McLean & Kappelman, 1992–3; Rockart & Flannery, 1983; Wetherbe & Leitheiser, 1985).

EUC activity is already diffused throughout the organization. All levels of workers can use microcomputers, workstations or networks to improve their task performance. EUC has achieved rapid acceptance in organizations; it can be regarded as an innovative phenomenon in the use of IT. EUC can enable end-users to reduce task uncertainty and complexity, as well as to satisfy the end-users' diverse information needs and increase their information-processing capabilities. Hence, EUC is key to improving information-handling efficiency, one of the solutions available to problem-solving. Many studies also discuss EUC's disadvantages, including selection of unsuitable hardware and software, incorrect systems analysis or design, lack of data integrity or system compatibility, etc. If these are not addressed, not only is there no benefit from EUC, but this lack of cost-effectiveness results in wasted investment (Alavi & Weiss, 1985–6; Sumner & Klupper, 1987).

Recently, a very popular concept in the management field has been the philosophy of total quality management (TQM), which brings quality management activity into the whole organization, not leaving it solely on the production line. TQM has a customer-satisfaction orientation, building the whole business so that all departments accept the ideas of quality, faith and value (Kanji, 1990). TQM also emphasizes employee involvement to improve processes, promoting quality culture and outcome continuously (Dotchin & Oakland, 1992; Morrison & Rahim, 1993).

As already discussed, EUC's purpose is to allow end-users to use, control and develop application systems directly. Therefore, the essence of EUC is a divergence of innovative activity, resulting from end-users building application systems to solve the problems they face; that is, a problem-solving orientation. But the essence of TQM is a convergence of management processes, asking for company-wide cooperation to meet the quality goal. Hence, this paper will address the issue of how to use the TQM strategy to manage EUC, maintaining the tight organizational management of the TQM strategy, while achieving the users' freedom of EUC, with the end result being high information quality.

This paper is divided into five sections. The first is an introduction, describing the motivation for this study, and the purpose of the paper. The second is a literature review, with the main point being to review TQM and EUC research and current status. The third section proposes the framework for using the TQM strategy to manage EUC. The fourth addresses the research propositions based on the conceptual framework. The last section discusses directions for future research.

Literature review

Benefits and risks of EUC

Cotterman and Kumar (1989) defined EUC as a means for end-users—non-information department staff—to increase work performance and task quality through using, developing and controlling information systems to satisfy the process of meeting information requirements, directly or through consultation with information centre professionals. Besides satisfying individuals' desire for work autonomy, this process must also be responsive to the organization in the area of task responsibility, especially in providing the high quality of information which yields customer satisfaction (Marchand, 1990). EUC sometimes uses

Table 1. *Problems and risks in EUC infrastructure*

EUC infrastructure	Problems and risks confronting EUC
Support	Lack of education for end-user; lack of support for end-user
Technological	Database not easy to access; incompatible soft/hardware; poor documentation; lack of documentation; not suited for system analysis and design; use of wrong software tools; solving wrong problems
Data	Lack of data security; lack of data integrity; incompatible data
Evaluation/justification and planning	Lack of top management planning; top management afraid of computers; lack of recognizable economic benefits

fourth-generation tools and very powerful software packages to meet business requirements. Thus EUC can bring the following three benefits to companies (Alter, 1996):

- improved end-users' requirements determination, and more accurate determination of business requirements;
- increase in end-users' involvement and satisfaction, boost in work autonomy;
- reduction in application systems backlog, decreased dependence on information professionals.

Although EUC is a future thrust, with expectations for benefits to be confirmed by end-users, development with no control and no direction will bring about short- and long-term risks (Canning, 1983; Galletta & Hufnagel, 1992). Henderson and Treacy (1986) basically covered all kinds of problems related to EUC, which can be divided into four fundamental infrastructure issues: support infrastructure; technological infrastructure; data infrastructure; and evaluation/justification and planning. Based on the investigations of Alavi and Weiss (1985–6), Amoroso (1988), Brown and Bostrom (1989, 1994), Henderson and Treacy (1986) and Pyburn (1986–7), we have categorized each type of EUC problem and risk as shown in Table 1.

EUC management models

For organizations to benefit from the phenomenon and activity of EUC, top management or information departments must invest in strategic planning and evaluation, and even in EUC support service, creating control policies and process management to prevent the evolution of potential 'white elephants'. Academia has developed many different management models to address the diverse dimensions of EUC under study. The following is an outline to bring out and discuss some criticisms.

- *Managed free economy approach:* Gerrity and Rockart (1986) argued that previous EUC management methods, such as monopolist, *laissez-faire* and information centre, all have drawbacks. They proposed a new management approach which is similar to the planned free economy approach in economics. This concept uses more of an evolving management method for EUC, but lacks implementation methodology for how to use a planning approach to reach EUC objectives.
- *Contingent strategic perspective approach:* Henderson and Treacy (1986) proposed that an organization's EUC depends on the balance between support and control in

management and strategy. They also proposed an evolving management framework to allow management of different growth stages utilizing different actions—from the implementation and marketing perspectives, leading to the operations perspective and finally reaching the economic perspective. These four perspectives have to match the EUC growth framework in order to form a basis for strategy. We can derive different goals, strategy, structure and control mechanisms for each different stage. However, these perspectives are all just contingent thinking; there is no effective method for reference.

- *Expansion/control approach:* From empirical studies of information centre managers, Munro *et al.* (1987–8) discovered that the EUC strategy can be considered to be divided into two dimensions: expansion, meaning the rate of development of EUC in a business; and control, meaning the restriction of end-user choice and activity at each step. Each dimension has a high and low degree which creates a matrix with four cells: *laissez-faire* acceleration, containment and controlled growth. This matrix is an EUC management strategy grid. Unfortunately, there is no guideline for how to lead the company from one strategy to another.

All these management models are based on information centre-based thinking about growth and control of EUC in the organization. They lack totality and integrated solutions for addressing EUC problems and risks.

TQM philosophy

TQM is a new management philosophy permeating our approach to doing business that quality is not just the responsibility of a certain department but, rather, a responsibility shared by all (Berk & Berk, 1993). This is one of the reasons why our study proposes TQM as a total solution. TQM philsophy includes the following points:

- *Customer orientation:* Use customer satisfaction to define quality, not only just to pursue customer satisfaction; in other words, the starting point is pursuit of customer satisfaction, including internal and external customers.
- *Total employee involvement:* The involvement chain not only includes the organization's employees, but also reaches back to suppliers' employees and forward to the customers. The involvement process must include two sides: empowerment and accountability.
- *Top management commitment:* Top management should completely understand the corporation, using systematic thinking to oversee all departments (Wilkinson & Witcher, 1993). It must carefully consider compatibility, not only individual structures, for that can break down interdepartmental barriers, leading to the evolution of corporate quality culture and the establishment of shared vision and values.
- *Continuous improvement:* Evaluate and correct the outcome in the transformation process from customer needs to customer satisfaction. Only then can customer satisfaction really be achieved.
- *Education and training:* Any organization's value chain integrates the field of study (Nevis *et al.*, 1995). Establishing an organization's study systems will help in the acquisition, expansion and use of new knowledge, technology, vision and values to accelerate an organization's innovation and transformation.
- *Emphasis on quality technology:* Quality technology and tools can help employees to uncover problems, resolve problems and prevent deviations.
- *Establishment of quality culture:* Shared vision and values can define quality corporate

culture. Establishing a TQM quality culture for staff in different departments can build consensus and avoid self-centredness and inward thinking.

In theory, this type of methodology can be used for the management of EUC because the convergence of TQM can give boundaries to the free and diverging nature of EUC—which otherwise easily leads to trouble. Our paper, based on this kind of thinking, tries to apply the TQM strategy to EUC management.

A conceptual framework for managing EUC by TQM

Management of EUC by TQM: Extension of quality essence

When thinking of applying TQM to the management of EUC, we have to explore why TQM can solve EUC problems and how to do this. Our paper's premise is that when an organization applies TQM, this introduces a complete quality concept throughout the organization. It brings the positive effect of group consensus, and increases the individuals' sense of self-management and setting of self-demands (Grant *et al.*, 1994; Morrison & Rahim, 1993; Pierson *et al.*, 1990; Redman, 1995). This is the latest trend in management paradigms; applying it to EUC can set boundaries for EUC activity that will increase benefits to the whole organization. Inasmuch as EUC processes lead to divergence and freedom, easily leading to inconsistency and decreased output quality, EUC can often not produce the expected benefits. Our study suggests that managing in the TQM context can result in improved quality of information and hence this combination is an approach worth studying. Table 2 explains how the TQM strategy provides a boundary-setting method for EUC infrastructure issues.

From Table 2, it can be seen that these four management methods utilize the essence of TQM to solve the risks of EUC. This also points to the four infrastructure issues raised by Henderson and Treacy (1986), using quality management methods for solutions, as illustrated in Fig. 1.

Table 2. *TQM boundary-setting method applied to EUC infrastructure issues*

| EUC infrastructure problems	TQM strategy	Boundary-setting method
Support	Training/education	End-user involved in TQM education; delegate responsibility for quality; support for and coordination of decisions; company-sponsored training in EUC tools and technology
Technological	Quality technology	Establish standards for soft/hardware suppliers; quality assurance in service; soft/hardware compatibility; quality evaluation of EUC tools and technology
Data	Process management	Data security control; data back-up; consistency in data form and structure; professionalism in EUC flow charts
Evaluation/justification and planning	Ensuring accountability	Top management investment in value of TQM; evaluation of EUC performance and data quality; identification of EUC and TQM areas of responsibility; development of company strategy and goals for EUC
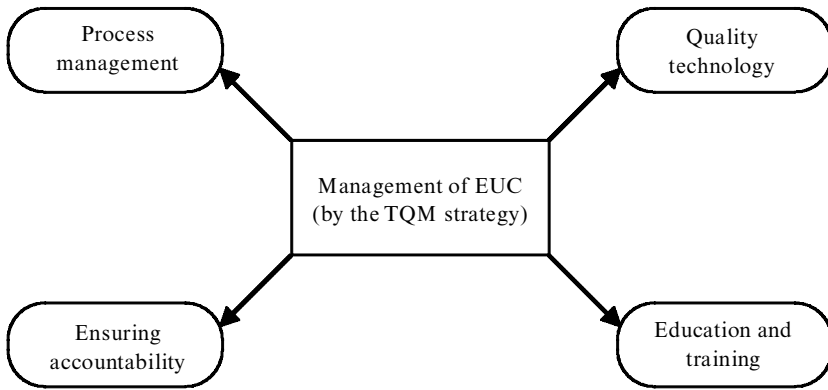
Figure 1. *Management of EUC by TQM.*

Corporate EUC: Top management commitment and employee involvement

Examples of successful TQM application show that TQM implementation must have top management commitment and employee involvement (Dotchin & Oakland, 1992; Porter & Parker, 1993; Powell, 1995). Top management commitment is for continuous investment in the mission of and tasks related to company quality, especially pursuit of excellent quality as part of the company's core strategy. Under this strategy, employee involvement is the key to spreading the pursuit of quality to every area of the company. Everyone will be included in the company's quality expectation, with the final goal being satisfying customers' diverse needs, creating more benefits and good reputation.

A number of information management scholars have predicted that the future will have both a strong push and a strong pull in the area of information technology (Alavi, 1985; Brancheau & Brown, 1993; Davis & Olson, 1985; McLean & Kappelman, 1992–3; Wetherbe & Leitheiser, 1985). This has forced organizations to move towards a corporate EUC environment, forming a type of organization centred on EUC, with support from an information centre. In this type of organization, middle management decreases, leading to a flattened administrative phenomenon, with the decision span and autonomy of end-users gradually increasing. Hence, one of the conditions for successfully using the TQM strategy to manage EUC is having the context of top management commitment and employee involvement. This is the essential condition for forming a corporate EUC environment.

Elevating information quality: Continuous improvement of EUC

The concept of information quality is more important than ever to business. Just as quality in goods/services has the capacity to satisfy people's needs (Dotchin & Oakland, 1992; Rajagopal *et al.*, 1995); information quality in decision-making has the capacity to satisfy internal and external customers. Hence, information quality has different implications under different decision dimensions. When EUC activity becomes an essential organizational trend, it can provide internal and external customer service—where the service form is presentation of information and the content is the quality concept.

The meaning of information quality, speaking on the basis of information systems concepts and purpose (data–information–decision–action), is that which achieves effective outcomes in making the right decisions. Decisions must be based on good, high-quality information, so information quality improvement is the critical element for EUC. But it is
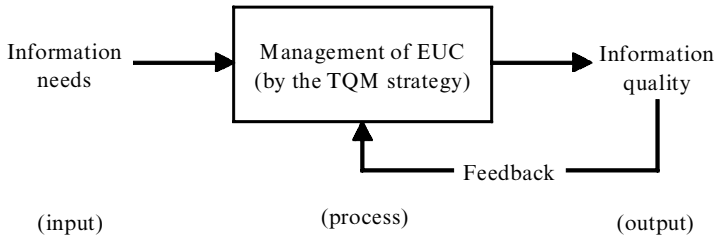
Figure 2. *Management of EUC and information quality.*

difficult to evaluate the value of information quality; moreover, the evaluation must be based on the actions resulting from all kinds of decisions made by the information user (Davis & Olson, 1985). If we analyze information quality from the point of view of the end-user, we generally have eight indices for reference: actual value, features, reliability, meaning over time, relevance, validity, aesthetics and perceived value (Marchand, 1990). In that we can see the close relationship between information quality dimensions and different levels of EUC activity, this paper maintains that EUC activity—regardless of whether it is solving problems or providing services for other users—must have improved information quality as the objective. Thus, the essence of managing EUC by the TQM strategy is the feedback process from input—different information needs—to outputs—high information quality—as shown in Fig. 2.

Thus, while EUC is in pursuit of high-quality information for output results, the end-user is facing input of diverse outside information needs. It is essential to think how to go through the proper transformation process, so that requirements for high information quality can be met. Besides being able to satisfy EUC infrastructure problems, the TQM strategy can also contribute a drive for continuous improvement to EUC. EUC must be disciplined by this kind of drive for continuous improvement. As end-users continuously refine information quality through feedback, value is added to decisions made with information provided through this kind of process.

Integrating previous deductions, we can use Fig. 3 to show management of EUC under TQM implementation. Through four quality management methods, EUC's four infrastructure problems are remedied, adding top management commitment and employee involvement to set the organization on a corporate EUC course. In order to seek a high information
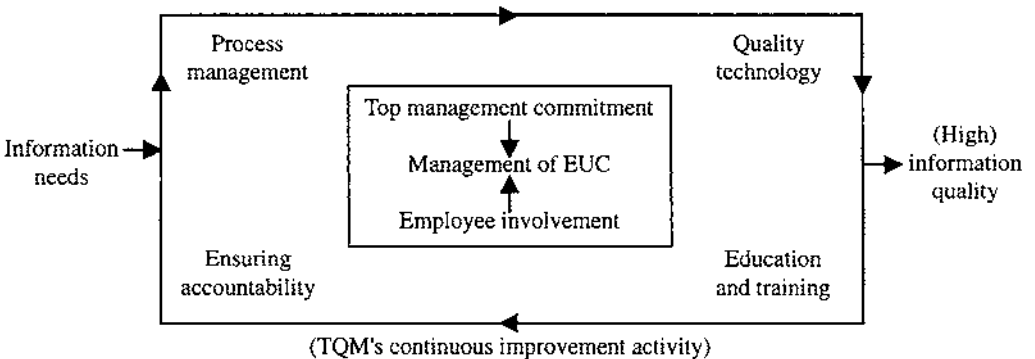

Figure 3. *Management of EUC by continuous improvement.*

quality outcome from EUC, the drive for continuous improvement must be added. In addition, Fig. 3 includes three meanings.

- According to the systems approach, EUC input is different kinds of information needs, and the output side is high information quality. The critical element is the process, meaning the process of transforming information needs into high information quality. This process is EUC centred, relying on the end-user's development, use and control to provide self or others with information necessary to make decisions.
- According to the driving force of TQM, the process retains the drive for continuous improvement so that TQM's four management strategies can solve the risks faced by EUC. Simultaneously, under top management commitment and employee involvement, a continuous improvement activity loop is formed for the pursuit of high information quality.
- According to the EUC management, applying the TQM strategy can cause the end-users to raise their quality concept, forming a corporate-wide consistent quality culture. Under this culture, EUC activity can more easily fit the corporate boundaries, not becoming too divergent. Such divergence would result in inability to integrate application systems or in a waste of EUC investment.

EUC empowerment: Based on customer satisfaction

Empowerment is the latest trend in management concepts (Shrednick *et al.*, 1992). In light of the complexity of the environment, a manager cannot do everything alone; he/she must delegate freedom of discretion in work or delegate decision-making to his/her staff so that staff members can take responsibility for making decisions in their tasks (Bowen & Lawler, 1992, 1995; Rothstein, 1995; Shrednick *et al.*, 1992). Empowerment represents staff autonomy and elevated value of individual work. It is also aggressive, initiating starting and learning. After the coming of the EUC era, if decisions are not properly delegated, EUC activities just stay in an elementary data-processing stage. If decision-making efficiency cannot increase, then certainly customer needs cannot be satisfied. Watson *et al.* (1993) have also proposed that only EUC has the suitable order for power-sharing management, adding one more benefit which EUC can bring to an organization.

In TQM philosophy, emphasis is on organizational satisfaction of customer needs, after which customer satisfaction can improve. The question is how to match customer needs and satisfaction. This study proposes that EUC empowerment is an effective method for two reasons.

(1) Because EUC empowerment allows end-users to use the computer to improve decision efficiency, this should also give end-users efficient discretion as they meet customer needs through processing, to result in improved customer satisfaction. In this process, EUC plays the role of a direct and effective middleman.

(2) Under the TQM concept, EUC outcome should have the responsibility for information quality and, even more, be responsible for customer satisfaction. EUC empowerment can force EUC activities into consensus, bring EUC under the organization goals of quality information and customer satsfaction, with self-correction and modification, in order not to deviate from corporate goals. This is necessary to avoid creating the situation of a 'reinless horse'.

Based on the previous inferences, this paper proposes the TQM strategy to manage EUC, with continuous improvement in information quality, applying EUC empowerment to
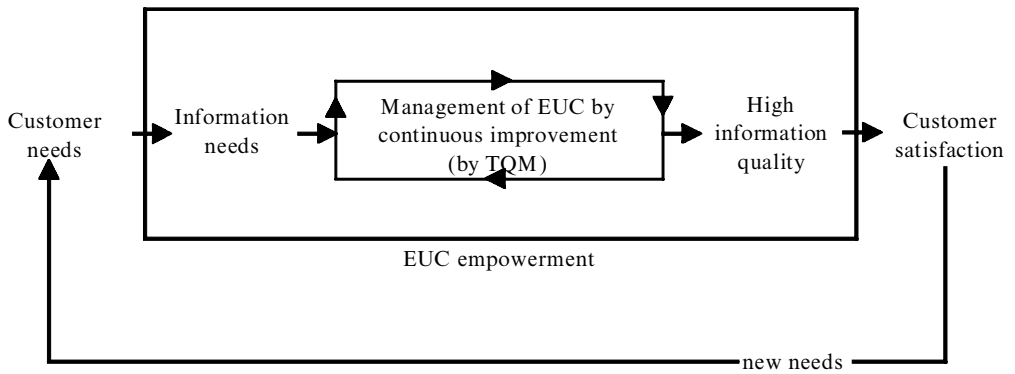
Figure 4. *Conceptual framework for managing EUC under the TQM strategy.*

strengthen the goal of customer satisfaction, forming the solid conceptual framework as illustrated in Fig. 4.

In the light of different and diverse customer needs producing a variety of information needs, our study considers that EUC empowerment activity must pursue high information quality for services to internal and external customers in order to reach the customer satisfaction. This concept emphasizes the discretion and decision-making power inherent in EUC which can not only match end-users' problems and solutions, but also directly raise the level of customer satisfaction. However, EUC empowerment is not unlimited, but should be based on the goal of pursuing high information quality. Based on the TQM drive for continuous improvement, managing EUC activity is a process which can link customer needs and customer satisfaction together, forming a framework for managing EUC by TQM strategy.

Moreover, a critical element in this framework is to point out that EUC activity must allow the end-user a range of freedom in decision-making; that is, all the autonomous decisions included in EUC empowerment, but under the 'game rules' of TQM concepts and strategy. In this way, EUC, under integrated TQM strategy and EUC empowerment, can meet the situation of customer dissatisfaction/new customer needs with responsive, rapid alterations which reduce response delays. In conclusion, management of EUC by TQM and EUC empowerment are complementary, resting neatly under quality culture, converging on the one hand and diverging on the other, achieving a balanced status.

Propositions

The framework proposed by this study comes from exploratory research; hence, the relationships between all variables need further confirmation. This framework can provide a useful viewpoint and the following propositions.

First, the TQM strategy and philsophy is a set of corporate quality pursuit concepts; it is holistic. From top to bottom, the corporation must integrate a comprehensive understanding of quality. We can see EUC as a holistic phenomenon, its quality concept reflected in the EUC outcome; that is, high information quality. So the TQM strategy can be applied to EUC, especially as TQM emphasizes the on-going improvement of each EUC process and quality system (Dotchin & Oakland, 1992).

Proposition 1: Applying the TQM strategy, such as in process management, quality technology, ensured accountability and education and training, can effectively solve the problems and risks faced by EUC.

Proposition 2: When applying the TQM strategy to solve the problems faced by EUC, TQM convergence can set boundaries for the divergence of EUC, increasing the benefits from EUC.

Again, the pursuit of quality is a task of continuous improvement; moreover, it is a mission requiring top management commitment and employee involvement (Dotchin & Oakland, 1992). Hence, EUC activity must come under management of the TQM strategy in order to acquire top management commitment and employee involvement. Only then will it be ready to progress to Corporate EUC. At the same time that an organization is implementing TQM, it is putting the drive for continuous improvement into place, to reach the goal of high-quality information.

Proposition 3: When applying the TQM strategy to support EUC, EUC must secure top management commitment and employee involvement in order to advance the organization from EUC to corporate EUC.

Proposition 4: When an organization advances to corporate EUC, it should be based on the TQM drive for continuous improvement, further assisting EUC activity to pursue its goal of high information quality.

Finally, the TQM emphasis on customer orientation and empowering employees for quality tasks as organizational goals, when applied to EUC, emphasizes EUC empowerment to enforce autonomous decisions by end-users and end-users taking responsibility for their own decisions and service quality. Thus, improvement of internal and external customer satisfaction increases organizational effectiveness (Dotchin & Oakland, 1992).

Proposition 5: When EUC activity is confronted with different customer needs, EUC empowerment must be advanced, increasing end-user autonomy, and thus boosting customer satisfaction.

Proposition 6: Application of the TQM strategy to manage EUC activity, as well as EUC empowerment and the drive for continuous improvement, are methods able to increase the effectiveness of an organization's EUC.

Conclusions and future research

Under the topic of the TQM framework for EUC, TQM is the basis for managing EUC activity. The purpose of discussing setting boundaries for problems faced by EUC under the TQM strategy is to provide solutions. After EUC growth and expansion, having entered the era of corporate EUC, top management commitment and employee involvement are two important strands of supporting strength. TQM stands for on-going corporate quality improvement, the concrete action of which is continuous improvement. While EUC is providing high information quality to internal and external customers, it must also grasp the drive for continuous improvement; only then can it use feedback for self-modification.

Empowerment is a new approach in service improvement. As the environment becomes more complex and customer requirements keep changing, the manager cannot do everything alone, but must delegate freedom of discretion in jobs and decisions to staff, letting the staff accept the responsibility for making decisions in their areas of responsibility. Empowerment represents employee autonomy and an increase in the value of individual work. It is also aggressive, initiating starting and learning. After the coming of the EUC era, if decisions are not properly delegated, EUC activity stays in an elementary data-processing stage. If decision-making efficiency cannot increase, then certainly customer needs cannot be

satisfied. Hence, EUC empowerment allows the end-user to use the computer to improve decision efficiency. This also gives end-users a large enough range of discretion as they meet customer needs through processing, resulting in efficiently improved customer satisfaction. Besides, under the TQM strategy, EUC outcome should have the responsibility for high information quality and, even more, be responsible for customer satisfaction. EUC empowerment can force EUC activity into consensus, bringing EUC under the organization goals of high information quality and customer satisfaction, with self-correction and modification, in order not to deviate from corporate goals.

Although this paper has already established a research framework, as exploratory research, it must also take the next step of refining, leading to the following three directions for future research work.

(1) Find companies which are already implementing TQM and study the phenomenon of EUC in these organizations. Investigate the effect of the TQM strategy on EUC activity.
(2) Refine and advance the study of the relationship between TQM and EUC, to give definition to and investigate the manipulation of the variables involved.
(3) Advance the propositions to become empirical hypotheses, and through empirical investigation, prove these hypotheses.

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