

CHAPTER 2

➤ REVIEW OF LITERATURE AND CURRENT STATUS

2. Literature Review

Researchers and experts in quality management view Total Quality Management as an umbrella for several business concepts, but more fundamentally there are two quite different perspectives on quality practices, 'Hard' and 'Soft' quality factors.

- The 'Hard' quality factors depend heavily on two techniques. Statistical Quality Control (SQC) and Statistical Process Control (SPC). These statistical approaches, normally applied for the measurements of production, proportion of products that do not conform to specification, reasons for this, and resultant changes that are required to prevent future similar problems. These are also used for improving the processes on continuous basis.
- The 'Soft' quality factors are people-based approach, which emphasizes empowerment, teamwork, responsibility and authority, communication, involvement, training for skill development and generating commitment to the quality policy and objectives of the organization.

Recent research on quality approaches supports the notion that people should be seen as an integral part of quality management. Mak (2000) found that the approaches on quality management practices with regard to the importance of people in successful implementation of quality programmes. Mak also argues that the Western approach is more

concerned with building an efficient system, while others prefer to seek the right people. In the past years, many good systems have been designed and developed but Mak claims that the challenges for the new millennium will be, using the right people to implement a quality system with a view to achieve business excellence.

In a wide variety of perspectives on quality practices, people are often seen as an essential part of the quality management. The top management involvement and leadership are essential for quality management success however they are not sufficient on their own. Thiagarajan and Zairi, (1997) point out that quality management succeeds only with employees' involvement in the process and their commitment to its goals. The importance of employees' involvement in the quality process of an organization is based on the belief that the best process innovation ideas come from the people actually doing the job. According to them, the quality reputation of Japanese companies is mainly credited to their great success in this area. Mak's argument with regard to the 'soft' people-based approach is similar to Deming's (1986) principle of 'Drive out fear in the workplace'. In other words, it provides an alternative view of people-based management.

Reflecting on the model of TQM proposed by Oakland (1993), the review of the literature suggests that the key components that impact on quality management implementation are synergic blend of 'hard' and 'soft' quality factors. Such factors have been thoroughly analysed by

Thiagarajan and Zairi (1997) in the article "a review of total quality management in practice: understanding the fundamentals through examples of best practice applications." According to them, systems and tools and techniques such as those that impact on internal efficiency (e.g. quality management systems, cost of quality and statistical process control), and external effectiveness (e.g. benchmarking and customer satisfaction surveys) are examples of hard quality factors.

Soft quality factors are intangible and difficult-to-measure issues and are primarily related to leadership and employee involvement. As Thiagarajan and Zairi (1997) noted, 'soft' quality factors may best be seen as issues discussed under leadership, internal stakeholders management policy. They are issues that impact on maximizing organisation-wide support and involvement in attaining the quality goals of an organisation.

As Wilkinson and Witcher (1992) demonstrated, soft quality factors may be seen as 'internal marketing' including the factors like : Top management commitment and involvement, Policy development and effective development of goals and objectives, Entire workforce commitment to quality goals of the organization, Empowerment, Effective communication, Teamwork, Training and education, System for recognition and appreciation of quality efforts and innovative ideas, and Internal customer supplier concept.

Thiagarajan and Zairi (1997) conducted a comprehensive review of literature and conclude that 'soft' elements are long-term issues, and therefore, must be emphasized and addressed accordingly in an organization's quality management implementation plan. They also emphasize that the 'soft' factors are essential to the attainment of the quality goals of the organization but these factors must be supported by the 'hard' factors to manage and improve the journey towards achieving the organizational goals and objectives. 'Hard' factors include : A documented quality management system, Supplier / customer management, Quality-control tools and techniques (SPC & SQC), Benchmarking, Performance measurement, Management by fact, Management by processes, Self-assessment etc. Moreover, 'hard' factors are described by Pegels (1993) as "tactics rather than strategies", and according to the literature these factors can extend the power of quality management in an organization.

From the above discussion it is evident that most organizations will implement some combination of these approaches. Historically, the statistical approach came first and there is a large degree of movement towards the people-based approaches.

Further, as pointed out by Oakland (1998), the requirement that quality should be inherent in the system, rather than simply a procedure for checking for faults and defects, shifts the emphasis of control from outside the individual to within, with everyone accountable for their own

performance . Deming, Feigenbaum and Ishikawa all see people as a vital element of successful quality management, whereas Crosby, Juran and Taguchi downplay their role. Another taxonomy used to structure the themes, issues, practices and trends of quality management was Oakland's (1998) model, which categories quality related issues into three dimensions:

1. Systems
2. Tools and techniques
3. People

According to the author, people aspects of quality management are as follows:

Leadership, employee involvement, teamwork, training and education, customer (internal and external) focus, ownership and self-assessment, and recognition and reward. Thus, it is a fact that people are an essential component of all human activity systems, involving people as employers, employees, customers and stakeholders. This recognition of importance of people resulted in a number of developments, including the use of socio-technical systems, and the differentiation between hard and soft systems. With regard to the systematic approach to quality management, as Waldman (1994) puts it, "performance management activities would be much more fruitful if directed at system characteristics." In particular, their reasoning was largely based on the problems regarding the degree of system contribution to variance in work performance. Further, Cardy

suggests that performance measurement in the area of quality management needs to be moved from person appraisal to an inclusive assessment of all the factors that influence performance. Only in this way can the performance measurement not be deficient.

2.2 Existing Methodologies :

2.2.1 SEI-CMM Based Approach

The Software Engineering Institute (SEI), Pittsburg, USA developed Capability Maturity Model (CMM) as a way to evaluate an organization's software development process [Humphery and Sweet,1987].It has been used by administrators of software development organizations for self assessments and their practices and processes. Humphery [1989] describes the software development process as a set of actions that efficiently transforms a user needs into an effective solution. From the literature survey it is found that, over the past several years, software process management has been touted as the key to developing software [Humphery, 1989; Paulk, Chrisis, Curtis, Weber,1993]. The development focuses on schedule, standards and practices. The CMM categorizes a software development organization one of five maturity levels. For each level, CMM specifies some key process areas(KPAs), which represent the areas on which an organization should focus if it wants to move to a particular level. [Humphery and Sweet, 1987; Jalote,2001; Paulk,1995; Agarwal and Singh, 2001]. Each KPA is associated with goals that

represent the requirements to be satisfied by process for that KPA. The KPAs for different maturity levels can be used for assessing the capability of the existing process as well as for identifying the areas that need to be strengthened so as to move the process from a lower level of maturity to a higher level. The placement is based on interviews and document reviews conducted by the assessors and on responses to a series of questions [see 1987 and 1994 version of the CMM] called maturity questionnaire. The assessment is performed by an assessment team, which is led by an SEI-authorized lead assessor, and consists of 6 to 10 experienced people [Jalote,2001] from the organization under scrutiny. The team members must be familiar with CMM and processes-related issues and receive assessment training from the lead assessor. During the course of the assessment, the team members collect information about the software process of the organization.

As a first step in assessment, the questionnaire is given to project leaders, their supervisors (middle managers), and some project team members. The answers are then compiled. If the answer to a question is overwhelmingly "yes", then the statement in the question could be treated as an observation about that practice. The assessment process requires at least two independent observations from two different sources before confirming that a practice is being followed. Frequently, however, a maturity questionnaire is used as an aid further exploration during interviews and document examination. However many points have been

raised in the form of criticisms on this process of assessment. Therefore the whole area of capability assessment is still immature and further studies and research is required.

2.2.2 ISO - 9000 Quality Management Systems Based Approach

ISO Literature survey reveals that Self-Assessment [ISO-9004:2000] is a careful considered evaluation resulting in an opinion or judgment of the effectiveness and efficiency of the organization. The indent of self-assessment is to provide fact-based guidance to organization for its improvement. It is usually performed by the organizations own management. The self-management approach described in ISO-9000 is intended to provide a simple, easy-to-use approach to determine the relative degree of maturity of an organization's (quality management) system and to identify the main areas of improvement.

ISO-9004 : 2000 (Supporting standard of ISO-9000) uses a broader perspective of to give guidance for performance management. Specific feature of ISO-9004 self assessment approach are that it can be applied to the entire organization, part of the organization or to any process of organization. Self-assessment can be carried out by a team of the multi disciplined personnel (cross-functional group of people) or even by one person in the organization who is supported by top management. Followed by group, review and analysis then consensus building to determine improvement priorities and action plans. ISO-9004 provides

guidance in the form of typical questions that the organization can ask in order to evaluate its performance for each of the main clauses in ISO.

The award models [ISO-9001, 9002 or 9003 :1994] as well as other self-assessment models have a wide range of detailed criteria for assessing the performance of management systems. Each organization should develop a set of questions against each clause of the International Standard that are suitable to its needs of the organization.

However self - assessment can be effectively and efficiently used in the organization is limited by the imagination and ingenuity of the individuals in the organizations who has an interest in achieving excellence.

The assessment is also performed by a team of qualified auditors and led by an authorized Lead Assessor. The number of team members vary as per the size of the organizations. During the assessment the auditors collect information about the process in line with ISO standard. Normally the information are elicited from the designated officials of the department with the help of questionnaires and observations are made based on the interview and objective evidences (supporting documents).

Finally the team consolidates the observations and recommended as "Satisfied Performance" only when all team members agree. If doubt persists then the possible gaps are identified and clarified during closing session of whole exercise.

2.2.3 TQM Based Approach

The Total Quality Management is a management system which has been attracting the attention of a wide range of organizations including large and small, public and private, local and multinational during the last decade. This system is designed as an integrated management philosophy and set of practices that emphasizes, among other things, continuous improvement, meeting customer's requirements, employees involvement and teamwork, to improve the quality of an organization's processes, products and services.

Literature pertaining to the link between total quality management practice and organizational performance [Mile and Danny, 1999] reveals that increased competition has motivated many senior managers in manufacturing organizations to evaluate their competitive strategies and management practices with the aim of improving organizational performance. With a diminished workforce and the need to sustain performance, organizations are striving to define, implement and sustain TQM practice. This is a relatively new management philosophy [Mile and Danny, 1999] that integrates strategy, management practice and organizational outcomes to create a quality organization that continuously improves and sustains performance.

Much has been written on the TQM philosophy and methods by quality practitioners or "gurus" (Deming, 1986; Crosby, 1979; Juran, 1991; Feigenbaum, 1983). Surprisingly, little rigorous research has been done

to establish the link between quality management practice and organizational performance. That which has been done is interesting but not conclusive. Numerous studies are reported in the literature on the link between TQM practice and organizational performance. The most widely cited empirical study on quality practices to date is the International Quality Study conducted by Ernst & Young and discussed by Bemowski (1991). The project studied quality practices of over 500 automotive, computer, banking, and health care organizations in the US, Canada, Germany and Japan. The study concluded that only three quality management practices have a significant impact on performance, regardless of industry, country, or starting positions. Those are process improvement methods, strategic plan deployment, and supplier certification programs.

The Malcolm Baldrige National Quality Award, patterned after the Deming Prize in Japan first awarded in 1988, is becoming highly valued in the United States (Garvin, 1991). What practices do Baldrige award winners follow, and what are their results? Some of these answers are provided by a US Government Accounting Office Study (GAO, 1991). The study examined the impact of formal TQM improvement strategies on the performance of 20 US companies, that had scored well on the 1988/1989 Malcolm Baldrige National Quality Award. The study found a strong relationship between the company's use of TQM (such as strong customer focus, senior management leadership, a commitment to

employee training, empowerment, involvement and the application of systematic fact finding and decision making processes), and organizational performance (measured by employee relations, quality, productivity, customer satisfaction, profitability). Garvin (1991), responded to the GAO findings by cautioning the reader that the GAO study was not performed scientifically using statistical methods and the 20 companies surveyed did not answer all survey questions. A proper test for the relationship between TQM and organizational performance requires a larger and more diverse sample of companies (and not only the high scorers on the Baldrige Award). This approach would allow researchers to test whether companies without TQM are still able to perform capably in the market place. One of the most rigorous studies on the relationship between TQM practice and firm performance is by Powell (1995). The study examines TQM as a potential source of sustainable competitive advantage. The findings suggest that most features generally associated with TQM, such as quality training, process improvement, and benchmarking, do not generally produce advantage, but that certain tacit, behavioral, imperfectly imitable features can produce advantage. The author concludes that these tacit resources, and not TQM tools and techniques, drive TQM success, and those organizations that acquire them can outperform competitors with or without TQM. Despite the extensive literature available on TQM and its long history, details of how to make transformations to a total quality culture are "murky" and the

nature of the promised outcomes unclear. TQM experts such as Deming, Juran, Crosby and others claim that long-term competitive advantage will result only if all elements of a complex methodology are applied correctly. Though different experts offer different paths to success however findings from several studies that claim TQM does have a significantly positive effect on organizational performance.

The most profound impact of TQM on organizational performance has been in the Australian Automotive Industry. This industry has clearly demonstrated that the revitalization of old manufacturing businesses is possible, has already happened in some firms and will continue to show improvements in quality and productivity. The Automotive Industry Authority is convinced that the evolution of the new manufacturing culture based on Kaizen is the major reason for the improvements that have taken place in the car industry. Similar findings were reported from a large study (1,300 manufacturing sites) conducted by the Australian Manufacturing Council (AMC Study, 1994). The study provides a detailed analysis of the approach undertaken by Australian and New Zealand manufacturing organizations in terms of manufacturing and quality management practices. The AMC study concludes that TQM is likely to lead to overall improvements in organizational performance. However, the AMC study suffers from statistical shortcomings. The analysis is based on simple statistics, and it does not rigorously test the strength of the relationship between TQM practice and organizational performance.

One of the most complete empirical study (184 manufacturing firms in New Zealand) conducted by Sluti (1992) to test the relationship and found Quality practice has significant positive impacts on performance measures for process utilization, process output, production costs, work-in-process inventory levels, and on-time delivery.

In order for a quality-focused organization to successfully compete on its strategic objectives, Dixon (1990) argues that relationship must exist between the organization's strategies, organizational actions, and performance measures. Further, as Lockamy and Cox (1994) also noted, not only are specific action programmes supporting strategic objectives required, but also integrated performance measurement systems which facilitate consistent organizational actions toward objective achievement.

Literature pertaining specifically to quality focused performance measurement systems can be classified into three broad categories: quality measures, quality measurement, and frameworks for developing quality measurement systems (Lockamy, 1998). The use of statistically-based measures to monitor and control process and product quality was pioneered by Shewart (1931), Juran (1951) and Deming (1975). In addition, Kane (1986) explored the use of capability indices as a measure of process quality. The concept of the 'cost of quality' as a means for determining optimal quality performance was introduced by Feigenbaum (1956).

Though this literature provided the framework for the development of the TQM philosophy, however, it provided little insight on the development of a comprehensive assessment of all factors that influence performance. i.e. HR-related performance measurement criteria. Many of the first articles written on employee performance measurement in quality organizational environment addressed the problems associated with the use of quality-based performance measurement in isolation, and highlighted the need for a holistic approach to HR-related performance measurement [Cardy, 1998; Scholtes, 1993; Deming; 1986;Ghorpade *et al.*, 1995; Cardy *et al.*, 1990].

In doing so, person factors and system elements and inclusion of both in the content of appraisal process are described which are identified to be compatible with quality organizational environment.

TQM mainly focus on continuous improvement of the processes in order to enhance the organization's performance and benefit it's customers, employee and society as well. The continual process improvement can be done by small step on going improvement activities [Atkinson,1990] conducted within existing process or implementation of new process. These are normally carried out by cross-functional teams in the organization [Singh,1985], outside routine operations.

The people in the organization that are involved should be provided with the authority, technical support and necessary resources for the changes associated with their improvement. In TQM culture, it is necessary from

identification of the input/output variables pertaining to the units being assessed. These must reflect all resources used. Outputs secured as well as the environment in which each unit operates.

Apart from the measure of the relative efficiency of each unit DEA also yields other information which proves useful in gaining a better insight into the performance of each unit and in guiding units to improve their performance. A DEA assessment identifies efficient peer units for every inefficient unit. Peer unit can be used to highlight the weak aspects of the performance of the corresponding inefficient unit. The input /output levels of a peer unit can also sometime prove useful target levels for the inefficient unit. DEA yields other target input/output levels as well for each inefficient unit. The assessment model [Thanassoulis, Dyson,1988] used can be manipulated to yield target that are compatible with preferences over changes to individual input/output levels for attaining relative efficiency or to allow for the fact that certain inputs and outputs are exogenously fixed.

The efficient units DEA identifies can prove useful for providing efficient operating practices which can be disseminated to all units assessed so that they may improve their performance. DEA yields managerial information not only in respect of individual units but also about units at the collective level. Where there are different sets of units operating under their own different policies or where a set of units has operated under different policies over time DEA can be used to ascertain the

the design phase to form a senior management performance management team. The team members meet frequently to discuss the progress. There should not be anywhere for people to escape from the commitment to improve. It is an approach to do process improvement and enhancement based on needs and analysis, and then later seek an assessment. The goal or desired end result must be extremely clear. Everyone in the organization must be fully committed to reaching the goals. Furthermore, demonstrating that goals have been met or that progress is being made toward and can require a considerable period of time to collect enough data to "prove" the case. The fulfillment of the goal can be demonstrated through an assessment. Assessing the effectiveness of TQM is done based on the structured questionnaires [Atkinson,1990; Besterfield,1995] by the competent and trained personnel.

2.2.4 Approach Based on Data Envelopment Analysis

There exists a very large volume literature on Data Envelopment Analysis as witnessed by bibliography compiled by Seiford [1990]. Indeed there is intensive research activity in the area. DEA is a linear programming based method for measuring the relative efficiency of organizational units. Such units (e.g schools, bank branches, health care organizations etc.) where there is a relatively homogeneous set of units use typically a number of resources to secure a number of outputs [Boussofiane, Dyson, Thanassoulis,1991]. A key stage in a DEA assessment is the

comparative efficiencies of the policies as distinct from those of the units. DEA can also be used for investigating the effects of resource transfer between units. Indeed it can be used to investigate the effects of setting up new units and/ or ceasing the operations of other units. Studies have been produced using DEA in higher education performance measurement [Sarrico and Dyson, 2000]. Recent work on strategic implementation of DEA yardstick found suitable in the health care organization [Agrell, Bogetoft, 2002], where problems are characterized by complex multi-input / multi-output technology, information uncertainty and unclear social priorities. The DEA approach captures what the units having performed the best - using the least inputs to produce the largest amounts of outputs have been able to achieve. This is attractive in many settings since the methods and procedures of the best units are more likely targets to other units.

2.2.5 Bayesian Approach

According to survey, the Bayesian paradigm is an attempt to utilize all available information in decision-making. Prior knowledge coming from experience, expert judgment, or previously collected data is fused with current data to characterize the current state of knowledge. Michael et al., [2001] use this paradigm in many applications, including reliability and performance measurement. The application of the Bayesian

paradigm requires the specification of following four aspects of the given problem.

- Decision space -- What are the possible decisions that can be made?
- Loss (or utility) Function -- Along with each decision is associated a loss (or utility), depending on what truth is.
- Prior probabilities -- The inferrer specifies current beliefs given all currently available information.
- Likelihood function -- A unified probability model which underlies the collected data must be specified.

If one is able to specify these four items, Bayesian inference is (theoretically) straightforward. The prior probabilities and likelihood function are fused via Bayes theorem to produce posterior probabilities. Then, for each decision, the loss function is integrated with respect to the posterior probabilities to produce the estimated risk. The decision with the minimum risk is then chosen. What is critical to meaningful Bayesian inference is the careful specification of these four items.

The key principle of Bayesian approach is to construct the posterior probability distributions for all the unknown entities in a model, given the data sample. There is a vast amount of literature and choice of this approach is large. Bayesian analysis yields posterior predictive

distributions for any variables of interest, making the computation of confidence intervals possible [Jouko Lampinen, Aki vehtari,2001].

The Bayesian approach permits propagation of uncertainty in quantities which are unknown to other assumptions in the model, which may be more generally valid or easier to guess in the problem. In Bayesian data analysis all uncertain quantities are modeled as probability distributions, and inference is performed by constructing the posterior conditional probabilities [Berger, 1985] for the unobserved variables of interest, given the observed data sample and prior assumptions. In statistical modeling, the generalization capability of a model, Classical or Bayesian, is ultimately based on the prior assumptions. Singpurwala [1999] has described this probabilistic approach for classifying a software house into five maturity levels. That is, he is able to specify the probabilities with which an organization belongs to the five levels. The approach is based on responses to the questionnaires as well as expert judgment (i.e experts from Government, Industry and Academia) about the organization that an assessor may have.

To implement this approach several probabilities and likelihoods have been specified and this specification is done by the expert judgments [Booker & Meyer, 1991] who are knowledgeable and experienced about the software development process.

In this Bayesian approach the constructed questionnaire with respect to the KPAs are subdivided. The subdivisions were performed by the

software development analysts familiar with various versions of the CMM. The response to each question of the questionnaire of the CMM is binary response (Y = yes, N = No) and used to classify an organization [Singpurwala, 1999] into one of five categories.