

**TOWARDS DESIGN AND IMPLEMENTATION OF AN
APPROACH ON CMM (CAPABILITY MATURITY
MODEL) FOR THE QUALITY PERFORMANCE
MEASUREMENT OF MANUFACTURING INDUSTRIES**

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By

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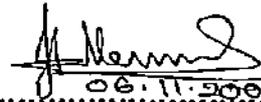
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**DEDICATED TO MY BELOVED PRINCIPAL
PROF (DR.) HARIPADA BHAUMIK
WITH LOVE AND ESTEEM**

This is to certify that the thesis entitled "**TOWARDS DESIGN AND IMPLEMENTATION OF AN APPROACH ON CMM (CAPABILITY MATURITY MODEL) FOR THE QUALITY PERFORMANCE MEASUREMENT OF MANUFACTURING INDUSTRIES**" submitted by Sri Aloke Kumar Ghosh who got his name registered on 12.06.2002 for the award of Ph.D (Engineering) degree of University of North Bengal , is absolutely based upon his own work under the supervision of Dr. J.K Mandal, Department of Computer Science, University of North Bengal and Prof.(Dr.) Haripada Bhaumik, Principal, Siliguri Institute of Technology and neither his thesis nor any part of it has been submitted for any degree / diploma or any other academic award anywhere before.

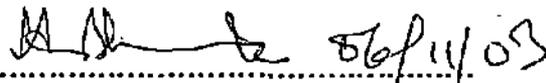
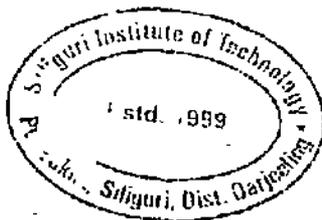


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DECLARATION

I hereby declare that neither the thesis nor any part thereof have been submitted for any degree whatsoever.

Ajane Kumar Ghosh,

Date : 05/11/03.

(Signature of the candidate)

OVERVIEW OF THE THESIS

The thesis contains 8 chapters. Chapter-1 presents Introduction, Scope and objective of the work. Review of literature and current status has been taken up in Chapter-2. The proposed design and development details are outlined in chapter-3 and the Implementation, result and discussion are presented in chapter-4. A comparative study of various methods, their merits and demerits has been discussed in chapter -5. Chapter-6 discusses some ideas for future scope of work and offers some concluding comments. Chapter-7 and 8 pertain to references and list of publications respectively. Appendix -A and B contains the survey findings and guidelines for performance evaluation pertaining to Annexure -I. The format for evaluation proforma based on characteristics criteria and assigned score are given in Annexure - I. Annexure -II contains the assessment form to be used by the assessor for each industry. Finally, the thesis is supplemented with the assessment forms used by the assessors during assessment of the individual industry.

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CHAPTER 1

- **INTRODUCTION**
- **SCOPE AND OBJECTIVE OF THE WORK**

1.1 INTRODUCTION

Humanity has always been conscious of quality. In the early days of human history, quality was largely a privilege enjoyed by the upper strata of society. It related to items where no quantitative indicators could then be provided, such as food, clothing and the like; one was conscious of quality as an attribute, and also of its significance for aspects of safety [Rao, 1996].

The Industrial Revolution brought about a major change, with mass production of goods that had a high degree of uniformity; it also made goods available to much larger numbers in society; and increasingly, quality became measurable in terms of a variety of physical parameters which could define the extent of uniformity, how products would behave through their life such as failure rates, and the like. Particularly over the past half a century, quality consciousness has grown tremendously. Consumers are now increasingly aware of defects, which affect appearance, performance, interchangeability, life, etc. Even in the present age of industrial production, there are high cost products conforming to the highest standards of quality; and it was assumed that large volume production would be subject to some departures. Japan changed this image, with its emphasis on "Zero Defects". It was able to sell its products for mass consumption not only at lower prices but also defect-free. This involved not only attention to production and production

technologies, but also equally to design and all that underpins it. The concept of quality now permeates hardware as well as software.

As a result of these transformations there has been increasing demand on areas of science that are of importance in design and production. One of the principal areas of scientific endeavour relating to this is statistics. As India moves into a new regime of taking its place in the global scene, it is good to bring to the notice of scientists, producers of goods in various areas, entrepreneurs and policy makers, the variety of aspects that relate to ensuring of quality and the role that science has to play in this.

MAHALANOBIS – A MESSIAH OF QUALITY

Professor Prasanta Chandra Mahalanobis put our country on the world map of statistics [Rao, 1996], although he began as a physicist and taught that branch of science in Presidency College, Calcutta for more than two decades. The Professor also created the national Sample Survey Organization, the Central Organization of the Government of India, as well as the Department of statistics. He also made distinctive contributions to the problem of transforming an ancient civilization and society through planning.

As our country transits from agrarian civilization to industrial civilization, we will have to pay a heavy price if our education system fails to sensitize every child to a feeling for Quality. Professor Mahalanobis understood this and brought to use the knowledge, which is known as

Statistical Quality Control and Quality Assurance as well as Reliability together with knowledge of operations Research and Multivariate Analysis.

Sensitiveness to quality as to beauty and love is not quantifiable. But without a passion for these, there will be neither an improvement in the quality of our daily life, nor quality of our production system or in the service sector. Prof. Mahalanobis was, in our country, a Messiah of "Quality".

The vital question of, what is now referred to as, "sustainable development". We have to define its parameters. So, even as we discuss in depth the specific problem of ensuring quality through engineering, we must not forget the wider dimensions of human predicament, as we stand poised on the eve of the commencement of the third millennia of history. We Indians have to come to grips not merely with the hardware of quality, engineering, production and processes, but the software of values of our evolving society, caught up by a conflicts and tensions.

We are of course aware of the fact that the processes of industrialization as have taken place in history create a severe problem of alienation of human beings from the production process. As the saying goes, he or she becomes a mere cog in the wheel. But it is possible to overcome the alienation if management, production engineers and, of course, the entrepreneurs inform their knowledge and expertise not only by a feeling for quality, but making production culture cooperative and not

individualistic. It is our impression that this has been successfully achieved in Japan. There is another point and it is addressed to our countrymen who are engaged in the production processes. It would be an absurdity on their part to think that one can divide the production process into two halves, one of which produces something for "export quality" alone and the rest is dumped on the Indian market. It is also an economically wasteful practice. The imperatives of quality cannot be ensured by appointing Quality Inspectors any more than the efficiency of a boiler can be maintained out of fear of the factory inspector. The fact that our scientists and engineers working in the Indian Space Research Organization (ISRO) and elsewhere too have shown that it is possible to sensitize everyone to the imperatives of "quality assurance", one can resume that the task in India is not abinitio hopeless, however, as the saying goes, one swallow does not make the summer, he "will and passion for quality" has to permeate in our educational system, in our value system, in our public life and projected through every institution involved in the process of communication, whether the communication is oral, written or electronic.

1.1.1 Quality :

Definition -1

Quality means "**Conformance to the Specifications or requirements**":

[Crosby,1996] The requirements are all the commitments involved in giving the customer what was agreed. Some of them are administrative,

some are procedural, some involve product specifications. They are the answers to all the questions involved in running the company. People must learn their job and requirements that are involved and then learn how to do them exactly. When we learn to improve and do things better, then the requirements are officially changed. This definition is something that can be easily explained to everyone. In this process it eliminates arguments about "how good" anything is. If we talk about the requirements, then the question comes "What are the requirements ? Are we meeting them ? Are they correct ?" Emotion leaves the scene and people can do business together.

Definition -2

Quality means **"Zero defects, or Defect free"** : [Crosby,1996] This means doing things right the first time, every time, with no allowable error. When something goes wrong we find out the root cause in order to prevent it from ever happening again. Quality must be achieved by prevention rather than detection. Prevention means that we will think out the process, learn how to implement it, get every trained, and in essence do things right the first time. We do not accept error in any form. We do not want to disappoint our customers.

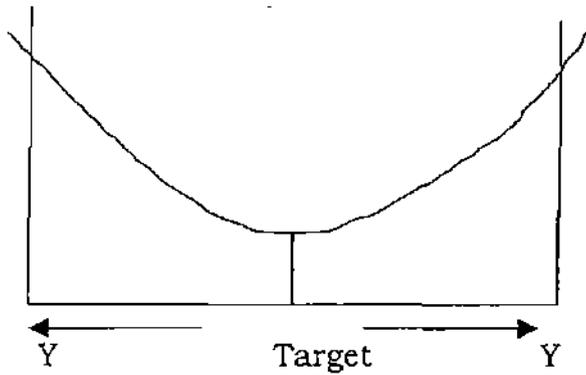
Definition -3

"Quality is the loss imparted to the society from the time the product is shipped". (Taguchi's definition of quality)

Where does the loss to society come from? There are two sources contributing the loss to the society. They are inconsistent product performance and harmful side effect [Anand,1996]. The automobiles emit too much smoke, air conditioners making too much noise are products of poor quality as they are polluting environment. This is so because pollution is the loss imparted to the third person, who is neither Product must be environment friendly and should not disturb or spoil the environment. The second source of loss to society comes from inconsistent product performance. Factors contributing to this are many and the important one are design, material and manufacturing process. Less variation during manufacturing always result in consistent high performance product. Our paradigm on quality as "conformance to specification or requirements" comes in the way of reducing manufacturing variation beyond the specification limits.

Our aim should be to reduce variability to zero. This will result in the production of consistent quality product. Variability increases as we move away from the target and loss to society also increases as we move from the target.

$$\text{Loss} = K Y^2$$



Taguchi Loss function

Definition -4

Quality means "**Customer Satisfaction**"

In a competitive environment, the customer is necessarily the focus of all activities of organizations producing and selling goods and services. Customer oriented quality control is one of the six basic principles of the Japanese Company Wide Quality Control (CWQC). Total Quality Management (TQM) calls for a change in the mind-set where company orientation is replaced by customer orientation [Anand,1996]. One of the core values and concepts promoted by the American Malcolm Baldrige Award is customer-driven quality and one of the award criteria categories is customer focus and satisfaction. Indeed customer satisfaction figures in some way or other in the declared quality policies of most organizations.

If customer satisfaction is not to remain an empty word, companies will have to build quality systems and activities around this objective. However, it is only the industrial buyers or large customers who are in a position to specify their quality requirements in precise details, measure quality after purchase and during use and thus rationally evaluate their sense of satisfaction. For the majority of customers, particularly those of consumer products or durable, satisfaction is a nebulous feeling. Inevitably answers will have to be found for some pertinent questions. What is customer satisfaction? What factors influence it and how? What are its consequences particularly with reference to customer retention? Should customer satisfaction be maximized or minimized? Researchers in Management Science have been increasingly pondering over these questions in recent years.

Definition -5 (As per ISO)

The totality of characteristics of an entity that bear on its ability to satisfy stated and implied needs.

1.1.2 THE ROLE OF THE SCIENTIST AND ENGINEER IN QUALITY IMPROVEMENT

Since the 1960s, the United State has found itself in an increasingly competitive world market. At present, we are in the midst of an international revolution in quality improvement. The teaching and ideas of W. Edwards Deming were instrumental in the rejuvenation of Japan's

industry. And in American industry, in order to survive, must mobilize with a continuing commitment to equality improvement. From design to production, processes need to be continually improved. The engineer and scientist, with their technical knowledge and armed with basic statistical skills in data collection and graphical display, can be main participants in attaining this goal [Richard,2000].

The quality improvement movement is based on the philosophy of "market it right the first time." Furthermore, one should not be content with any process or product but should continue to look for ways of improving it.

1.1.2.1 The Statistical Content of Quality-Improvement Programs

Although there is a tendency to think of the subject of quality as a recent development, there is nothing new about the basic idea of making a quality product characterized by a high degree of uniformity. For centuries skilled artisans have striven to make products distinctive through superior quality, and once a standard of quality was achieved, to eliminate insofar as possible all variability between products that were nominally alike. What is new in quality improvement is the idea that a product is never good enough and should be continually improved. This concept, honed to the fine edge in Japan, has created a crisis in the international market place for firms that do not follow suit. In quality-improvement programs, the emphasis is on employing designed experiments to improve the product in the design, production, and

assembly stages rather than in futile attempts to inspect quality into a product after it is produced. The main thrust of the statistical approach is that, in order to improve quality, it is better to work upstream on the processes. That is, build quality into the product by concentrating on the equipment, components, and materials that go into making it. The consumer has also a role in the new way of quality improvement. It has always been (1) design a product, (2) make it, and (3) market it. Now, there is a new fourth step, (4) find out the purchasers' reactions to the product. Also find out why others did not purchase. Statistical methods of sampling will provide a way of finding out what the consumer thinks. Changes can then be made in design and production to better match the product to the market. These four steps must be repeated over and over again in the search for continual product improvement [Richard,2000].

1.1.3 Performance Measurement and it's Purpose

Performance measurement is simply a process which involves the assessment of an organization's performance on a regular basis, and that alone has to be a good thing. But more importantly performance measurement has the capability to modernize culture by developing and unifying best business practice and thereby providing the energy needed to fashion the organizations development [Performance Measurement Manual, 1997]. A sound Performance measurement will keep the business focused on its vision, and keep everyone united behind business needs and objectives. A sound performance measurement

system is a strong creative driving force. Enlightened organizations realize that it is not simply the system but the energy that the system is capable of producing that will generate individual and corporate excellence. Enlightened organizations will remedy performance measurement shortcomings, train people in its use, extend the contribution performance measurement makes to corporate strategic life, make it relevant to people's daily needs, and end its isolation by linking it with other key management processes so that the culture will be transformed into one of progressive and continual organizational development. The employer should establish a scheduled performance measurement period. Ideally every six months. If the first performance measurement is scheduled say four months before the business plans are created then it represents an opportunity to cascade up change and development opportunities, needs, and resource requirements, etc. If the second performance measurement is scheduled immediately after the organization has established its annual business plans then the performance measurement represents an ideal opportunity to cascade organizational aims down and throughout the organization [Cardy, 1998]. It is therefore valid to have different performance measurement objectives depending on the above and the organizations current need with variation to recognize the needs of local situations. In this way performance measurement is both a proactive and a reactive, flexible and

adaptable and above all participative instrument. The performance measurement process provides opportunity to :

- ❖ Ensure that the organization effectively communicates its Business Plan objectives. The performance measurement will enable the appraisee to relate how their role and contribution supports the achievement of these objectives.
- ❖ Encourage/promote the desired managerial style and organizational culture management style is critical to business success and should organizations wish to move to a culture of empowerment, responsibility and trust the participative and development aspects of performance measurement will help them achieve it.
- ❖ Encourage team-working with performance measurement showing how the appraisees role links not just with the organizations objectives but with peer roles, team-working is fostered with the consequential positive effect on cost and quality.
- ❖ Encourage care for customers, colleagues, and the environment with performance measurement focusing attention not just on the appraisers contribution and competence but the impact of their behaviour (positive or negative) upon their environment and relationships, care for customers, colleagues and the environment will all be improved.

- ❖ Encourage individuals to take personal responsibility taking responsibilities for decisions and actions encourages everyone to work effectively and the performance measurement process allows such areas to be discussed and clarified.

- ❖ develop every individual to maximize their contribution to the business the performance measurement process commits the organization to the training and development of employees to maximize their job satisfaction and individual contribution. The performance measurement process therefore is a formal opportunity for the parties to agree on issues, needs and action plans.

The performance measurement system is therefore at the centre of organizational life and without effective performance measurement, change and development lacks purpose, direction and commitment. The performance measurement process has the biggest influence on culture and productivity. The performance measurement is not idealistic it is practical and essential. One of the most important aspects of performance measurement is that of personal development. The developmental approach to performance measurement recognizes employees as individuals with concerns and needs. The developmental approach uses performance measurement as a contributor to employee motivation, development, and human resources planning.

1.2 Scope and objective

The scope and objective of this work is to identify and interpret the content characteristics of organization performance evaluation in quality organizational environment. This is based on an examination of a range of source material such as books, papers, articles and the candidate's long experience in institutionalisation of quality system in various organizations. The study focuses on the important content issue with regard to the measurement of person factors and its relationship with system factors [Thiagarajan and Zairi, 1997] designed to support the performance measurement system. Managers can use the relationships and interdependencies between person and system factors to adapt their systems in important ways so that the practice maximally contributes to the quality effort. The study can be very useful to the organizations attempting to identify the characteristics that may provide a foundation for the quality-driven performance evaluation.

A very large volume of literature on performance measurement those suggest that performance measurement is an advanced management tool [Performance Measurement Manual, 1997] that is becoming more and more sophisticated in order to accommodate needs of different communities. It, therefore, necessitates to pay our attention to develop a performance measurement system that will enable it's users to spot weaknesses and threats, as well as strength and opportunities. Thus, better knowledge of strengths and weaknesses will give the users an

opportunity to diagnose organizational growth capabilities and take relevant actions. In this work, the proposed model 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 for improvement. The proposed model for assessment usually performed by the peer groups or by qualified assessors. The intent of assessment is also to provide fact-based guidance to the organization regarding where to invest resources for its improvement. The model is dedicated to extending the scope of organizational performance measurement beyond the conventional focus on internal, historic, financial, numeric and short-term data. It serves not only as a source of information but also as a guide for the evaluation of the effectiveness of a quality driven performance measurement system. The specific feature of the model is that it will keep the business focused on its vision, keep everyone united behind business needs and objectives. It will create a strong driving force in the organization and the organization will realize that it is not simply the system but the energy that is capable of generating the corporate excellence, transforming the culture into progressive and continual organizational development towards world class system. The present work has, therefore been undertaken with a view to classify a manufacturing industry into levels [Crosby, 1979; ISO-9004, 2000] based on their quality performance. For the purposes of our discussion we have implemented the model in different manufacturing

industries. The work may be extended to non-manufacturing industries also, if feasible.



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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

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

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

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.

CHAPTER 3

➤ PROPOSED DESIGN AND DEVELOPMENT DETAILS

3. Proposed Design and Development Details

The work described here is to develop an approach for a hierarchical classification problem that arises in the context of quality management, pertaining to the classification [Singpurwala, 1999] of manufacturing industries. The existing approaches classify an industry into one of the five maturity levels based on its quality performance. The classification will then serve as an input to any decision making process that is used to determine the relative degree of maturity of an organization's quality management system, to identify the main areas for improvement, to judge the effectiveness and efficiency of the organization and to facilitate the development of the quality management system towards world class performance. The proposed method provides guidance in the form of typical questions that the organization can ask in order to evaluate its performance.

The typical performance measurement system is based on weighted measures [Uede,2001] of eleven parameters. i.e. Leadership, Policies and Strategies, Human Resource Management, Resources, Design and Development, Processes, Improvement Processes, Customer Satisfaction, Employees' satisfaction, Impact on Environment and Society and Business Results. Each parameter can also have the sub-parameters as shown in Annexures. A numerical score / weightages is given to each parameter. The weightages assigned to each sub-parameter are also

shown. The weights, when suitably combined, yield a score for each parameter and also an overall score for the organization.

The overall score is used to classify an organization into one of the five levels. Classifications and comparisons that are based solely on this overall score. Of course, depending on the size and type of the organization and its needs and expectations, evaluation must be appropriately done. Our motivation for undertaking this activity is the Capability Maturity Model as a way to evaluate an organization's performances and for improving their practices and processes.

3.1 An Over view of the CMM

Based on a frame work envisioned by Philip Crosby [1979;1996], a manufacturing organization maturing through the five stages which he labels "Uncertainty" "Awakening" "Enlightenment" "Wisdom" and "Certainty". Indicators of these stages are attribute, quality organization status, problem handing, cost of quality as a percentage of sales, quality improvement actions and the like.

The need for long-range programs in quality can be deduced intellectually through the maturity grid. A manager of any operation can spend a few moments with the grid, recognize familiar events and pinpoint where the operation is at that moment. Then all that is necessary is to refer to the following stage of the grid in order to know what actions need to be taken for the improvement. And in cases where

an established program is now deteriorating, the grid can be read back wards one can see the last successful points and figure out how to get back there . It is also possible to identify his own situation in one of the five levels of maturity.

3.1.1. Proposed Maturity Levels

The proposed model is a strategy for improving the manufacturing process. It can also be used to assess the maturity of the processes of an organization and to identify the areas that are required to increase the maturity level of the organization.

The model is organized into five maturity levels [Crossby,1979;1996] and [ISO -9004 :2000] as shown in fig.1 below.

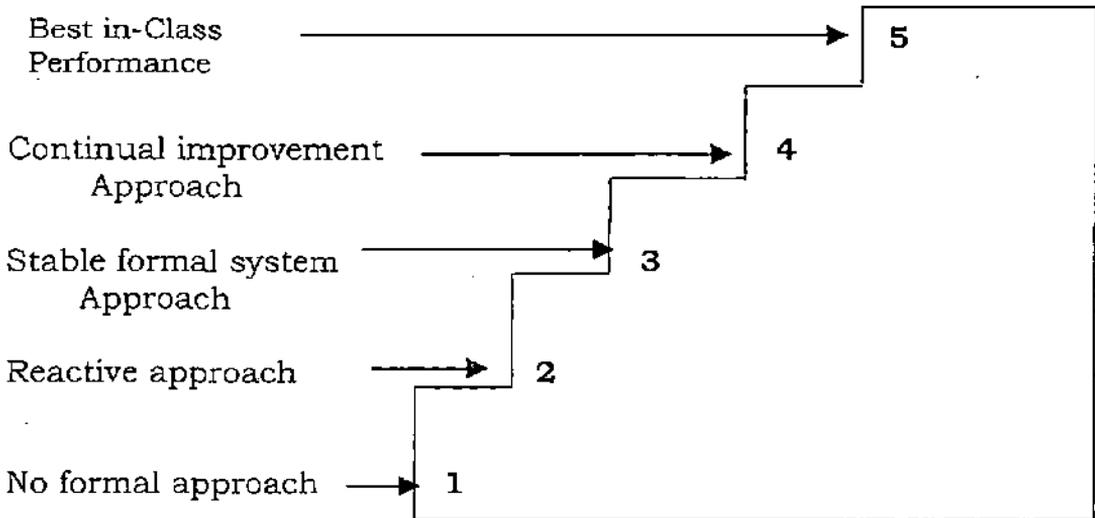


Fig. 1 - Maturity Levels

1. **No Formal Approach (Level 1)** : This is the lowest level, there is essentially no systematic approach existing in the organization. No results, poor results or unpredictable results, Everything is done on an adhoc basis [Crossby,1979;1996] and [ISO -9004 :2000].

It is indeed confused and uncommitted. Management has no knowledge of quality as a positive management tool. Management speak regularly of their quality function in terms of being the policeman whose job is to catch the criminals in the act. Problems of non-conformances are considered the fault of not being tough enough on the bad guys. No formal approach casually places the quality function deep in the bowels of one of the operating departments. Inspection is sometimes a separate operation and is assigned to the production people so they can have the tools to do the job. These restriction create the self-fulfilling prophecy that unsolved problem mile always be around.

Every problem will be considered unique, even if it has been encountered before problems breed problem and the lack of discipline in the method of openly attacking them breeds more problem. Personalities are the predominate factors in problem attacking as the result is emotion on the management level and the question becomes "who" rather than "what" caused the difficulty. This some times results in illogical firing and quitting as it becomes impossible to methodically examine a situation and solve whatever problems exit. The management of this type of company does not know much about the Cost of Quality.

Quality improvements will never be a part of the organization and it is not considered as an option. At this level the companies know that they have problems but do not know why, although they do know it is not because they are not working hard. Everyone in this level perhaps work hard, and most are frustrated at the amount of brute force it takes to keep the operation moving.

2. **Reactive approach (Level 2)** : At this level organization is more pleasant but no less frustrating . Here the management is beginning to recognize that quality management can help, but is unwilling to devote the time and money to make it happen. A stronger quality leader, who understands professional quality is appointed for management strengthening the quality operation.

At this stage [Crossby,1979;1996] and [ISO -9004 :2000] inspection and testing and performed more often and problems are identified earlier in the manufacturing process. This cuts rework costs a little while permitting some attention to resolving problems. The chronic problems are listed and assigned to teams for action but the prime attention is paid to keep the product moving. Team set up to attack the problem accomplish quite a bit. Though the corrective base systematic approach is found at this level however minimum data on improvement result are available. The scope is limited to the near future and long range solutions are not considered.

3. *Stable formal system approach (Level 3):* At this level , the standard processes for both engineering and management processes across the organization is documented . This level appears with the decision to go ahead [Crossby,1979;1996] and [ISO -9004 :2000] and really conduct a formal, regulation, card-carrying quality improvement program. At this level, organizations can be summarized as “Standard” and “Constituent” because both engineering and management activities are stable and repeatable. Organizations establishes its quality department as a balanced, well organized, functioning unit. This department has to lead the crusade and it must have the capabilities and resources to do so. All inspection and testing, quality engineering, data reporting and similar activities must be included. One of the most recognizable changes in this stage involves the approach to problem resolution . Facing problems openly, without searching for individual to blame, produces a smoothly functioning system for resolving the problems. Corrective action communication is established. Data are available on conformance to the stated quality objectives. Management is committed to the quality and existence of improvement trends is seen.

4. *Continual improvement approach (Level 4):* At this level, the organization sets quality goals for both products and processes . Productivity and quality are measured for all important processes activities [Crossby, 1979;1996] and [ISO -9004 :2000] throughout the organization as part of the organizational measurement program.

Meaningful variations in process performance can be distinguished from random variations, particularly within established product lines. Problems are identified early in their development. All functions are open to suggestions and improvements. Prevention becomes a routine part of the organization. Level 4 organizations can be summarized as "predictable" because the processes are measured and operate within measurable limits. It allows an organization to predict trends of processes and product quality within quantitative bounds of the limits. When these limits are exceeded, action is taken to correct the situation and therefore the products are predictably of high quality. Improvement processes are in use, good results and sustained improvement trends are noticed.

5. *Best-in-class performance (Level 5):* At this level, the organizations consider quality management as an essential part of the company system. Entire organization is focused on continuous process improvement [Crossby,1979;1996] and [ISO -9004 :2000]. The organizations have the means to identify weaknesses and strengthen the process proactively, with the goal of preventing the occurrence of defects. Except in the most unusual cases, problems are prevented. Data of the effectiveness of the processes are used to perform cost benefit analysis of new technologies and proposed changes to the organization's process. Innovations that exploit the best engineering practices are identified and transferred throughout the organization in an orderly manner.

Organizations at this level can be characterized as “continuously improving” because they are continuously striving to improve the range of their process capability, thereby improving the process performance . Improvement occurs both by incremental advancements in the existing process and by innovations using new technologies and methods and best-in-class benchmarked results are demonstrated.

Guidelines for Assessment :

APPROACH	EXTENT OF IMPLEMENTATION	SCORE
No formal approach	Ineffective, Major gaps in implementation which inhibit achieving desired goals	0-20%
Reactive approach	Partial implementation	20-40%
Stable formal system approach	Implementation in most of the areas and activities with few major gaps	40-60%
Continual improvement approach	Effective implementation in most of the areas and activities with minor gaps	60-80%
Best in-class performance	Very effective implementation in all relevant areas and activities, emphasizes on continuous review and improvements	80-100%

RESULTS

<ul style="list-style-type: none">- No results or poor results in many areas and activities reported- Results not reported in many key areas and activities	0-20%
<ul style="list-style-type: none">- Improvement trends reported in few areas and activities- Good performance in some areas- No evidence of adverse trends	20-40%
<ul style="list-style-type: none">- Improvement trends reported in some of the key areas and activities- Good performance in most of the key areas and activities	40-60%
<ul style="list-style-type: none">- Current performance is very good in some key areas and activities- Evidence of improvement trend in most of the key areas and activities.	60-80%
<ul style="list-style-type: none">- Current performance is excellent in most key areas and activities- Excellent improvement trends in most of the areas and activities- A strong evidence of industry and benchmark leadership in most of the key areas and activities	80-100%

Consistency in Assessment :

There is a need for consistency in assessment [ISO -9004 :2000] and scoring. It is desirable that the variation in scores assigned by different assessors for the same item / parameter is minimum for achieving consistency. For the purpose whenever the difference of scores assigned by different assessors is more than 10% efforts should be made to bring it down through discussion.

Evaluation Proforma :

The format of the **Evaluation Proforma** based on the documents is given in **Annexure I**. The score assigned shall be based on the average score of different assessors for each characteristic. It shall then be converted into weighted score according to the assessment criteria. The **Summary of Assessment Form** is given in **Annexure II**. The proforma given in **Annexure I and II** shall be used for giving scores during fact finding and evaluation. Further guidelines are also provided in **Appendix B** that can be referred by the assessors during assessment. The last column of **Annexure II** will give the score obtained by the industry separately for each parameter of assessment criteria, as well as total score obtained out of the maximum score of 1000. The organization will be placed in one of the five maturity levels discussed above based on the score obtained.

CHAPTER 4

➤ IMPLEMENTATION, RESULT AND DISCUSSION

4.1 Implementation, Result and Discussion

The proposed model was implemented in one Beverage factory and in Tea industry. The Beverage factory and three local tea factories were assessed as per this proposed model. (The name of the all factories are changed here due to the security reason and details are available with the researcher). The findings of these factories are discussed one by one.

BEVERAGE FACTORY

4.1.1 Beverage factory:

The organization was assessed as per the model developed. The assessment team was comprising of two assessors, the Quality Manager (Mr. X)of the company having more than 13 years of experience in the field and the researcher (Mr. Y), a certified Lead Assessor having experience in assisting the various industries in institutionalization the quality system conforming to ISO :9000) and the whole exercise took two days.

The score given by assessors are as follows. The assessment form and scores put by assessors are also enclosed.

Parameters	Questionwise scores		Average score	Parameter weigthage	Paremeter Score
	Mr. X	Mr. Y			
Leader ship	87	85	86	1.0	86
Policies and Strtégies	91	85	88	1.0	88
Human Resources Management	90	82	86	0.5	43
Resources	91	85	88	1.0	88
Design and Development NOT APPLICABLE				
Processes	89	85	87	0.5	43.5
Improvement Processes	88	84	86	1.0	86
Customer Satisfaction	89	85	87	1.5	130.5

Employees' Satisfaction	92	88	90	0.5	45.0
Impact on Environment and society	92	86	89	0.5	44.5
Business Results	91	89	90	1.5	135
Total score obtained (Out of 900)					789.5

From the above assessment scores (i.e 87.7%), the organization is placed at Level 5 of the stated Model.

4.2 Some Strong Points Observed :

4.2.1 Good manufacturing practices:

The organization focuses attention on a number of areas which includes:

4.2.1.1 Building and facilities –

The building and the infrastructure are tailored to suit particular operation of the industry. The buildings are well designed to exercise effective control on dust, vermin, pests and rodents. Also, special facilities like air conditioning, sterilization and special equipment, storage, etc. The area surrounding the building are properly maintained.

4.2.1.2 Raw Materials and Finished Product Specification

The organization is having well defined specifications (supplied by centralized R & D unit for all plants) of all raw materials and same are being used in procurement, in house inspections and tests of materials before use. Similarly specifications are established for all finished

products and those are to be used to verify the quality of outgoing products.

4.2.1.3 Manufacturing Procedure

Plant is also technically sound for improvisation of the existing range of product if so called for. Personnel with technical competence and experience backed with good quality and to the excellence of operations and the products. Well considered and well planned operational control on manufacturing further ensures inherently good quality products. Statistical Process Control is applied to carry out the process capability studies, measure the dispersion in the variability of the product and control is effected to maintain the variations within the predetermined limits.

4.2.1.3 Packaging & Traceability

The importance of packaging is greatly taken care of. Packaging not only provides protection against damages during shipment and handling but also preserves the intended shelf-life. Proper specifications are laid down for packaging, cleanness level are specified and controls are exercised to ensure premature deterioration of food quality due to contaminations. The finished product packages are having date of manufacture, batch and lot codes on the package. This information helps product recall / withdrawal from market or product recovery' should a situation require so.

4.2.1.4 GOOD SANITATION PRACTICES:

The organization has not only undergone progressive refinement and processing sophistication during the recent years but also plant sanitation functions which are equally important, have received the same attention. Management are committed to and supportive of in-plant sanitation programmes covering all aspects of cleanliness including equipments, housekeeping (5S), environmental and pest controls and the operators also recognize its importance. Since GMP and GSP are closely interrelated and hence a real effort is made by the organization covering these two areas.

4.2.1.5 Impact on Environment and Society

The organization maintaining eKO system for entire plant operations in compliance with applicable environmental laws and regulations. The organization has been implemented Environment Management System conforming to ISO-14000 Standard and also going for ISO-14000 EMS certification.

4.2.1.6 Social Obligations

The organization is engaged the following social works and helps to redesign our society as a whole.

- Blood Donation camp
- Road dividers for helping Traffic Police
- Sponsorship
- Building Charity homes
- Making school buildings

- Making temples
- Conducting sports
- Health check-up programme in rural areas

4.2.1.7 Recognition and appreciation

The organization measures employees' contribution towards organisation's performance and the following awards are given each year to the individual based on their performance measured.

- Gold Pin award
- Star of the year
- Associate of the year
- Best of the year

4.2.1.8 Customer Care Cell

The organization has set up a customer care cell which takes care of customers. Customer complaints are taken care almost immediate, whether the complaint is made by written, verbal or over telephone.

4.3 Areas need improvement

The material handling especially loading the finished product into the trucks is done manually. It is suggested that same may be automated so that maximum care may be taken during loading.

4.4 Remarks on the proposed Model

The assessment result was shown to the top management of the organization. They too are agreed that the material handling area needs improvement and they are giving priority to this area so that efficiency will be improved further.

The organization claims that the system already exists in the organization to measure the performance and responsibilities are given to the managers to their working areas and finally it is integrated to see the performance of the organization as a whole. Though they too have agreed that the model will help the industry to evaluate its performance however they have not shown much interest to take and use this model for the performance measurement of their organization. Only remarks came out of them that "The assessment may be made once in a year by using the model".

FIRST TEA FACTORY

➤ **A MANUFACTURER OF CTC TEA**

4.1.1.a First Tea Factory : A Manufacturer of CTC Tea

The first factory was assessed by two assessors. Asstt. Manager (Mr. A) of the factory having 10 years of experience in the field and the researcher (Mr. B) , a certified Lead Assessor having experience in assisting the various industries in institutionalization the quality system. and the exercise took one day.

The score given by assessors are as follows. The assessment form and scores put by assessors are also enclosed.

Parameters	Questionwise scores		Average score	Parameter weigthage	Paremeter Score
	Mr. A	Mr. B			
Leader ship	40	38	39	1.0	39
Policies and Strtegies	44	40	42	1.0	42
Human Resources Management	43	41	42	0.5	21
Resources	40	38	39	1.0	39
Design and Development NOT APPLICABLE				
Processes	38	37	37.5	0.5	18.75
Improvement Processes	30	26	28	1.0	28
Customer Satisfaction	40	36	38	1.5	57
Employees' Satisfaction	20	18	19	0.5	9.5

Impact on Environment and society	30	28	29	0.5	14.5
Business Results	41	40	40.5	1.5	60.75

Total score obtained (Out of 900)					329.5

From the above assessment scores (i.e 36.6%), the organization is placed at Level 2 of the stated Model

4.2 Observations :

4.2.1.a Building and facilities -

The building and infrastructure are well designed to suit the requirements of industry and the operations. Proper provisions for support facilities like air-conditioning, material loading - unloading, exhaust and ventilation as per industry norms

4.2.2.a Manufacturing facilities

Plant is technically sound and recently modernized with the latest equipments hence production efficiency is improved remarkably. Company takes measures of effective control on dust, vermin, pests and rodents in the production area..

The industry should have well defined specifications of all raw materials. These are being used in procurement, in-house inspections of materials before use. Similarly specifications are established for all finished products and those are used to verify the quality of outgoing products.

4.2.3.a Storage Environment

Products are suitably stored after final inspection and test and prior to transportation following the stated guidelines by the company. Proper care is being taken so that product is protected during transportation and storage.

4.2.4.a Good Sanitation Practices:

Management is committed for in-plant sanitation programme. Documented procedure are being followed covering all aspects of cleanliness including equipments, housekeeping, environmental and pest controls. A regular and well established schedule of plant, equipment clean-up and sanitization are being maintained.

4.2.5.a Weak Areas :

Raw material handling requires special attention on withering trough. Use of iron rods to spread the plucked leaves on the weathering trough causes the damaging of leaves which further degrades the tea quality. The weathering area must be surrounded with net so that entry of rodents and insects may be avoided. Since the product is for human consumption, HACCP (Hazard Critical Control Point) programme to be used in conjunction with good manufacturing and sanitation practices. Cleanliness of CTC rollers and rotor vane is very essential for quality tea manufacture and it is desirable to clean the machine with high-pressure water jet or high-pressure boiling water after a day's manufacture so that

there is an effective control of bacteria. However, due to production pressure it is not being followed strictly, and there is a chance for bacterial contamination.

4.3.a Discussion :

The assessment result was shown to the top management of the organization. Initially, they started arguing on most of weak points mentioned above, however agreed to the their deficiencies later. They too are agreed that these shortcomings are due to the production pressure and non-availability of efficient labours in the area. The top management of the company became happy and accepted the model to implement the same in their organization to establish a scheduled performance measurement period for it's improvement and for the evaluation of the maturity of the organization.

SECOND TEA FACTORY

➤ **A GREEN TEA MANUFACTURER**

4.1.1.b Second Tea Factory : A Green tea manufacturer

It is a medium Scale industry manufacturing green tea. Assessment was carried out by the researcher as per the model proposed and assessment took one day. The score given against the each characteristics is given below : The assessment form and scores put by assessor is also enclosed.

Parameters	Questionwise scores	Parameter weighthage	Paremeter Score
Leader ship	22	1.0	22
Policies and Strtegies	10	1.0	10
Human Resources Management	25	0.5	12.5
Resources	21	1.0	21
Design and Development NOT APPLICABLE		
Processes	20	0.5	10
Improvement Processes	14	1.0	14
Customer Satisfaction	19	1.5	28.5
Employees' Satisfaction	14	0.5	7
Impact on Enviornment And society	13	0.5	6.5
Business Results	28	1.5	42

Total score obtained (Out of 900)			173.5

From the above assessment scores (i.e 19.3%), the organization is placed at Level 1 of the stated Model

4.2.b Observations :

The building and infrastructure are just meeting the production requirements of industry and the operations. Lack of involvement of top management is noticed. Plant is to be modernized with the latest equipments so that production efficiency will improve. Company does not take measures of effective control on dust, vermin, pests and rodents in the production area. The two leaves and one bud concept is not at all followed as top management is interested with the quantity only. Since the quality of green leaf depends on the chemical composition (catechins and caffeine) of plucked leaf and the leaf composition decreases as someone adds 4th, 5th leaf etc. therefore care has to be taken two to three leaves and a bud as raw material as recommended. Products are not suitably stored after final inspection and test and prior to transportation. No guidelines are being followed by the company and no documented procedure is established.

Management is not committed for in-plant sanitation programme. No procedure is being followed for cleanliness of equipments, housekeeping, environmental and pest controls. A regular schedule of plant, equipment clean-up and sanitization are to be established and maintained. Most of

the employee are casual and staff members are also not interested for the quality. The management also did not hear about HACCP programme.

4.3.b Discussion :

The assessment result was shown to the top management of the organization. Since the product is totally export oriented the quality certification, HACCP programme etc are the need of the hour. Absence of these, they are not in a position to cater the export market directly and just remaining as a sub-contractors of the main exporter. After listening the benefits of quality products, certification, HACCP programme, top managements became delighted and requested me to conduct few programmes for their management and staff regarding quality. As per survey, it is revealed that there is a great scope in the tea industry to introduce state-of -the art quality assurance method, good manufacturing and sanitation practices. This will surely go a long way to serve the consumer better and acquire larger market share.

THIRD FACTORY

➤ A MANUFACTURER OF CTC TEA

4.1.1.c Third Factory : A Manufacturer of CTC Tea

Factory was assessed by two assessors. Manager (Mr. A) of the factory having 26 years of experience in the field and the researcher (Mr. B) , a certified Lead Assessor having experience in assisting the various industries in institutionalization the quality system and the assessment took one day.

The score given by assessors are as follows. The assessment form and scores put by assessors are also enclosed.

Parameters	Questionwise scores		Average score	Parameter weigthage	Paremeter Score
	Mr. A	Mr. B			
Leader ship	34	34	34	1.0	34
Policies and Strtegies	39	35	37	1.0	37
Human Resources Management	48	42	45	0.5	22.5
Resources	52	48	50	1.0	50
Design and Development NOT APPLICABLE				
Processes	37	34	35.5	0.5	17.75
Improvement Processes	38	34	36	1.0	36
Customer Satisfaction	46	40	43	1.5	64.5
Employees' Satisfaction	28	22	25	0.5	12.5

Impact on Environment and society	50	42	46	0.5	23
Business Results	38	34	36	1.5	54
Total score obtained (Out of 900)					351.25

From the above assessment scores (i.e 39%), the organization is placed at Level 2 of the stated Model

4.2.c Observations :

4.2.1.c Building and facilities

The building and infrastructure are found suitable as per the requirements of CTC tea manufacturing. Support facilities like air-conditioning, material loading - unloading, Blower, Hot-blower, exhaust and ventilation as per industry norms

4.2.2.c Manufacturing facilities

Plant is technically sound however some old equipments required replacement with the latest equipments so that production efficiency can be further improved. Company takes measures of effective control on dust, vermin, pests and rodents in the production area..

The industry is having well defined specifications of all raw materials. These specifications are being followed during procurement of raw materials, in-house inspections and for all finished products to verify the quality of outgoing products.

4.2.3.c Storage Environment

Adequate storage facilities are provided for storing the outgoing products after final inspection and test and prior to transportation.

4.2.4.c Good Sanitation Practices:

In-plant sanitation programme is being carried out regularly covering all aspects of cleanliness including equipments, housekeeping, environmental and pest controls

4.2.4.c Weak Areas :

Since the product is for human consumption, HACCP (Hazard Critical Control Point) programme to be used in conjunction with good manufacturing and sanitation practices. This is the need of the hour to export tea to the other countries, as without this certificate products can not move to export market.

4.3.c Discussion :

The assessment result was shown to the top management of the organization. In fact they appreciated on this model because they were totally in dark about their performance and in fact, they were not knowing how to evaluate. Top management understood that it is an interactive process and provides an opportunity for the employee to respond to the assessment, everyone needs to be aware of the performance appraisal process, what is required during the performance

measurement and what performance measurement benefits will accrue to both the individual and the organization. The top management of the company became happy to note that the model is a positive influence on personal development and corporate development as well and accepted the model to implement in their organization.

CHAPTER 5

> A COMPARATIVE STUDY OF VARIOUS METHODS

5. A Comparative Study of Various methods

5.1 Merits and Demerits

More and more interest is being shown in the development of comprehensive strategic performance measurement approaches. Such as SEI-CMM based approach, ISO-9000 based approach, TQM based approach, Approach based on Data Envelopment Analysis, Bayesian approach etc. (as discussed in Ch.2). In the following section, the merits and demerits of the different approaches for measuring the performance measurement are described.

5.1.1 Performance Measurement and Software Engineering Institute - Capability Maturity Model

The first three levels of the SEI – CMM (i.e. Initial, Repeatable & Defined) are relatively simple to understand. The key process areas include practices, which are currently used in industry. There are, however, relatively few projects which operate at levels 4 and 5 (i.e. Managed and Optimizing) [Jalote, 2001]. Humphrey has described practices, which he considers appropriate for these levels [Humphery, 1988;1989]. The model is mostly used in software industries and the practices are so limited that it is difficult to say how effective they are problems at the higher levels do not negate the usefulness of the SEI model. Most organizations are at lower levels of process maturity. There are, however, three more serious problems with SEI model. These may mean that it is an

unreliable predictor of an organization's capability to produce high quality software. These problems are:

- The model focuses exclusively on project management rather than process control and product development.
- It does not take into account an organization's use of technologies such as prototyping, formal or structured methods, tools for static analysis and so on.
- It excludes risk analysis and resolution as a key process technology. The domain of applicability of the model is not defined.

There are practical as well as conceptual limitations of the CMM. Consequently, not all software development organizations use the CMM. Thus, the CMM is one of several prototypical applications [Singpurwala, 1999]. The authors of the SEI model [Humphery, 1989; Paulk et al. 1993] admit that the development focuses on schedules, standards and practices rather than on technology and the user abilities. Therefore, technology assessment was excluded because they could not find any standard way of assessing technology usage. Though the CMM framework specifies the process areas that should be improved to increase the maturity of the process, it does not specify how to bring about the improvement. That is, essentially a framework that does not suggest [Jalote, 1997] detailed prescriptions for improvement. The model is intended to represent the capabilities of organizations rather than the maturity of particular projects. This makes sense from a contractual

point of view but because an organization is rated at level 1(say), this does not mean that all of its projects are at that level. Within the organization, there may be particular projects or groups working at a much higher maturity level.

Capability assessment is based on a standard questionnaire that is designated to identify the key processes in the organization. This is applied during an evaluation visit where project managers from a number of different projects are interviewed. After discussion of their response to the questionnaire and refinement of these responses, an evaluation score is reached. Bollinger and Mc Gowen [1991] have criticized this evaluation process, these criticisms have been refuted by the model authors. Both the criticisms and the refutations are possible. This illustrates that the whole area of capability assessment is still immature and further studies and research is required. The principal problem with the current model is its stratification into levels and the judgmental association of numbers with these levels. The assessment guidance requires an organization to have all the practices at a particular level in place before it can be accredited at that level. Thus, an organization which has 80% of level 2 practices in place (say) and 70% of level 3 practices would receive a level 1 rating. Another limitation of the CMM is that all questions pertaining to a KPA are given equal weight. In actually, some questions are more important than other, and methods to accommodate such differences need to be developed [Singpurwala, 1999].

5.1.2 Performance Measurement and ISO-9000 Quality management System

It is true that ISO 9000 provides a concrete frame within which to grasp fuzzy concepts of quality. For many Indian companies, ISO 9000 provided a starting point as well as a focus. Every speaker in this issue, is pointing out that, in concentrating too narrowly on ISO 9000, companies are in danger of missing the wood for the trees [Abraham,1994]. ISO 9000 is a minimum requirement arrived at, by a consensus of group of countries.

It was intended for a contractual agreement between the parties [ISO-9001:1994; 2000]. It is a stepping stone to quality, not an end in itself. For goal oriented management as well as executives it is easier to say "We will try to achieve the certification" rather than to say "We will continuously improve our processes, products and people". There must be a separation between certification and the standard. The failure is not in the standard itself but in the fact that it is interpretable by consultants and companies. We have a situation where the people making the money are more aggressive than the people paying it. The quality Systems Accreditation committee of the ISO itself is grappling and trying to control this [Abraham, 1994]. Recently a survey of ISO certified Indian Companies has been carried and the findings of the survey is given in APPENDIX-I. It is revealed from the survey findings that the companies are interested for ISO certification because customer

demanding, prevent non-conformance etc. and continuous improvement is ranked at the last among the reasons. The results were also presented at the convention of the National Institution for Quality and Reliability at Bangalore, however there has been negligible impact. Therefore, it is the need for creating organizational conditions [Kondo, Yoshio, 1994] that are tolerant of individualism, so that innovative, continuous improvement can flourish.

ISO only describes the system as a set of actions that efficiently transform a user's need into the solution. The development focuses on system, schedules, standards, and practices rather than on technologies and attributes of the people [Lesley et al, 1993]. The main thrust of ISO 9000 approach to quality management system is one of making activities explicit and formalizing them. This addresses possibly the single most contributory factor in human error. It also discourages use of unofficial, informal procedures as an alternative to those that are documented [John, 1994]. ISO also sets requirements for competence and training, roles and responsibilities, and recording rather than remembering information. All of these do much to reduce risk of error. In practice however, implementation of these ISO requirements do not go far enough to achieve sufficient risk reduction to be fully effective. ISO 9004-2 gives some further guidance by pointing the need for identification of root cause of human error but stops short of suggesting how this might be achieved. Further, 1987 & 1994 versions of ISO did not suggest any

questionnaire with respect to the process areas. The 2000 version of ISO : 9004 has suggested the questionnaires[ISO-9004:2000] for the self appraisal. The need of the hour is to further work on this to put the weightage of the said questionnaire and make readymade format, with the guidelines for the evaluation of the maturity of the organization. Leaving to the self appraisal may be yield biased answer and, perhaps it would be difficult to draw the conclusion about the maturity of the organization. Without a Balanced Scorecard framework, performance measurement is also problematic at the operational level with questions about how best to measure performance in the context of efficiency, competitiveness and product and service quality. The Performance Audit must be carried out by "Peer Groups" [ISO-9004:2000] focusing on the development and use of performance measurement approaches at both the strategic and operational levels. There is a need to develop this approach to measuring and reporting performance, which are practical to apply in the industry and ISO can contribute to organizational performance if a climate of change is created [Mile & Danny, 1999]. However this is not yet happening on a widespread basis.

5.1.3 Performance Measurement and TQM

For organizations wishing to undertake Total Quality Management, one of the most important tools for organizational success is the measuring of its performance. Measuring requires an intimate knowledge of the workings of the organization. Performance management must be

supported by a well-designed information and analysis system. Emphasis is placed on the word information and not data. The transformation of data to information is key to understanding management in a quality environment. These systems are more than hardware and software. It includes the systems for collecting and disseminating information that engage employees, customers, investors and management in the giving and receiving of data about the company's activities and its products and services.

Using measurement information to manage, shifts organizational culture and management style. Reliance on information and facts about a company's performance replaces a reliance on supervising employee activities, the traditional management style in command and control environments.

Recently it was seen that TQM was using the "W-5" journalistic approach [Mik, 2001] to elicit the following facts based information to evaluate the performance of the organization.

- Why information is collected
- What information gets collected and what is it used for
- When to measure
- Where does the information come from
- How information is collected, analyzed and used in managing for quality
- Who collects the information and who uses the information

TQM does a lot to help [Oakland, John, 1993] to learn by :

- Developing a "No blame culture" whilst retaining accountability
- Helping organization to absorb new concepts and technologies
- Making process chain explicit
- Identifying error occurs and quantifying it
- Providing tools in identifying causes
- Improving communication channels
- Making continuous improvement everybody's business.

However, there are important areas in which the range of TQM tools and models need to be extended. Total Quality Management (TQM) is a philosophy for managing organizations as well as a set of tools for doing so. We must explore the historical development of this approach. Contrasting the new management model with traditional management methods. Exploring this radical new perspective of workplaces as systems. Understanding the system and how all of the activities, employees, customers, suppliers along with the machines and hardware form an integrated and interdependent whole. The goal of TQM is to constantly improve this system to create services and products that delight and exceed customer needs. The application of TQM approach must create whole and healthy organizations that understand themselves as systems that are a part of and interdependent on the individual systems of customers, suppliers, employees and the community around them. There are other problems too. For instance, looking at

benchmarking is a great problem [Zairi and Youssef,1995] because most organizations are closed to sharing information, especially with competitors and most benchmarking so far found had been in non-competing organizations. Therefore, most of the cases benchmarking is done not with a competitor but with people [Abraham,1994] with similar process, at process level. In India, Motorola has used only international benchmarks, and their Indian factories benefit from Motorola Centers of Excellence. Motorola worldwide has benchmarking trips to different companies to look at the areas of soldering or chip placement, sharing the results with their factories elsewhere in the world. And there is other option too. Companies with a foreign collaboration or parent can benchmark against division or companies overseas. But there is still some problems getting information from the principals since the merger is still young, but for most part one can compare without secrecy, get real time data .

Another imported buzzword is empowerment. Often it stumbles against the harsh reality of cynical managers and strong unions who use it as bargaining chip. Most problems originate with management, not workers [Abraham, 1994] and therefore, solutions also ultimately depend on management . That is of course, a chicken and egg question of whether lack of empowerment leads to bad worker relations or whether poor relations make management reluctant to empower workers. However empowerment can take a different form. It might mean negotiating a

settlement that lets workers share in gains made through quality improvement or productivity. Similarly, "Continuous improvement" is also a management function. Management must practice it or it is difficult to preach. The overall direction for any quality movement must come from the top, even if it doesn't necessarily begin there. Management has to make clear to employees, suppliers, customers and the world exactly where it stands on quality. It is not enough to lay out stirring words like "Continuous improvement" or TQM. Neither ISO nor conventional application of TQM give organizations enough guidance about how to deal with human factors [Cardy, 1998; Deming, 1986; Ghorpade et al, 1995] that in turn has a direct impact on productivity and quality. Little research focuses on the assessment of the performance appraisal systems in a TQM context. More specifically, little empirical research has been conducted in quality management that aims to shed light on the following three questions: What are the key generic criteria of a quality-driven performance appraisal? Does 'best practice' TQM-based performance appraisal exist? Do the current performance measurement systems in TQM organizations meet both TQM demands and employees' expectations in order to maximize customer satisfaction? Research must be made to investigate these questions by examining critical quality management practices as well as performance appraisal criteria. The researcher has identified that there is a lack of informative research on employee performance measurement in TQM-focused

organizations. It is also believed that there is no pre-packaged standard approach to employee performance evaluation or performance improvement that fits all the requirements of different TQM organizations so efforts may be made to identify and develop the most important quality-driven performance measurement criteria in TQM organizations. This will help to determine what criteria shape the acceptance and success of quality programmes efficiently and cost effectively.

Prof. Yoshio Kondo [1994] has rightly pointed out to the need for creating organizational conditions that are tolerant of individualism, so that innovative, continuous improvement can flourish. This is only likely to be achieved where mechanisms of inherent human vulnerability are well understood and accommodated, when processes and systems are designed and developed. In addition to system factors, Cardy and Dobbins[1994] argue that another important issue in regard to appraisal is the measurement of person factors. According to them, the content of HR performance evaluation can be divided into one of the three categories : traits based measures [Fisher et al,1996; Ghorpade et al, 1995; Torrington, Hall , 1998], result based measures [Cardy and Dobbins,1994; Fisher et al, 1996] and behavioral measures [Cardy, 1998]. These must be considered and integrated if a compatible assessment leading to rational approach to performance improvement to be made.

In industry, a lot of confusion exists about measuring effectiveness by TQM. Further work may be done to provide a new insight into how managers not only cope with apparent mismatches between TQM practices and performance evaluation criteria, but also utilize the system to both organization and customer's advantages.

Moreover, the "biased" responses received from the organizations during interviews, based on the structured questionnaires may be misleading. The industries find difficult to implement the system without the proper guidance and they are not able to make significant contribution to its quest for continuous improvement. Further, it may not be out of place here to mention that there is no procedure to categorize the industries based on the responses. One can only come into the conclusion whether TQM is being followed or not.

5.1.4 Performance Measurement and DEA

Data Envelopment Analysis (DEA) is an approach to measure and compare the efficiency of similar organizational units, called decision making units (such as local authority departments, schools, hospitals, shops, bank branches and similar instances where there is a relatively homogeneous set of units) that use the same inputs to produce same outputs. DEA [Boussofiene, Dyson, Thanassoulis, 1991] takes the observed input and output values to form a production possibility space, against which the individual units are compared to determine their efficiencies. The output efficiency of a unit measures the amount by

which the output of that unit can be increased without the need to increase the inputs. The input efficiency is defined likewise.

DEA has become tremendously popular relative performance evaluation tool [Thanassoulis, Boussofiane, Dyson, 1996]. Many of these have been published in high quality international journals. The relative performance evaluations are advantageous in several sectors. DEA solves some of the fundamental information asymmetry problems in real evaluation. The DEA approach captures [Sarrico, Dyson, 2000] 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 since the methods and procedures of the best units are more likely targets to other units.

But there is a recognized need for appropriate performance evaluations and regulatory mechanisms. The conception evaluation and characterization of such systems from an empirical or theoretical economic viewpoint have also attracted a fair amount of interest from the academic community. The strength of DEA are [Agrell, Bogetoft, 2002] :

- Requires no or little preferences, price or priority information
- Requires no or little preferences, technological information
- Handles multiple inputs and multiple outputs
- Identifies best practices
- Uses minimal extrapolation
- Supports planning, learning and motivation

The weakness of this approach [Agrell, Bogetoft, 2002] are:

- The non-availability of correct data and selection of both input and output as well
- If one has access to relatively high quality data but a complex technology with considerably uncertainty about the structure of the input – output correspondences, DEA is preferable. However, in case of a simple technology and very noisy data, the use of parametric statistical models are preferable .
- Relatively weak theory of significance testing (sensitivity, re-sampling, bootstrapping)
- Environmental factors, which add resource, must be incorporated in efficiency measurement.
- Lack of focus of organizational goals and objectives.

5.1.5 Performance Measurement and Bayesian approach

The Bayesian approach used as a probabilistic hierarchical classification model and applied for the classifications of software houses [Humphery and Sweet, 1987; Singpurwala, 1999] supplier rating [Lindley,1982] and defect classification, personnel management, educational placement and health care industries. What distinguishes this probabilistic scheme from the prevailing deterministic ones is that, there is a probability that an item belongs to a particular class and these probabilities are spread out

among all classes. Such probabilities reflect the inherent uncertainties behind the underlying statistics that are used to make the classification. Further, the model based on binary responses to the questionnaire and weightages are not given [Singpurwala,1999] in proportion to their importance. These are the limitations of this existing classification scheme and evidently the proposed method does not make the decision process easier, nor it can be claimed that the process [Singpurwala,1999] necessarily leads to correct decision.

Moreover, the organization must be equipped with the personnel with sufficient knowledge of statistics and a lot of assumptions to be made to apply the model thus the approach is difficult to use in the real industrial scenario.

5.1.6 Proposed approach

The accomplishments of this model in promoting management innovation with a widespread view those industries should aim for quality enhancements not only in products and services, but also in the quality of their overall assessment.

The system is aimed at awarding companies that have a "management system with excellent performance" and that continue to create new values driven by customers through self innovation so that they can improve the quality of organizations towards globally competitive management systems.

The framework consists of the core values and measures taken to achieve management innovation, which create performance excellence through quickly responding to business environment or market changes. This system includes a wide range of corporate activities, such as management that combines work activities and processes to meet the demands and expectations of customers and markets, along with the necessary recruitment and training of employees.

A mature organization has high overall management capability. They implement strategic elements into management, define clear processes to achieve customer value, follow this planned process, and understand the results. They know the goals and results at all times using data and are continuously learning how to effectively improve management. The different management capabilities of organizations are expressed in five different levels as depicted in Fig.1

A low maturity organization cannot turn around and become a high maturity organization in the short term. Organizations set goals for the next level of maturity and achieve higher maturity levels by continuous improvement. If an organization with a low maturity level tries to copy an organization with a high maturity level, they will not succeed since they do not have fundamental management activities.

Scoring Guidelines indicate which level an organization should aim for as an improvement goal. The theory of maturity level is based on the principles of management quality that have been utilized widely for the

past years. Specifically, these are the principles of statistical quality control, which were developed by Walter Shewhart, W. Edwards Deming, and Joseph M. Juran.

Based on the consensus review and/or site visit review findings, comments and scores are reviewed and a feedback report is prepared and submitted. The feedback report is a description of the strengths and suggestions for improvement based on the consensus comments for every assessment item. The applicant then utilizes the feedback report to plan and implement improvements.

The proposed model is better than other approaches for the following reasons :

- ❖ It provides a simple, easy-to-use approach
- ❖ It determines the relative degree of maturity of an organization's quality management system
- ❖ It helps to identify the main areas for improvement.
- ❖ It takes account of all the critical factors that contribute to business risk and hence enables more informed decision making.
- ❖ It also provides fact-based guidance to the organization regarding where to invest resources for its improvement.
- ❖ The model can be applied to the entire organization or part of the organization's quality management system or to any process.

- ❖ The proposed method may be applied to the various sectors such as education, medical and healthcare, and government or public service.
- ❖ It also helps to identify and facilitate the prioritization of opportunities for improvement, and maturing of the quality management system towards world-class performance.
- ❖ The results monitored over time can be used to appraise the maturity of an organization.

CHAPTER 6

➤ CONCLUSION AND FUTURE SCOPE OF WORK

6. CONCLUSION AND FUTURE SCOPE OF WORK

The framework suggested to assess the organizational performance measurement and also assist the organizations to manage better their business risk. It considers all aspects of enterprise performance, including business, organization, products, services and processes. It also generates specific improvement recommendations appropriate and relevant to the organization. Despite it is still in its developmental stage and has to accumulate experience so that the program could be further refined and its impact on the industry magnified. The system may be implemented to the various sectors such as education, medical and healthcare, and government or public service. The findings from the literature survey also revealed that performance measurement is still a vital necessity in quality driven context, but it needs to be adapted in important ways so that the practice maximally contributes to the quality effort. In addition, the following needs to be implemented in order to continuously improve the quality.

- The quality driven performance measurement system will be successfully implemented only those organizations having some track record in quality management and some structure to their measurement therefore quality management system need to be developed in the organizations.

- Evaluation of the performance measurement system should be approached like any other quality improvement effort.
- Within a quality driven environment, the focus of measurement system should be on behavior, with input and output used for diagnostic and development purposes.
- Conduct studies to determine the correlation between the degree of quality based approaches and business results.
- The performance management system should incorporate a formal process for investigating and correcting for the effects of situational constraints on performance.
- Increase the number of examiners and improve their competence and quality.
- Expand the number of assessors
- Incorporate innovative concepts and secure advanced position in award systems development:
- Responsibility for appraisal should continue to rest with the managers.

Performance measurement is a necessary instrument for quality management. It makes possible the assessment of whether or not an organization fulfills its goals and objectives, and whether or not particular objectives remain relevant.

Performance measurement cannot provide a totally objective, "true" and comprehensive image of an organization's function. A quality conscious organization cannot do without it, though, even if it will always be flawed or incomplete. So, management will go on being an art and decisions will still have to be made on the basis of approximate knowledge and intuition. A performance measurement system that address corporate, departmental and individual developmental needs. Recognize that even the most well designed performance measurement system is worthless unless the company is committed to ensuring that it is used properly and consistently and that feedback is acted upon. For the performance measurement to be successful organizations must listen to what employees say, must communicate action intent, must seek participation in getting action, must act with conviction and collectively to deliver value adding results that benefit both the organization and its employees. If this organizational culture can be created then the proposed performance measurement system will be well received. The performance measurement process is a positive influence on personal and corporate development but only if approached professionally and with commitment. Everyone needs to be aware of the performance measurement process and what performance measurement benefits will accrue to both the individual and the organization.

CHAPTER 7

➤ REFERENCES

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CHAPTER – 8

➤ LIST OF PUBLICATIONS

LIST OF PUBLICATIONS

A Hierarchical Classification Model for Designing and Developing Quality Performance Measures in Manufacturing Industries

J.K. Mandal and A. K. Ghosh

Paper sent to France for publishing in Journal "Association for the Advancement of Modeling and Simulation Technique in Enterprises".

A Comparative study on different methods of assessing the effectiveness of performance evaluation systems in different organizations.

J.K. Mandal and A. K. Ghosh

Paper sent to France for publishing in Journal "Association for the Advancement of Modeling and Simulation Technique in Enterprises".

APPENDIX - A

➤ SURVEY FINDINGS

ISO 9000 SURVEY FINDINGS

A survey of ISO certified Indian companies was carried out . The name of the companies are given below. The highlights of the findings are as follows :

FINDINGS OF THE SURVEY

Satisfaction level with auditing agencies

Over 95% of the companies reported that they are satisfied with the auditing agencies style and methods of auditing. Only 2 % said that they are not very happy while 3 % commented they are not at all happy with the conduct and reporting method of auditing.

Reason for selecting a Auditing Agency :

- A. Most sought after 40%
- B. In the Group others had it from them30%
- C. Audit for improvement.....28%
- D. Cost was competitive..... 19%
- E. Preferred by the consultant15%

Reason for ISO Certification:

When the Top Management were asked as to why they sought ISO 9000 certification, The reasons sited are :

- Customer demanded 68%
- Prevent Non-conformance 54%
- Competitive edge 44%

- Focusing Quality 24%
- Install a formal system 22%
- Global deployment 18%
- Continuous Improvement 12%

Implementation Process of the ISO 9000 system- experiences :

Time taken for certification :

Total time taken for implementation and certification varied from as low as 4 months to as high as 3 years. The frequency distribution of time taken for certification is given below :

< 1 Year	28%
1 -1.5 Year.....	39%
1.5 -2 Year	24%
2.2 - 5 Year	6%
2.5 - 3 Year	3%

Documentation :

Size of documentation was generally bulky

Index	Procedure	Work Instruction
Average	59	216
Minimum	12	15
Max.	465	1500

Clauses difficult to implement :

Of the twenty clauses of ISO 9000 series, 4.5, 4.11 and 4.20 have been reported as most difficult to understand and implement.

Internal Quality Audit :

Generally good number of internal quality auditors are available. In 2 number of cases, no internal auditors were available :

Auditors	Frequency (%)
0-10.....	37
10-20.....	34
20-30.....	10
30-40.....	12
40 & above.....	7

In 62% of the cases, certification was preceded by 5 or more internal quality audits but in 8% of the cases, with just 1 or 2 internal quality audits, certification was granted.

Statistical Techniques :

More than 60% of the companies reported found or no awareness of SPC/SQC concepts.

Awareness Level	%Frequency
Good	38
Somewhat	33
Low	17
Non existent	12

Most frequently used statistical techniques included, QC tools, SPC charting and sampling inspection. In 70% of companies, resources in terms of number of persons trained in SQC was less than 10. In quite a few companies there were none.

Benefits of ISO 9000 Certification:

- Better understanding of process and responsibilities (66%)
- Improvement of communication leading to better management control (45%)
- Better linkage to other functions (40%)

General Findings :

After the certification, the focus is now on :

Theme	% of Frequency
Continuous Improvement	95
Delivery Performance	29
Retaining the certificate	10
Others	8

Three most important lessons learnt in the process are :

- Team work is essential (75%)
- People make the system work (63%)
- Cooperation and information sharing is needed (43%)

If any organization has to go for certification, it has to do the following things differently :

- More emphasis on training 47%
- Better process management 41%
- Top down commitment 26%
- Proper documentation of procedures 24%

Recommendations :

Based on the survey findings, the following recommendations have been made :

- Benchmark the auditing methodology and standardize the frame for audit, possibly industry based. This is to facilitate uniformity in audit style.
- Educate and enlighten the lead auditors/auditors on the importance of unified approach on audit style and auditing technique, so that auditor orientation each time and every time is minimised.
- Companies should adopt KISS (Keep it Simple & Short) principle as regards volume of documentation. Too many or unconnected Procedures/Work instructions are prepared and as a result document control has become a nightmare in most cases.

- ISO should encompass all operations of an industry so that everyone is apart of it. As of today some function/departments do not come under ISO scheme.
- Quality Policy deployment through “SMART” objectives/goals should be encouraged. Audit should be extended to this activity as well.
- Awareness on statistical techniques is generally poor. In most cases, data representation tools viz. Graphical techniques only are made use of. For continuous improvement, use of advanced techniques becomes essential. There is an urgent need to educate both the top management and auditors on the utility of statistical methods in quality improvement. Lack of such knowledge forces management to practice find and fix approach as regards corrective actions and preventive actions on non-conformance, arising in the system.

LIST OF THE COMPANIES

1. HMT Ltd., CNC, Bangalore-13
2. Indian Aluminium Company Ltd. Nanjangud, Karnataka
3. Stumpp, Schuele & Somappa Ltd., Bangalore
4. Electronics Research Laboratory Ltd., Bagalore
5. HMT Ltd., Machine Tools, Bangalore
6. HMT Ltd., Watch Factory, Bangalore
7. HMT Ltd., Machine Tools, Kalamassery
8. HMT Ltd., Machine Tools, Hyderabad
9. HMT Ltd., Press Division, Hyderabad
10. HMT Ltd., Printing Dividion, Kalamassery
11. HMT Ltd., Machine Tools, Pinjore
12. HMT Ltd., Precision Machinery Division, Bangalore
13. HMT Ltd., Machine Tools, Ajmer
14. HMT Ltd., Watch Factory, Tumkur
15. HMT Ltd., Watch Factory, Ranibagh
16. HMT Bearings Ltd., Hyderabad
17. HMT Ltd., Die Casting Division, Bangalore
18. Kirtoskar Brothers Ltd., Kirloskarwadi
19. Grasim Industries Ltd., Pulp Division, Harihar
20. Grasim Industries Ltd., Fibre Division, Harihar
21. Glowtronics Ltd., Mysore
22. Auma India Limited, Bangalore

23. Kirloskar Copeland Ltd., Karad
24. Peninsula Polymers (P) Ltd., Trivandrum
25. Balmer Lawrie & Co. Ltd., Aror, Kochi
26. Cuttast Abrasives Tools Ltd., Chennai
27. TANFAC Industries Ltd., Cuddalore
28. Salem Textiles Ltd., Salem
29. Florind Shoes Ltd., Ambur
30. Floram Shoes Ltd., Amur
31. UNISCO Shoes Ltd., Ambur
32. Jayashree Textiles Ltd., Kolkata
33. Exide Industries Ltd., Haldia
34. Birla Cements Ltd., Durgapur
35. ICI Rubber Chemicals (QC Operation) Ltd., Kolkata
36. A Sirkar (Jewellers) Pvt. Ltd., Kolkata
37. ICI-Paints Business, Kolkata
38. Andrew Yule (Togami Unit)
39. Andrew Yule (Brentford Unit)
40. Orissa Cements Ltd.
41. Indian Oil Blending Ltd.
42. Wipro, Consumer Products, Amalner
43. JAIN PLASTICS & Chemicals Division (Papain Product Group)

Jalgaon

44. Grasim Industries Ltd., Mavoor

45. Glowtronics Ltd., Mysore
46. Sundaram Fasteners Ltd., Hosur
47. Visalakshi Textiles Ltd., Madurai
48. Hical Magnetics ltd., Bangalore
49. Rao Insulating Company Ltd., Bangalore
50. Murudeshwar Ceramics Ltd., Hubli
51. Gokak Mills Ltd., Gokak
52. Modi Xerox Ltd., Bangalore
53. Widia (India) Ltd., Bangalore
54. NGEF Ltd., Bangalore
55. Motoroal (India) Ltd., Products Division, Bangalore
56. Hewlett Packard Ltd., Bangalore
57. Wipro Peripherals Ltd., Mysore
58. Larsen & Toubro Ltd., Bangalore
59. TAFE Ltd., Doddaballapur
60. ABB, Corporate Office, Bangalore (Short Projects)
61. Aerospace Division, HAL, Bangalore
62. NVT-QC, Bangalore
63. Stumpff Schuele & Somappa Ltd., Bangalore
64. INDAL, Alumina Plant, Bangalore
65. RHW Autoliv India Ltd., Bangalore
66. Yukogawa Blue Star Ltd., Bangalore (short projects)
67. TITAN Industries, Hosur

68. BEML. KGF (short project)
69. Kinetic Engineering Ltd., Ahmednagar
70. INDAL, DMW Mines, Kolhapur
71. ATIRA, Ahmedabad (short projects)
72. BPL Ltd., Corporate Office, Bangalore (short projects)
73. General Optics Ltd., Pondicherry
74. Rajapalayam Mills, Rajapalayam
75. Sri Lakshmi Saraswathi Textiles, Arni
76. Gnanambika Mills Ltd., Coimbatore
77. Thambi Modern Spinning Mills. Salem
78. Sudarsanam Spinning Mills, Rajapalayam
79. Sri Vishnu Shankar Mills. Rajapalayam
80. Sree Narayana Krishna Spinners Ltd., Udumalpet
81. SLS Textiles, Andhra Pradesh
82. Sambandham Spinning Mills, Salem
83. Sree Akkamamba Textiles Ltd., Tanuku, Andhra Pradesh
84. Kandagiri Spinning Mills Ltd., Salem
85. Palani Andavar Cotton & Synthetic Spinners Ltd., Udumalpet
86. Gujarat Communications & Electronics Ltd., Baroda
87. Patwa Kinariwala Electronics Ltd., Baroda
88. L. K Pace India Private Ltd., Baroda
89. Gujarat State Fertilizer Company Ltd., Baroda
90. United Catalysts (I) Ltd., Baroda

91. BHEL, Bhopal
92. Kalpataru Power Transmissions Ltd., Gandhinagar
93. Atlas Mye-Chem Industries
94. ATE Enterprises Ltd., Ahmedabd
95. Arvind Mills Ltd., Ahmedabad
96. DGP Windsor India Ltd., Ahmedabad
97. Antifriction bearings Corporation Ltd., Bharuch
98. Gujarat Propack Ltd., Ahmedabad
99. New Shorrocks Mills Ltd., Nadiad
100. Crompton Greaves Ltd., SPC Division, Nasik
101. Sudarshan Chemical Industries Ltd., Pune
102. Fleet guard Filtration Systems (India) Pvt. Ltd., Pune
103. The Kolhapur Steel Limited, Kolhapur
104. Precimax Bearings Pvt. Ltd., Kolhapur
105. Kirloskar Pneumatic Co. Ltd., Pune
106. Mahindra & Mahindra Ltd., Bombay
107. KSB Pumps Ltd., Pune
108. Spentex Industries Ltd., Baramati
109. Indian Oil Blending Ltd., Bombay
110. Indian Oil Blending Ltd., Vashi
111. Technova Imaging Systems ltd., Talaja
112. Bharat Electronics Ltd., Talaja
113. Standard Batteries Ltd., Mumbai

114. Bumper (India) Ltd., Mumbai
115. Gratex Ltd., Mumbai
116. Godrej & Boyce Mfg. Co. Ltd., Typewriter Division, Mumbai
117. Bharat Petroleum Corporation Ltd. Mumbai
118. BHEL, Project Engineering Management, New Delhi
119. Sri Jataraj Cermics & Chemical Industries Ltd., Dalmiapuram
120. T Abdul Wahid & Co. Ambur
121. Antrieb Technik Private Ltd., Chennai
122. Engine Valves Ltd., Chennai
123. Engine Valves Ltd., Hyderabad
124. Whirlpool India Ltd., Washing Machine Division, Pondicherry
125. Sundram Fasteners Ltd., Chennai
126. Tractors & Farm Equipments Ltd., Chennai
127. Mathia's Packaging Industries Ltd., Chennai
128. N. F, Private Ltd., Madras
129. Farida Shoes Private LTD., Chennai
130. Sunil & Co. Chennai
131. Heavy Alloy Penetration Project, Ordance Factory, Tiruchirapalli
132. Gramophone Company of india Ltd., Kolkata
133. Hyderabad Industries Ltd.
134. Hindustan Motors Ltd.
135. ICI (Paints), Rishra
136. DCM ltd., Delhi

137. Ordnance Factory, Dehradoon
138. BHEL, Corporate Quality Assurance, Secunderabad
139. Ferro Allowys Corporation Ltd., Garivedi
140. Nagarjuna Steels Ltd., Patancheru
141. SRMT, Kakinada
142. Bharat Dynamics Ltd., Bhanur
143. Nava Bharat Ferro Alloys Ltd., Hyderabad
144. Dr. Reddy's Laboratories, Hyderabad
145. Nationa Ship Research Development Centre. Vishakapatnam
146. FACOR, Shreeramnagar
147. SCL, Bolarum
148. SAMKRG Pistóns Ltd., Hyderabad
149. Naravita Agro Products Ltd. Hyderabad
150. Western India Plywoods Ltd., Kanpur
151. Tata Tea Ltd., Munnar
152. Thruvananthapuram Regional Co.op Milk Producers Union,
Trivandrum
153. Peninsula Polymers Ltd., Trivandrum
154. Balmer Lawrie & Co. Ltd. Arror, Kochi
155. United Catalysts (India) Ltd., Ernakulam
156. Whirlpool India Ltd., Faridabad
157. FAL Industries Ltd., Chennai
158. Sundarma Fasterners Ltd., Pondicherry

159. Sundaram Fasteners ltd., Madurai
160. L & T Enginnering Project and Equipment group, Kolkata
161. ITC (Tribeni Tissue Division), Kolkata
162. Peerless Hospital, Kolkata
163. Rifle Factory, Ishapore
164. Jayashree Textiles Ltd., Kolkata
165. Metflow Industries Ltd., Kolkata
166. Balmer Lawrie & Co. Ltd., (Tea Division)
167. Birla Jute and Industries Ltd., Kolkata
168. Andrew Yule Limited (Togami Unit)
169. ICI-Explosives Division
170. Exide Industries (Haldia Unit)
171. Department of P & T
172. Indian Oil Blending Ltd., Kolkata

APPENDIX - B

➤ GUIDELINES FOR PERFORMANCE MEASUREMENT

GUIDELINES FOR PERFORMANCE MEASUREMENT

The following points may be considered by the assessors during the assessment of the organization. In this following section the guidelines are given related the different characteristics mentioned in Annexure - I

1. LEADERSHIP

[Top management behaviour and personal involvement in leading quality management function and efforts in driving the organization towards total quality.]

- i) Describe top management's personal involvement in leading quality management function and visibility in quality related activities of the organization, which may include steps taken by top management to:
 - a) demonstrate commitment to quality;
 - b) communicate with employees;
 - c) make themselves accessible and listen to employees;
 - d) give and receive training;
 - e) reinforce the organization's customer orientation through all levels of management and supervision;
 - f) benefit the society in terms of safety, health, energy conservation and environment protection etc; and
- ii) Describe how the top management demonstrates a consistent total quality culture, which may include the positive steps taken by the management to :

- a) be involved in assessing awareness of total quality
 - b) be involved in reviewing progress in total quality and performance objectives; and
 - c) Include commitment to and achievement in total quality in appraisal and promotion of staff at all levels.
- iii) Describe the top management's support to total quality by provision of appropriate resources and assistance.
- iv) Describe top management's involvement with customers and suppliers, which may include the steps taken to:
- a) meet customers and suppliers;
 - b) establish and participate in 'partnership' relationships with customers and suppliers; and
 - c) establish and participate in joint improvement teams with customers and suppliers.
- v) Describe how the top management promotes the total quality outside the organization, which may include the steps taken for:
- a) membership of professional bodies;
 - b) publication of booklets, articles, etc;
 - c) presentation at conferences and seminars; and
 - d) assistance to local community.

2. POLICIES AND STRATEGIES

[The organization's mission, values, vision and strategies related to total quality and customer focus.]

- i) Describe how the organization's policy and strategy reflect the concept of Total Quality in:
 - a) values,
 - b) vision,
 - c) mission, and
 - d) strategy.

- ii) Describe how the organization's policy and strategy are formed on the basis of information relevant to Total Quality, which may include the manner of utilizing:
 - a) feedback from customers and suppliers;
 - b) feedback from the competitors; and
 - c) data on performance of competitors; and
 - d) data on regulatory and legislative issues.

- iii) Describe how the organization's business plans are evolved, evaluated, improved and aligned with its established objectives. The description may include :
 - a) Internal evaluation such as available data in organization.
 - b) External evaluation such as customer satisfaction and market appraisal.

- iv) Describe how the policies and strategies are communicated. The description should include how:
 - a) various publicity media, such as, newsletters, posters, video, etc, are used;

b) communications on policy are planned and prioritized; and

c) organization evaluates the awareness of employees of its policy.

v) Describe how the policy and strategy are regularly reviewed and improved, which may include the manner in which the organization evaluates the effectiveness and relevance of its policy and improves it.

vi) Describe how the organizations discharge its public responsibility such as business ethics, public health and safety, environmental protection and waste management in its quality policies and practices.

3. HUMAN RESOURCE MANAGEMENT

[The management of the organization's employees with a view to developing and realizing their full potential to continuously improve organizational development]

i) Describe how the organization's overall human resource management efforts support its quality objective, which may include:

a) how human resource plans are derived from the quality goals, strategies and plans;

b) key quality goals and improvement methods for human resource management practices such as recruitment and career development.

c) how the organization evaluates and uses its overall employee related data to improve the development and effectiveness of

all employees.

- ii) Describe the means available for all employees to contribute effectively to meet the organization's performance and quality objectives. Summarize trends and current levels of involvement of employees, covering aspects such as:
 - a) specific mechanisms and practices, like teams or suggestions systems used to promote employees' involvement/ contribution towards organization's performance and quality objectives;
 - b) actions to enhance employees' authority, responsibility and innovation; and
 - c) key indicators used to evaluate and improve the extent and effectiveness of involvement of employees.
- iii) Describe how the skills and capabilities of the employees are preserved and developed through recruitment, training and career development. The description may include how:
 - a) skills of employees are defined and compared with the organization's requirements;
 - b) recruitment and advancement of employees are planned;
 - c) training plans for employees are established and implemented;
 - d) the effectiveness of training of employees is reviewed; and
 - e) summary and trends in quality related education and training received by the employees, are prepared.

- iv) Describe how the employees' recognition, reward, performance and feedback process for individuals and groups, support its performance and quality objectives, which may cover:
- a) how employees are involved in the development and improvement of performance measurements;
 - b) trends in rewards and recognition for employees as individuals and groups, for contributions to quality and performance objectives; and
 - c) key indicators used to evaluate and improve its recognition, reward and performance measurement process.
- v) Describe how the organization maintains work environment conducive to the well-being and growth of its employees. Summarize trends and levels in key indicators of well-being and morale of the employees. The description is expected to cover :
- a) how well-being and morale factors such as health, safety, satisfaction and ergonomics are included in quality improvement activities. For accidents and work-related problems, how underlying causes are determined and adverse conditions are prevented;
 - b) mobility, flexibility and retraining in job assignments to support employee development and accommodate changes in technology;

- c) special services, facilities and opportunities made available to the employees;
 - d) how the employees satisfaction is determined and interpreted for the use in quality improvement;
 - e) trends and levels in key indicators of well-being and morale, such as , safety, absenteeism, grievances, strikes and workers' compensation. Explain noticeable adverse results, if any, and how problems were solved; and
 - f) compare the current levels of the most significant indicators with the industry averages and industry leaders.
- vi) Describe how effective top down and bottom communication is achieved. The description may include how ;
- a) regular two-way briefing meetings are used;
 - b) the organization keeps in touch with its employees; and
 - c) the organization transmits information to its employees.

4. RESOURCES

[The management's utilization and preservation of resources(financial, information and material) and application of technology towards continuous business improvement]

Describe the organization's resources are effectively developed in

support of its policy and strategy. The description may include the total quality approach of the organization and continuous business improvement through the management of :

- i) financial resources (financial strategies reflecting total quality, criteria for financial decision-making in support of total quality, use of quality cost concepts, etc);
- ii) information resources (management of information system, information validity, integrity, security and scope, accessibility of information to customers, suppliers and employees involved in improvement and information strategies in support of total quality);
- iii) material resources (management of sources and supplies of raw materials, optimization of material inventories, minimization of material waste and optimum utilization of fixed assets); and
- iv) application of technology (identification and evaluation of alternative and emerging technologies according to their business, exploitation of technology to achieve competitive advantage, development of personnel, skills and capabilities of personnel in harmony with development of technology and protection of intellectual property and its exploitation).

5. DESIGN AND DEVELOPMENT

(The organization ensures that design and development activities satisfies customer and market requirements)

- i) Describe how organization meets the needs of customers and markets. The description may include :
 - a) Present and future demands in order to develop appropriate organizational activities.
 - b) Relationships between the work activity and the added value to the customer and market for consistent and excellent response.
- ii) The design and development activities may include :
 - a) Design Input relating to products including statutory and regulatory requirement.
 - b) Design output meets the input requirement, makes reference to acceptance criteria, safe and proper functioning of product, maintenance and disposal requirements.
 - c) Design review at the presence of all functions concerned including specialist personnel.
 - d) Design verification includes performing alternative calculation, comparing new design with a similar proven design, performance tests and demonstrations.
 - e) Design validation to ensure that products conforms to defined user needs under operating conditions on final products or earlier stages prior to product completion.

iii) Design changes / modifications are identified, documented, reviewed and approved before implementation, written customer approval or waiver of such approval.

6. PROCESSES

[The management of all the values adding activities within the organization including identification, review and revision to ensure continuous improvement]

Describe how the organization identifies value-adding activities, reviews them and if necessary revises them to ensure continuous improvement of its business. The description may include:

- i) identification of processes critical to the success of the business;
- ii) system for management of the processes;
- iii) rework levels.
- iv) System to control, calibrate and maintain the measuring and monitoring devices including test hardware and test software both.

7. IMPROVEMENT PROCESS

(Organization philosophy to all business process and support devices for continuous improvement including the need for innovative improvements)

- i) Use of corrective actions by investigating the cause of non-conformities relating to product, process, system and recording result for investigation, determination of corrective action needed to eliminate the cause of non-conformities and application of controls to ensure that corrective action is effective.
- ii) Use of appropriate sources of information such as process, work operations, audit results, service reports, customer complains to detect, analyze and eliminate the potential causes of non-conformities. Determination of steps needed to deal with any problem requires preventive action. Initiation of preventive action and application of control to ensure that it is effective.
- iii) Plan for continuous improvement in processes. Perfection of process methods to ensure that requirements are always met. Optimizing the characteristics and parameters at a target value and tools such as control chart FMEA, PPM analysis, problem solving, benchmarking etc.
- iv) Process performance measurements such process capability study and feedback system used to review and set target for improvement.

8) CUSTOMER SATISFACTION

[The organization's achievements and projections in terms of customer satisfaction]

Describe the perception of customers about the organization, its products and services, also indicate current levels and trends in customer satisfaction. Indices, if any, to measure customer satisfaction shall be indicated. Description may include customer's perception of the organization with respect to:

- i) capability of meeting specifications
- ii) product quality
 - a) defect, error, rejection rates
 - b) consistency, reproducibility
 - c) maintainability
 - d) durability
 - e) reliability
 - f) responsiveness, flexibility
 - g) product training
 - h) sales support
 - i) technical support
- iii) Indications of customer protection which may include:
 - a) information provided to the customer through informative labeling, brochures and other product literature (enclose

copies). If you are using any guidelines/standards for this purpose, details of the same may also be provided.

iv) Additional indications of customer satisfaction which may include:

- a) number and nature of customer complaints
- b) redressal mechanism including time of response and final redressal
- c) customer returns (by value and quantity)
- d) warranty payments
- e) reports on customer surveys by the organization and/or by the customer/consumer
- f) awards and prizes received.

9. EMPLOYEES SATISFACTION

[Organization's success in satisfying the needs and expectations of its employees]

Describe the feelings of employees about the organization and the system of getting their responsiveness. Description may include:

- i) Employees perception of the organization with respect to:
 - a) working environment , location, space amenities
 - b) health and safety provisions
 - c) communication at local organization level

- d) appraisal, target setting and career planning
 - e) career development, training and retraining
 - f) awareness of job requirements
 - g) awareness of organization values, vision and strategy
 - h) awareness of total quality process
 - i) involvement in total quality process
 - j) recognition schemes
 - k) reward schemes
 - l) job security
- ii) Additional indications of employees satisfaction, such as,
- a) absenteeism and sickness
 - b) staff turnover
 - c) grievances
 - d) use of facilities provided by the organization
- iii) Timely recognition and appreciation of the efforts and success of the individuals and teams.

10. IMPACT ON ENVIRONMENT AND SOCIETY

[Organization's success in satisfying the needs and the expectations of the community at large, for example, approach to: quality of life; the environment; the preservation of resources; and minimizing loss to the society]

- i) Describe the steps taken by the organization for environment protection and preventing harm to its neighborhood as a result of its operation in terms of:
- a) adoption of environment-friendly and efficient technology
 - b) environment friendliness of products
 - c) effluent and pollution hazards
 - d) noise
 - e) health risks
 - f) proportion of cost of environmental protection in production cost
 - g) other indices used for measuring the effectiveness of environmental protection/pollution control measures
 - h) measures taken to correct any ecological imbalances that the unit might have caused.

Awards and prizes received, etc for the efforts made by the organization for environmental protection may also be indicated.

- ii) Describe how the organization is fulfilling its responsibilities to the public for health, safety, and ethical business practices, which may include:
- a) Involvement in community in terms of:
 - 1. education and training
 - 2. medical welfare
 - 3. sports and leisure

- iii) Activities to assist in preservation of resources in terms of:
 - 1. energy conservation
 - 2. usage of raw materials and other inputs
 - 3. usage of recyclable materials
 - 4. extent to which renewable energy resources are used and efforts made to regenerate those already consumed
 - 5. reduction of wastes
- iv) Additional indications of impact on society may include:
 - 1. number of general complaints
 - 2. number of infringements of national and international standards
 - 3. number of safety related accidents

Awards and prizes received, etc for the efforts made by the organization towards fulfilling the needs and expectations of the society may also be indicated.

11. BUSINESS RESULTS

[Organization's success is achieving its planned business performance and in satisfying the needs and expectations of its stakeholders]

Describe what the organization is achieving in relation to its planned business performance in terms of financial and non- financial measures, which may include:

- i) Financial measures in terms of:

- a) profit
- b) cash flow
- c) sales
- d) value added
- e) working capital
- f) equity
- g) return to shareholders
- h) reinvestment and redeployment of profits in relation to capital employed
- i) details of investors' grievances and their redressal

These may be expressed in absolute terms or as ratios per unit of capital or per employee.

ii) Non financial measures in terms of:

- a) market share
- b) percentage growth in terms of turnover
- c) wastes
- d) defects per unit of output
- e) variability of product
- g) cost of non-quality, etc

This may also cover cycle times such as, order processing time, product delivery time, batch processing time, time to introduce new products in the market, time to break-even on new developments and inventory turn-over ration.

iii) Describe performance of the organization in respect of compliance with statutory and legal requirements. The description may cover the following aspects:

- a) number and nature of violations, if any
- b) number of cases pending in courts/consumer forums and their status.

11. ANNEXURES

11.1 Evaluation Proforma and Summary of Assessment

Annexure I

EVALUATION PROFORMA

CHARACTERISTICS /CRITERIA	Assigned Score (Out of 100)
1. Leadership	
Q.i) Visible involvement of top management in leading quality management function	25
Q.ii) Consistent quality culture	25
Q.iii) Support to quality by appropriate resources and Assistance	20
Q.iv) Relationship with customers and suppliers	15
Q.v) Promotion of total quality outside organization	15
2. Policies and Strategies	
Q.i) Based on the concept of total quality in organization's value, vision, mission and strategy	20
Q.ii) Formulated on the basis of information relevant to total Quality	20
Q.iii) Establishment of quality objectives	15
Q.iv) Communication and publicity	20
Q.v) Review and improvement at regular interval	20
Q.vi) Social responsibility of management	15
3. Human Resource Management	
Q.i) Alignment with organisation's quality goals, strategies and Plans	20
Q.ii) Measures to promote employees' involvement / contribution towards organization's performance and quality objectives and the evaluation of their effectiveness.	15
Q.iii) Preservation and development of employees' skills and capabilities through training and career development	15
Q.iv) Steps taken and key indicators used by the organization to evaluate and improve it's recognition, reward and performance measurement process	15
Q.v) Steps taken for maintaining work environment like following 5S,safety etc.and growth of it's employees	20
Q.vi) Measures for effective top-down and bottom-up Communication	15

4. Resources	
Q.i) Financial Resources	25
Q.ii) Information Resources	25
Q.iii) Material Resources and fixed assets	25
Q.iv) Application / advancement of technology	25
5. Design and Development	
Q.i) Based on needs and expectations of customers and Market	50
ii) Activities such as design input, output, review, verification, validation considered	20
iii) Implementation of design changes and communication	15
6. Processes	
Q.i) Identification of processes, critical to the success of Business	30
Q.ii) System for management of processes	25
Q.iii) Rework levels	20
Q.iv) Control of measuring and monitoring devices to Ensure correct data	25
7. Improvement processes	
Q.i) Use of corrective actions for evaluating, eliminating Recorded problems	20
Q.ii) Use of preventing action for potential causes	20
Q.iii) Use of systematic improvement methods and tools towards continuous improvement	18
Q.iv) Process performance measurement such as process capabilities studies and feedback system used to review processes and set targets for improvement	30
Q.v) Implementation of process changes and evaluation of Benefits	12
8. Customer satisfaction	
Q.i) Capability of meeting specifications	30
Q.ii) Customers' perceptions of the organization with respect to product (including service) quality	25
Q.iii) Indications of customers' protection by means like providing information through labeling / brochure / product literatures, on time delivery, product availability, accessibility of key staff.	25

9. Employees' Satisfaction	
Q.i) Employees' perception of the organization and the system used for getting their responsiveness	40
Q.ii) Additional indications of employees' satisfaction	30
Q.iii) Timely recognition and appreciation of employees' effort	30
10. Impact on environment and society	
Q.i)Steps taken for environment protection and preventing harm to it's neighbourhood	40
Q.ii)Organization's active involvement in community Welfare	20
Q.iii) Activities to assist in preservation of resources	25
Q.iv) Additional indications of impact on society	15
11. Business Results	
Q.i) Financial Resources	40
Q.ii) Non- Financial Resources	40
Q.iii) Compliance to legal and statutory requirements	20
Total Scores	1100

ANNEXTURE II

SUMMERY OF ASSESSMENT FORM

(To be used for each industry)

Name of the organization:

Category : Large Scale / Medium Scale / Small scale

Industrial Sector : Manufacturing / Service Sector

Name of the Assessors :

Date of Assessment :

Parameter (1)	Questions & score for Assessor (2)	Average score for All Assessors (3)	Parameter weighthage (4)	Parameter Score (5)
Leadership	Q.i Q.ii Q.iii Q.iv Q.v Sub Total		1.0	
Policies and Strategies	Q.i Q.ii Q.iii Q.iv Q.v Q.vi Sub Total		1.0	
Human Resources Management	Q.i Q.ii Q.iii Q.iv Q.v Q.vi Sub Total		0.5	

Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Resources	Q.i Q.ii Q.iii Q.iv Sub Total		1.0	
Design and Development	Q.i Q.ii Q.iii Sub Total		1.0	
Processes	Q.i Q.ii Q.iii Q.iv Sub Total		0.5	
Improvement processes	Q.i Q.ii Q.iii Q.iv Q.v Sub Total		1.0	
Customer satisfaction	Q.i Q.ii Q.iii Q.iv Sub Total		1.5	

Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weighthage (4)	Parameter Score (5)
Impact on Enviornment and Society	Q.i Q.ii Q.iii Q.iv Sub Total		0.5	
Business Results	Q.i Q.ii Q.iii Sub Total		1.5	

Total Score obtained (Out of 1000)

11.2. ASSESSMENT RESULTS

ANNEXTURE II

SUMMERY OF ASSESSMENT FORM

(To be used for each industry)

Name of the organization : Beverage factory

Category : Large Scale / ~~Medium Scale~~ / ~~Small~~/scale

Industrial Sector : ~~Manufacturing~~ / ~~Service~~ Sector

Name of the Assessors : Mr. X & Mr. Y

Date of Assessment : 04.7.2003 & 05.7.2003

Parameter (1)	Questions & score for Assessors (2) Mr. X Mr Y	Average score for All Assessors (3)	Parameter weigthage (4)	Parameter Score (5)
Leadership	Q.i 20 21 Q.ii 20 20 Q.iii 18 18 Q.iv 13 13 Q.v 14 14 Sub Total 87 85	86	1.0	86
Policies and Strategies	Q.i 18 17 Q.ii 19 18 Q.iii 13 12 Q.iv 14 13 Q.v 13 12 Q.vi 14 13 Sub Total 91 85	88	1.0	88
Human Resources Management	Q.i 18 16 Q.ii 14 12 Q.iii 12 11 Q.iv 13 13 Q.v 19 18 Q.vi 14 12 Sub Total 90 82	86	0.5	43

Parameter (1)	Questions & score for Assessor (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Resources	Q.i 23 20 Q.ii 22 21 Q.iii 24 23 Q.iv 22 21 Sub Total 91 85	88	1.0	88
Design and Development	Q.i Q.ii Q.iii Sub Total	N/A	1.0	
Processes	Q.i 25 25 Q.ii 22 22 Q.iii 19 18 Q.iv 23 18 Sub Total 89 85	87	0.5	43.5
Improvement processes	Q.i 18 18 Q.ii 18 18 Q.iii 17 17 Q.iv 25 21 Q.v 10 10 Sub Total 88 84	86	1.0	86
Customer satisfaction	Q.i 26 25 Q.ii 23 22 Q.iii 22 22 Q.iv 18 16 Sub Total 89 85	87	1.5	130.5

Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Employees' Satisfaction	Q.i 38 36	90	0.5	45
	Q.ii 26 25			
	Q.iii 28 27			
	Sub Total 92 88			
Impact on Environment and Society	Q.i 38 36	89	0.5	44.5
	Q.ii 19 18			
	Q.iii 22 20			
	Q.iv 13 12			
	Sub Total 92 86			
Business Results	Q.i 38 38	90	1.5	135
	Q.ii 37 36			
	Q.iii 16 15			
	Sub Total 91 89			

Total Score obtained

789.5

N.B - Since the "Design and Development" parameter is not applicable for the particular industry, Total score obtained is calculated, out of 900 instead of 1000, i.e 87.7%.

Signature of Assessors with Date :

[Signature]
5/7/03

[Signature]
5.7.03

ANNEXTURE II

SUMMERY OF ASSESSMENT FORM. (To be used for each industry)

Name of the organization : CTC Tea Manufacturer

Category : Large/Scale / Medium Scale / Small/scale

Industrial Sector : Manufacturing / Service/Sector

Name of the Assessors : Mr. A & Mr. B

Date of Assessment : 11.7.2003

Parameter (1)	Questions & score for Assessors (2) Mr. A Mr B	Average score for All Assessors (3)	Parameter weighthage (4)	Parameter Score (5)
Leadership	Q.i 07 06 Q.ii 08 07 Q.iii 07 08 Q.iv 08 10 Q.v 04 03 Sub Total 34 34	34	1.0	34
Policies and Strategies	Q.i 06 05 Q.ii 08 07 Q.iii 07 07 Q.iv 04 05 Q.v 08 06 Q.vi 06 05 Sub Total 39 35	37	1.0	37
Human Resources Management	Q.i 08 06 Q.ii 04 04 Q.iii 08 07 Q.iv 08 06 Q.v 10 10 Q.vi 10 09 Sub Total 48 42	45	0.5	22.5

Parameter (1)	Questions & score for Assessor (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Resources	Q.i 18 16 Q.ii 07 06 Q.iii 15 13 Q.iv 12 13 Sub Total 52 48	50	1.0	50
Design and Development	Q.i Q.ii Q.iii Sub Total	N/A	1.0	
Processes	Q.i 08 06 Q.ii 12 11 Q.iii 05 06 Q.iv 12 11 Sub Total 37 34	35.5	0.5	17.75
Improvement processes	Q.i 08 07 Q.ii 06 07 Q.iii 06 05 Q.iv 12 11 Q.v 06 04 Sub Total 38 34	36	1.0	36
Customer satisfaction	Q.i 13 12 Q.ii 12 10 Q.iii 10 10 Q.iv 11 08 Sub Total 46 40	43	1.5	64.5

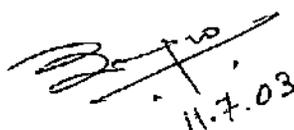
Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weighthage (4)	Parameter Score (5)
Employees' Satisfaction	Q.i 12 10 Q.ii 06 04 Q.iii 10 08 Sub Total 28 22	25	0.5	12.5
Impact on Environment and Society	Q.i 12 10 Q.ii 18 14 Q.iii 15 14 Q.iv 05 04 Sub Total 50 42	46	0.5	23
Business Results	Q.i 20 16 Q.ii 10 12 Q.iii 08 06 Sub Total 38 34	36	1.5	54

Total Score obtained

351.25

N.B - Since the "Design and Development" parameter is not applicable for the particular industry, Total score obtained is calculated, out of 900 instead of 1000, i.e 39%.

Signature of Assessors with Date :


11.7.03


11/7/03

ANNEXTURE II

SUMMERY OF ASSESSMENT FORM (To be used for each industry)

Name of the organization : Manufacturer of Green Tea

Category : Large/Scale / Medium Scale / Small/scale

Industrial Sector : Manufacturing / Service Sector

Name of the Assessors : Researcher

Date of Assessment : 24.7.2003

Parameter (1)	Questions & score for Assessor (2) Mr. A	Average score for All Assessor (3)	Parameter weigthage (4)	Parameter Score (5)
Leadership	Q.i 05 Q.ii 05 Q.iii 04 Q.iv 08 Q.v 00 Sub Total 22	22	1.0	22
Policies and Strategies	Q.i 05 Q.ii 00 Q.iii 00 Q.iv 00 Q.v 00 Q.vi 05 Sub Total 10	10	1.0	10
Human Resources Management	Q.i 05 Q.ii 04 Q.iii 04 Q.iv 04 Q.v 05 Q.vi 03 Sub Total 25	25	0.5	12.5

Parameter (1)	Questions & score for Assessor (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Resources	Q.i 06 Q.ii 05 Q.iii 08 Q.iv 02 Sub Total 21	21	1.0	21
Design and Development	Q.i Q.ii Q.iii Sub Total	N/A	1.0	
Processes	Q.i 08 Q.ii 05 Q.iii 02 Q.iv 05 Sub Total 20	20	0.5	10
Improvement processes	Q.i 05 Q.ii 03 Q.iii 03 Q.iv 00 Q.v 03 Sub Total 14	14	1.0	14
Customer satisfaction	Q.i 04 Q.ii 05 Q.iii 06 Q.iv 04 Sub Total 19	19	1.5	28.5

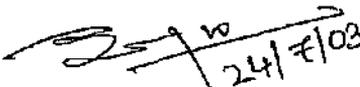
Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Employees' Satisfaction	Q.i 08 Q.ii 06 Q.iii 00 Sub Total 14	14	0.5	7
Impact on Environment and Society	Q.i 05 Q.ii 03 Q.iii 03 Q.iv 02 Sub Total 13	13	0.5	6.5
Business Results	Q.i 10 Q.ii 08 Q.iii 10 Sub Total 28	28	1.5	42

Total Score obtained

173.5

N.B - Since the "Design and Development" parameter is not applicable for the particular industry, Total score obtained is calculated, out of 900 instead of 1000, i.e 19.3%.

Signature of Assessors with Date :


24/7/03

ANNEXTURE II

SUMMERY OF ASSESSMENT FORM (To be used for each industry)

Name of the organization : CTC Tea Manufacturer

Category : Large/Scale / Medium Scale / Small/scale

Industrial Sector : Manufacturing / Service/Sector

Name of the Assessors : Mr. A & Mr. B

Date of Assessment : 30.7.2003

Parameter (1)	Questions & score for Assessors (2)		Average score for All Assessors (3)	Parameter weigthage (4)	Parameter Score (5)
	Mr. A	Mr B			
Leadership	Q.i	10 09	39	1.0	39
	Q.ii	10 10			
	Q.iii	08 09			
	Q.iv	08 07			
	Q.v	04 03			
	Sub Total	40 38			
Policies and Strategies	Q.i	10 08	42	1.0	42
	Q.ii	08 07			
	Q.iii	08 06			
	Q.iv	05 05			
	Q.v	08 07			
	Q.vi	05 07			
Sub Total	44 40				
Human Resources Management	Q.i	10 09	42	0.5	21
	Q.ii	08 08			
	Q.iii	05 04			
	Q.iv	05 05			
	Q.v	10 09			
	Q.vi	05 06			
Sub Total	43 41				

Parameter (1)	Questions & score for Assessor (2)	Average score for All Assessors (3)	Parameter weightage (4)	Parameter Score (5)
Resources	Q.i 15 14 Q.ii 05 05 Q.iii 10 11 Q.iv 10 08 Sub Total 40 38	39	1.0	39
Design and Development	Q.i Q.ii Q.iii Sub Total	N/A	1.0	
Processes	Q.i 10 10 Q.ii 08 07 Q.iii 05 04 Q.iv 15 16 Sub Total 38 37	37.5	0.5	18.75
Improvement processes	Q.i 10 09 Q.ii 05 04 Q.iii 06 04 Q.iv 00 00 Q.v 09 09 Sub Total 30 26	28	1.0	28
Customer satisfaction	Q.i 10 11 Q.ii 10 09 Q.iii 12 10 Q.iv 08 06 Sub Total 40 36	38	1.5	57

Parameter (1)	Questions & score for Assessors (2)	Average score for All Assessors (3)	Parameter weigthage (4)	Parameter Score (5)
Employees' Satisfaction	Q.i 10 09	19	0.5	9.5
	Q.ii 05 04			
	Q.iii 05 05			
	Sub Total 20 18			
Impact on Enviorment and Society	Q.i 10 09	29	0.5	14.5
	Q.ii 06 05			
	Q.iii 10 11			
	Q.iv 04 03			
	Sub Total 30 28			
Business Results	Q.i 15 15	40.5	1.5	60.75
	Q.ii 10 10			
	Q.iii 16 15			
	Sub Total 41 40			

Total Score obtained

329.50

N.B - Since the "Design and Development" parameter is not applicable for the particular industry, Total score obtained is calculated, out of 900 instead of 1000, i.e 36.6%.

Signature of Assessors with Date :

[Signature]
30.7.03

[Signature]
30/7/03

