TOTAL QUALITY MANAGEMENT (TQM) IMPLEMENTATION IN CONSTRUCTION FIRM

A LITERATURE REVIEW AND ANALYSIS

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Submitted in partial fulfillment of the requirements for the degree of

Master of Science in Management Engineering

POLITECNICO DI MILANO

2014

ABSTRACT

Purpose - The aim of this report is to examine how TQM can be implemented in the construction firm in most effective and efficient way, by taking into account alignment between TQM philosophies and organizational objectives, behavior, and culture in order to develop the comprehensive reference model of TQM implementation.

Methodology / Approach – Review of scientific journal from around the world,which published from 1982 to 2012. The main objective of this literature review is to find the proper methodology for TQM implementation and to find the determinants of TQM in the construction industry.

Findings – The report concludes that TQM implementation will differ from one company to another. The company should perform a cultural assessment before implementing TQM so that corporate objectives and behaviors can be aligned to the goal of the TQM program and establish proper TQM implementation methodology for the company.

Originality / value – This paper presents a solution to the difficulties in TQM implementation in construction firm by various empirical studies published in academic literature websites. The report also suggests some possible future research related to the main topic.

Keywords : Total quality management, construction firm, cultural assessment, TQM determinants

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I. SCOPE AND METHODOLOGY

1.1 Introduction

Total Quality Management, TQM, is a method by which management and employees can become involved in the continuous improvement of the production of goods and services. It is a combination of quality and management tools aimed at increasing business and reducing losses due to wasteful practices. It has been successfully implemented in manufacturing sector among world-class company, including Ford Motor Company, Phillips Semiconductor, SGL Carbon, Motorola and Toyota Motor Company.

One of the main principles of the TQM concept is to achieve customer satisfaction and this is an important objective for any organization, including construction firms. The construction industry differs from the manufacturing in such a way that makes introducing TQM more challenging. Just like manufacturing industry, The construction industry also suffers from problems such as workmanship defects, time, and cost overrun.therefore TQM implementation is one of the proper solution

TOM is both an operational philosophy and a methodology in which there is a strong commitment to customers, employees, and improvement. It goes well beyond the traditional limits of quality assurance and quality control (Chase, 1993).

A lot of researches have been done with regard to the implementation of TQM and it is believed that the benefits of higher customer satisfaction, better quality products, and higher market share are often obtained following the adoption of TQM by construction companies. It requires a complete turnaround in corporate culture and management approach (Quazi and Padibjo 1997).

The aim of this literature review is to examine how TQM can be implemented in the construction firm in most effective and efficient way, by taking into account alignment between TQM philosophies and organizational objectives, behaviour, and culture before developing the comprehensive reference model of TQM implementation.

The report is organized as follows :

1) The first section sets the scope and methodology of the review presented by identifying the selection process, inclusion criteria, keywords used and the review methodology adopted.
2) The second section explains the concept of TQM and construction industry and the reason why TQM can be implemented in a construction firm.
3) The third section briefly summarizes all key journals that will be utilized in the developing TQM implementation reference model.
4) The fourth section will explain the comprehensive reference model which developed based on a literature review in the third section.
5) The fifth section, conclusion is drawn; strength and innovative aspect of the report are described; and research limitations are identified.

1.2 Literature Review Methodology

The journals founded in various internet websites such as scopus, sciencedirect, emerald, google scholar, etc. The searching started by using key words : Total quality management; construction. After collecting several related journals, the review of abstract of each paper was conducted. Based on review on abstracts, the journals can be classified into two categories :

- TQM implementation
- Qualitative study of TQM in construction industry

Since the focus of the report is creating a guideline in TQM implementation, detail analysis on related journals was conducted, while journal related to the qualitative study considered as a reference. As the result, there are two kind of methodology in TQM implementation :

1) Sequential approach
   Step-by-step approach in TQM implementation, including the necessity of cultural alignment before implementing TQM and TQM implementation road map.

2) Determinants of TQM
   The implementation started on the factors of TQM practices itself. Selection of TQM determinants based on determinants which are mentioned in every reviewed journals (See appendix).

Development of the comprehensive reference model will be based on cultural alignment, TQM determinants, and TQM road map. The model will be discussed in the fourth section.
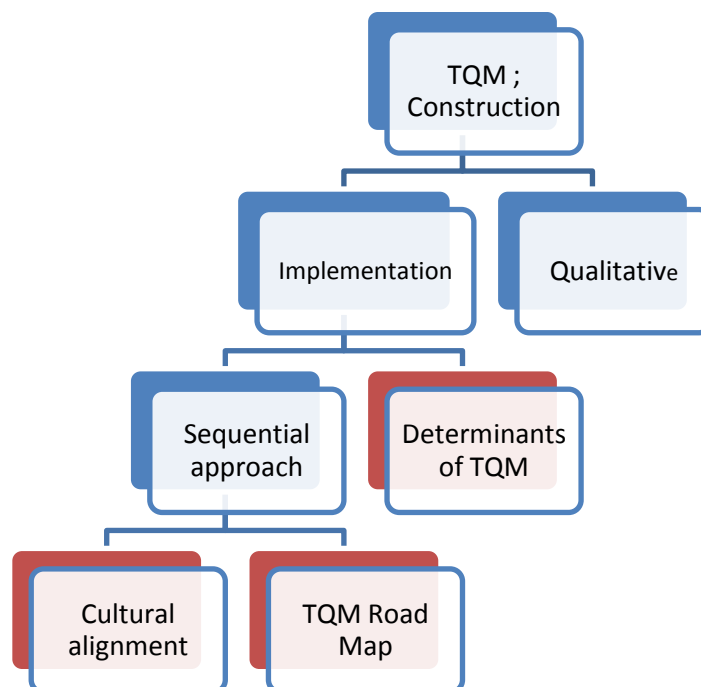
Figure 1.1 - Framework of literature review

II. TQM AND CONSTRUCTION FIRM

2.1 Basic Concepts of Total Quality Management (TQM)

Citing from the book "The Management and Control of Quality" by James R. Evans and William M. Lindsay; In classic research article, James W. Dean,Jr. And David E. Bowen characterizes total quality (TQ) by its principles, practices, and techniques. The Principles are the foundation of the philosophy, practices are activities by which the principles are implemented and techniques are tools and approaches that help managers and employees make the practices effective. All must work together.

TQ principles
Total quality is based on three fundamental principles :

1) Focus on customers and stakeholders
2) Employee engagement and teamwork
3) A process focusses supported by continuous improvement and learning

<u>Customers and stakeholders focus</u>. The customer is the principal judge of quality. Perceptions of value and satisfaction are influenced by many factors throughout the customers overall purchase, ownership, and service experiences. To accomplish this task a company's effort need to extend well beyond merely meeting specifications, reducing defects and errors, or resolving complaints.

Employees and society represent important stakeholders. An organization's success depends on the knowledge, skills, creativity, and motivation of its employees and partners. Therefore, TQ organization must demonstrate commitment to the employees, provide opportunities for development and growth.

<u>Employee engagement and teamwork.</u> Juran credited Japanese managers' full use of knowledge and creativity of the entire workforce as one of the reasons for Japan's rapid quality achievements. When managers give employees the tools to make good decisions and the freedom and encouragement to make contributions, they virtually guarantee that better quality products and production process will result. Employees who are allowed to participate – both individually and in teams – in decisions that affect their jobs and the customer can make substantial contributions to quality.

<u>Continuous improvement</u> refers to both incremental changes, which are small and gradual, and breakthrough, or large and rapid, improvements. These improvements may take any one of several forms:

    1. Enhancing value to the customer through new and improved products and services
    2. Reducing errors, defects, waste, and their related costs
    3. Increasing productivity and effectiveness in the use of all resources
    4. Improving responsiveness and cycle time performance of such processes as resolving customer complaints or new product introduction

A process focuses support continuous improvement efforts by helping to understand these synergies and to recognize the true sources of the problem.

TQ Practices

TQ practices are activities by which the principles of TQ are implemented. Since the topic of the report is TQM implementation in a construction firm, literature review regarding the topic was conducted (see appendix) to find the determinants of TQ practices for construction firms. As the result TQ practices can be classified into ten basic areas of management :

1) Top management commitment
2) Employees empowerment and involvement
3) Sub-contracting and vendor involvement
4) Cost of quality
5) Process Improvement
6) Continuous Improvement
7) Training
8) Customer and shareholder focus
9) Vision, mission, and guiding principles
10) Quality control policies

Further explanation of these determinants of TQ will be discussed in the next section of the report.

TQ Techniques

TQ Techniques include a wide variety of tools and statistical methods to plan work activities, collect data, analyze results, monitor progress, solve problem.

2.2 Overview of Construction Firm

The construction industry is typified by a uniqueness in every construction project, they are single order, single production products. Unlike other industries, which usually have a fixed site with similar conditions for production, each construction production site always displays different conditions. The life-cycle of a construction project is much longer than the life-cycle of most manufactured products. There is no clear and uniform standard in evaluating the overall construction quality as there is in manufactured items and materials; thus, construction projects usually are evaluated subjectively. Since construction projects are a single-order design project, the owner usually directly influences the production. The participants in the construction project - owner, designer, general contractor, subcontractor, material supplier, etc.--differ for each project (Rounds and Chi, 1985).

Definition of Quality

Quality can be defined as meeting the legal, aesthetic and functional requirements of a project. Requirements may be simple or complex, or they may be stated in terms of the end result required or as a detailed description of what is to be done. But, however expressed, quality is obtained if the stated requirements are adequate, and if the completed project conforms to the requirements.

Citing from Arditi and Gunaydin (1997), In the construction industry quality can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner. Quality can be characterized as follows :

- Meeting the requirements of the owner as to functional adequacy; completion on time and within budget; life cycle costs; and operation and maintenance.

- Meeting the requirements of the design professional as to provision of well-defined scope of work; budget to assemble and use a qualified, trained and experienced staff; budget to obtain adequate field information prior to design; provisions for timely decisions by owner and design professional; and contract to perform necessary work at a fair fee with adequate time allowance.

- Meeting the requirements of the constructor as to provision of contract plans, specifications, and other documents prepared in sufficient detail to permit the constructor to prepare priced proposal or competitive bid; timely decisions by the owner and design professional on authorization and processing of change orders; fair and timely interpretation of contract requirements from field design and inspection staff; and contract for performance of work on a reasonable schedule which permits a reasonable profit.

- Meeting the requirements of regulatory agencies (the public) as to public safety and health; environmental considerations; protection of public property including utilities; and conformance with applicable laws, regulations, codes and policies.

2.3 Rationalization TQM in and Construction Firm

Within the construction industry, architects, quantity surveyors, engineers, contractors and various other specialists all have, in addition to their special technical skills, their own trade or professional customs and practices. These may have an effect on the building process either individually or collectively. The pressure for change and improved quality in the construction industry has come from external sources by well-informed clients in industry and government.

By providing the integrative mechanism to counteract against inhibitive tendencies caused by different professions, TQM consciously focuses all parties to the common goal of systematically identifying and meeting the customer's requirements as the superordinate goal. (Pheng & Ke-Wei, 1996)

The construction industry has tended to confuse TQM with quality control (QC) and quality assurance (QA), believing that compliance with QA standards such as ISO 9001 and 9002 is all that there is in the application of TQM on construction projects (Jaafari, 2001). This confusion has led to the use of these expressions interchangeably. QA and QC may be considered as separate and related sub-elements of total quality (TQ). However, QA and QC do not represent the only elements of TQM, as it is a much more comprehensive and broader concept. QA and QC are applied during project implementation while TQM is a strategic philosophy adopted by an organization and implemented on a continuous basis, even if the organization is waiting to perform a new project (Harrington & Voehl, 2012).

2.4 Benefit of TQM Implementation

Citing from Love *et al* (2004), A major benefit of initiating a TQM program reported by eight Australian construction firms was that there was an increasing awareness and focus by all employees on satisfying both internal and external customers. There was also greater focus by top management

on the activities and the needs of lower level employees in the organization. Other benefits reported included improved:

- project performance (e.g. reductions in rework, waste);
- client satisfaction (e.g. repeat clients);
- marketshare;
- relations with customers/suppliers (e.g. partnering);
- staff morale (training and education);
- measurement of performance (e.g. internal and external benchmarking); and
- organisational competitiveness (e.g. success in bidding).

All companies reported that the benefits of TQM were not visible during the early stages of implementation. Companies that had started their TQM initiatives in the late 1980s and early 1990s had not realized the financial benefits/rewards inherent within TQM until the late 1990s and early 2000. Bardoel and Sohal (1999) reported the benefits achieved adopting TQM in seven Australian construction organizations based on case study research. The reported benefits are:

- better control of processes resulting in consistency from design through to delivery;
- reduced construction cycle time;
- a reduction in the quantity of goods damaged in transit and construction;
- reduced delivery time to the site;
- decreased fallout of chemicals;
- increased measurement of performance; and
- improvement in customer perceptions of the company.

2.5 Obstacles in TQM Implementation

According to love et al (2004), Employees (particularly site based employees) showed some resistance to the introduction of TQM for a host of reasons, which included fear of the unknown, perceived loss of control, personal uncertainty, "it may mean more" syndrome, and an unwillingness to take "ownership" and be committed to change. Other barriers that were identified included:

- perceived threat to foreman and project manager roles;
- disinterest at the site level;
- lack of understanding of what TQM was,particularly on site as many perceived it to be synonymous with QA;
- geographically dispersed sites;
- fear of job losses;
- inadequate training;
- plan not clearly defined;
- employee scepticism; and
- resistance to data collection (e.g. rework costs,
- non-conformances material waste, etc.).

The contracting organisations identified a number of lessons they had learnt from the introduction of a TQM program, which include:

- TQM should be implemented by line managers;

- a quality improvement system has a role in improving the morale of employees;
- there needs to be a link between informationtechnology and quality systems;
- continued commitment to education and training;
- TQM needs to be defined and integrated with the organisation's business strategy; and
- there needs to be complete commitment from top management. Management must drive the TQM program and gain the support from all employees by making their leadership visible.

Harrington and Voehl (2012) point out that, Some of the construction problems such as fluctuation of demand and custom work (non-steady state) create difficulties in TQM implementation and TQM could only help organizations cope with such fluctuations. In other words, while TQM could be a solution for the construction industry problems, some of the construction industry problems are themselves obstacles for TQM implementation.

III. LITERATURE REVIEW

After understanding the benefits and importance of TQM implementation in a construction firm, this section will discuss several methods to implement TQM which are based on previous researches. These methods will be utilized to build comprehensive reference model for TQM implementation in the next section of the report. There are two kinds of methods which concluded from the journals that have been reviewed :

a) Sequential Approach

This method focused on step-by-step approach in TQM implementation. Starting from cultural alignment, introduce TQM to employee, training, maintaining and so on. All journals mention that TQM is an endless journey since contain continous improvement concept.

b) Determinant of TQM

Those reviewed journals stated that there is no step-by-step approach in TQM implementation, therefore the implementation started on the factors of TQM practices itself.

3.1 Sequential Approach

3.1.1 Creating pre-condition for successful TQM Implementation

Before implementing TQM, management must determine whether a change in culture, or a change in the behavior of the organization's employees, is needed (Bardoel and Sohal, 1999; Bounds et al., 1994). For many organizations, behavioral change may be considered sufficient. However, sustained commitment is more likely if employees share the same mental models of quality in the organization. A cultural audit can enable senior management leadership to identify assets as well as liabilities in their culture (Bardoel and Sohal, 1999; Glover et al., 1994). This can be done by carefully reviewing the results and determining which aspects are assets of the existing culture and therefore contributing to the organization's TQM mission and goals. Simultaneously, the organizational leadership can identify those aspects of culture, which are impeding organizational performance (liabilities). Given a set of corporate objectives and behaviors that a contractor would want its employees to exhibit, a process for achieving effective TQM implementation based on (Glover et al., 1994) cultural assets profiles (CAPS) is presented in Figure below.

In step 1, a cultural audit is undertaken to determine the organization's common shared values and the attitudes and behaviors possessed by employees. The audit considered able provide a basis for describing profiles of the organization's culture. As contractors invariably do not have the in-house expertise to carry out such cultural audits, it is suggested that an external management consultant should be employed to undertake such a task.

In step 2, the current values and attitudes that are aligned with the organization's corporate goals are identified. Those attitudes that conflict with the desired set of behaviors should also be developed. By undertaking these tasks, a basis for analyzing cultural alignment with the organization's vision and goals for quality can be undertaken. Glover et al. (1994) developed the CAPS, which is a multi-method approach to measuring an organization's culture from a quantitative and qualitative perspective. The CAPS system is particularly useful for strategic planning and to reduce the risk of organizational change failures (Glover et al., 1994).
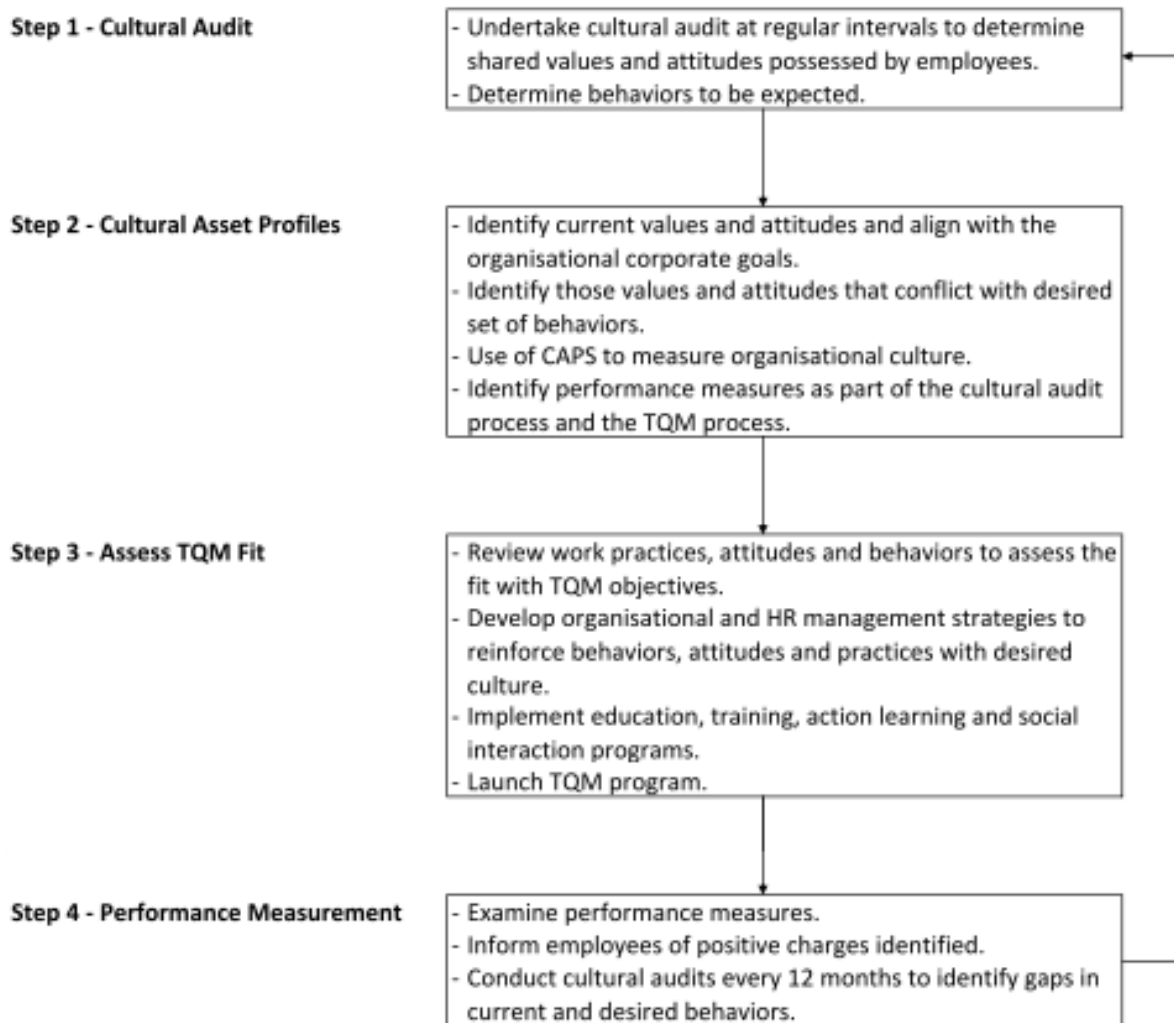
Step 1 - Cultural Audit	- Undertake cultural audit at regular intervals to determine shared values and attitudes possessed by employees. - Determine behaviors to be expected.
Step 2 - Cultural Asset Profiles	- Identify current values and attitudes and align with the organisational corporate goals. - Identify those values and attitudes that conflict with desired set of behaviors. - Use of CAPS to measure organisational culture. - Identify performance measures as part of the cultural audit process and the TQM process.
Step 3 - Assess TQM Fit	- Review work practices, attitudes and behaviors to assess the fit with TQM objectives. - Develop organisational and HR management strategies to reinforce behaviors, attitudes and practices with desired culture. - Implement education, training, action learning and social interaction programs. - Launch TQM program.
Step 4 - Performance Measurement	- Examine performance measures. - Inform employees of positive charges identified. - Conduct cultural audits every 12 months to identify gaps in current and desired behaviors.

Figure 3.1 - Cultural Audit Process for TQM Implementation (Love et al, 2004)

In step 3, current work practices, organizational behaviors and values are reviewed to assess the fit with TQM objectives. Thus, it may be necessary to develop organizational and human resource management strategies to reinforce behaviors, attitudes and practices in the organization to align with the desired organizational culture. Consequently, this is likely to require extensive education and training, action learning exercises and social interaction (Holt et al., 2000a, b).

In step 4, performance measures of the cultural audit are examined and employees are informed of positive changes that are identified. Areas that do not perform as expected are investigated and the appropriate actions are taken to ensure that performance is improved. It is suggested that contractors who have implemented, or about to implement, TQM should regularly undertake cultural audits every 12 months so they can readily identify gaps in current and desired behaviors and therefore, maximize their investment in TQM.

The difficulties with implementing TQM because it was not aligned to the organization's current structure and processes and the behavior and values of employees. In considering these points, it was suggested that contractors should perform a cultural audit before implementing TQM so that corporate objectives and behaviors can be aligned to the goals of the TQM program. A process for

conducting a cultural audit was proposed, which may help contracting organizations to better understand how they make the most of change strategy such as TQM (Love *et al*, 2004).

3.1.2 Implementing TQM in Construction Firm

Burati and Oswald (1993) interviewed seventeen major companies involved in the engineering and construction (E&C) industry (eight owners and nine contractors) were interviewed. The companies were selected based on their known successful implementation of total quality management (TQM). The intent was to collect and describe the proven best practices in TQM implementation in the E&C industry. There was no single universal, cookbook approach to TQM implementation in construction firm, a general sequence of four implementation phases emerged as offering the .best opportunity for successful implementation. These phases include: **exploration and commitment; planning and preparation; implementation; and sustaining.**

Each of those phases has its own TQM road map, even though TQM is often termed a journey, not a destination. This is because of its nature as a collection of improvement-centered processes and techniques that are performed in a transformed management environment. The concept of continuous improvement holds that this environment must prevail for the life of the enterprise, and that the methods will become routinely used on a regular, recurring basis. The improvement process never ends, therefore no true destination is ever reached.

The road map is a composite of the experiences of the 15 out of 17 companies interviewed that have comparable TQM processes. (The remaining two were quasi-independent consulting organizations, spun off the parent companies' internal TQM processes.) As such, the road map constitutes a composite sequence of highly successful practices, perhaps best practices.

 1) Exploration and Commitment Phase

The exploration and commitment phase (see Figure 3.3) is characterized by:
- Top management becoming aware of a need for change in the way the organization is run, to achieve increased profitability of owners, contractors, and suppliers, on a win-win basis
- Top management investigating modem QI philosophies
- Engaging a consultant to provide basic education concerning the selected QI approach
- Appointing an in-house coordinator
- Developing a plan for organization-wide training
- Basic training of the uppermost tier of management

The work of this phase is essentially concluded when top management, having had the benefit of training in quality awareness, and having understood its implications and requirements, formally commits to major change in the philosophical and operational conduct of the enterprise.
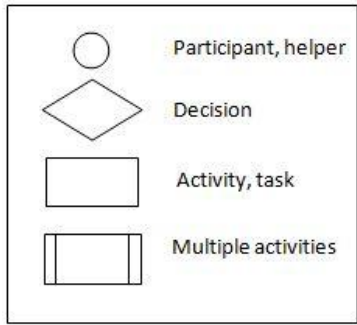
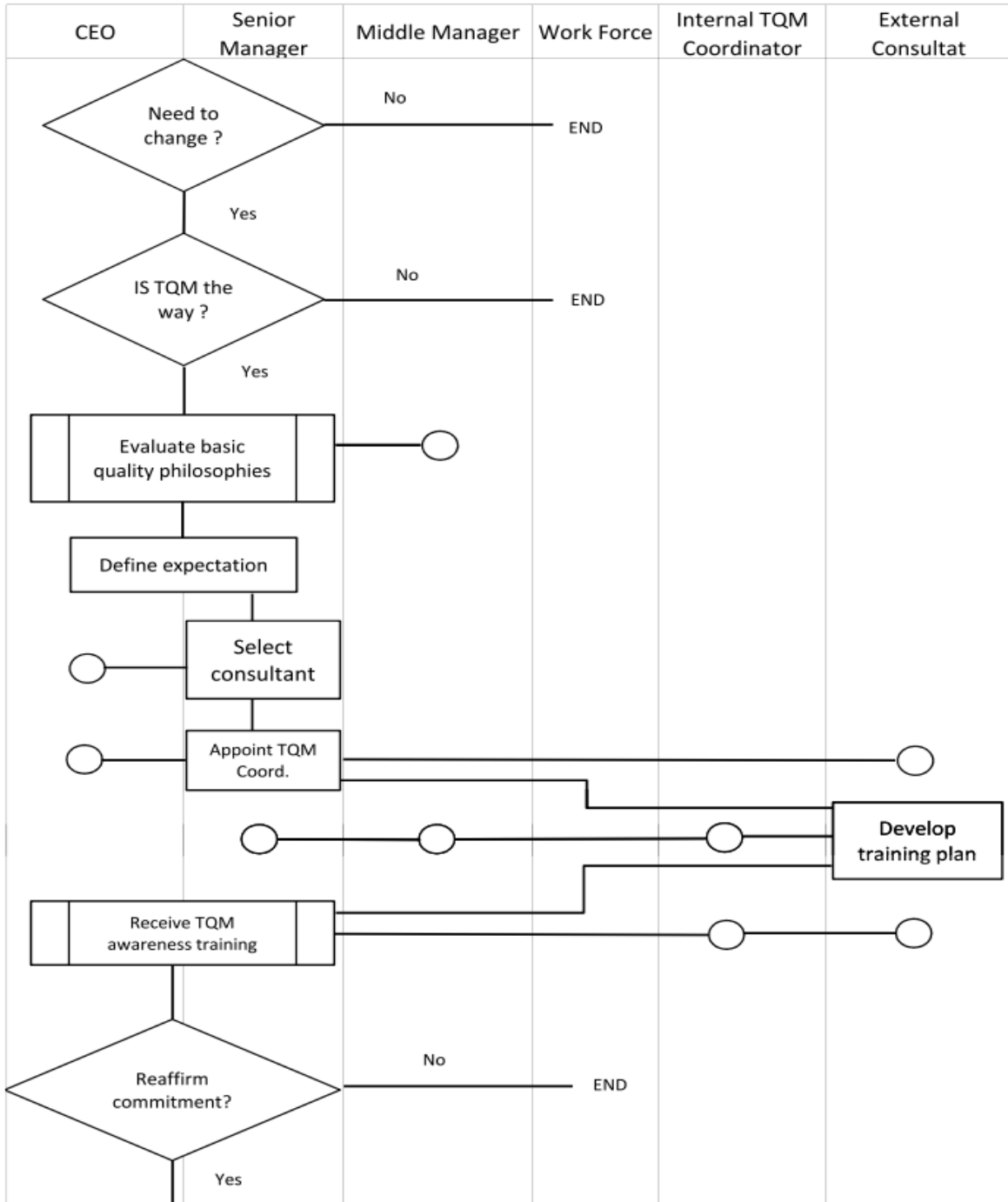**Figure 3.2 - Legend of Symbols on Road Map**

Figure 3.3 - TQM Road Map : Exploration and Commitment Phase (Burati and Oswald, 1993)

All 15 companies used outside consultants at some stage in their implementation. Their use is recommended in the early stages to ensure that opportunities for a successful implementation are not losing out of ignorance of the fundamentals of TQM commitment. The internal coordinator can perform valuable liaison in helping the consultant understand and have proper access to the company and being present to advance the process after the consultant leaves (Burati and Oswald, 1993).

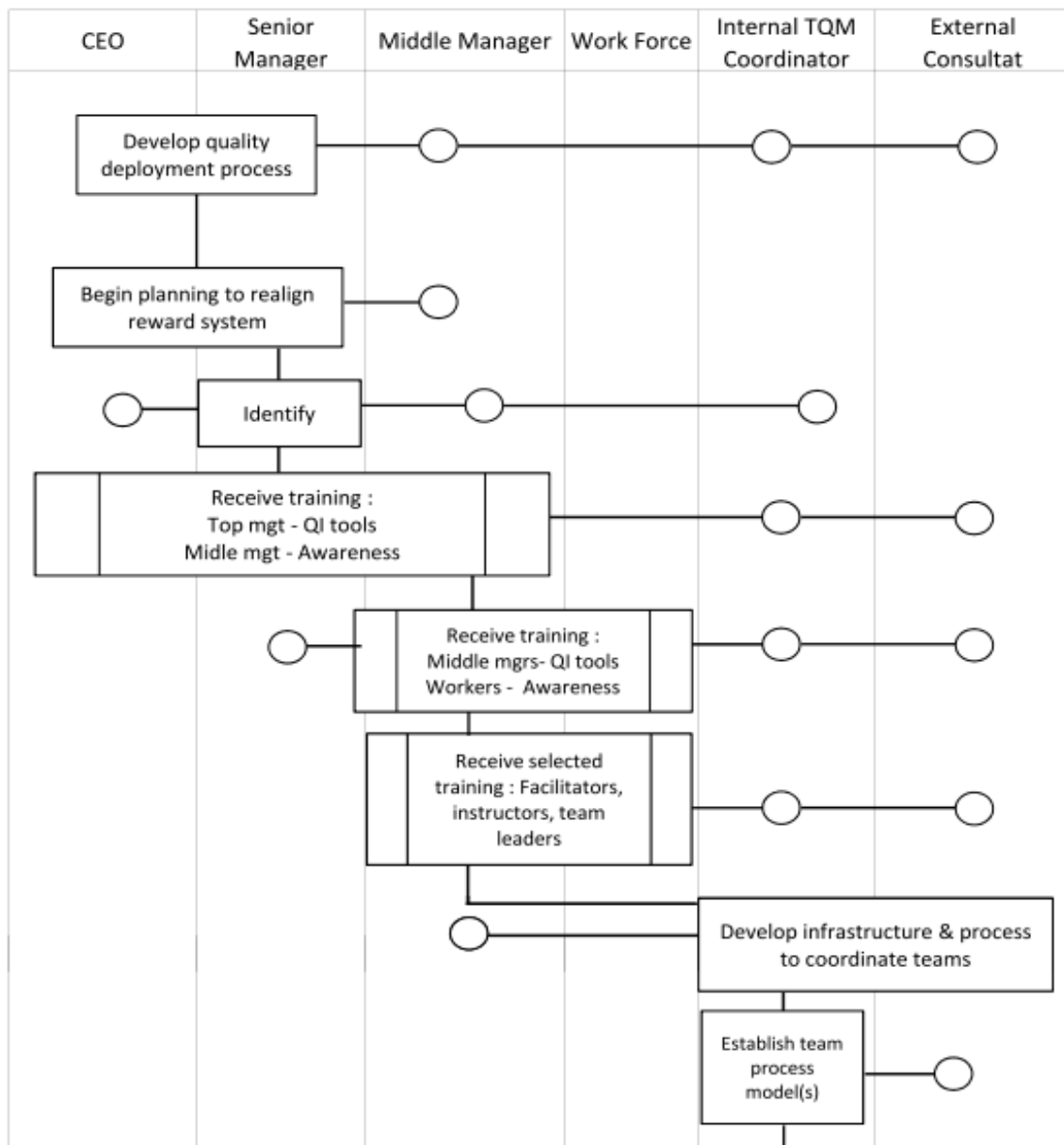2) Planning and Preparation Phase

Figure 3.4 - TQM Road Map : Planning and Preparation Phase (Burati and Oswald, 1993)

The planning and preparation phase (see Figure 3.4) is characterized by:
- Developing a strategic quality deployment process and the basic infrastructure within which the TQM process will be pursued
- Continuing top management's training, into quality improvement (QI) tools

- Extending training to middle managers and the work force, in that order, with quality awareness training given first at each level, followed by QI tools
- Developing a network of "champions"

The work of this phase can be considered to be concluded only when the necessary planning, including commitment of resources, and basic training are in place.

The strategic quality deployment process is the heart of a successful TQM program. It is the means by which the QI efforts are aligned with the corporate mission, vision, goals, and objectives. The process provides not only the framework for achieving this alignment, but also overall measures of effectiveness.

Awareness and tools training. There is an essential sequence for training, managers and supervisors should be trained before their people are trained, to avoid building expectations that supervisors are unable to accommodate, if they are able to understand at all. Identified champions should be included in the first class of trainees in their respective organizational levels.

A practical reason for having a **team coordination system** is to achieve better control of time and resources used in the quality process, and to focus those resources on desired results. Operating **team process models**, both for process improvement and for corrective action, must be developed to prevent failure in accomplishment the objectives.

3) Implementation Phase

The implementation phase (see Figure 3.5) is that period of time in which the commitment, planning, and preparation of the two initial phases are translated into action. The major activities are:

- Extending the infrastructure by creating and chartering teams at various levels, including high-level oversight teams, and action teams to perform a few strategically chosen pilot QI projects
- Continuing to realign the reward system to support the desired behaviors
- Training teams, as teams, in the skills and techniques needed to perform their assigned QI projects
- Top management rolling out the TQM process, by implementing the results of the pilot project teams, publishing the attendant success stories, and extending the QI effort to teams and projects throughout the organization
- Formally celebrating the implementation results to date
- Extending the TQM process to vendors and suppliers once the in-house program is considered to be progressing satisfactorily

The TQM process can be considered up and running when most of the people at all levels see visible evidence that management has indeed been serious in its commitment to fundamental change in the way the organization is run.

The just-in-time (JIT) training, including team skill and QI tools, was specifically endorsed by several of the companies, and implied to exist by others. The stated benefits are that training must be

immediately applied to be remembered, and that teams that learn together function better
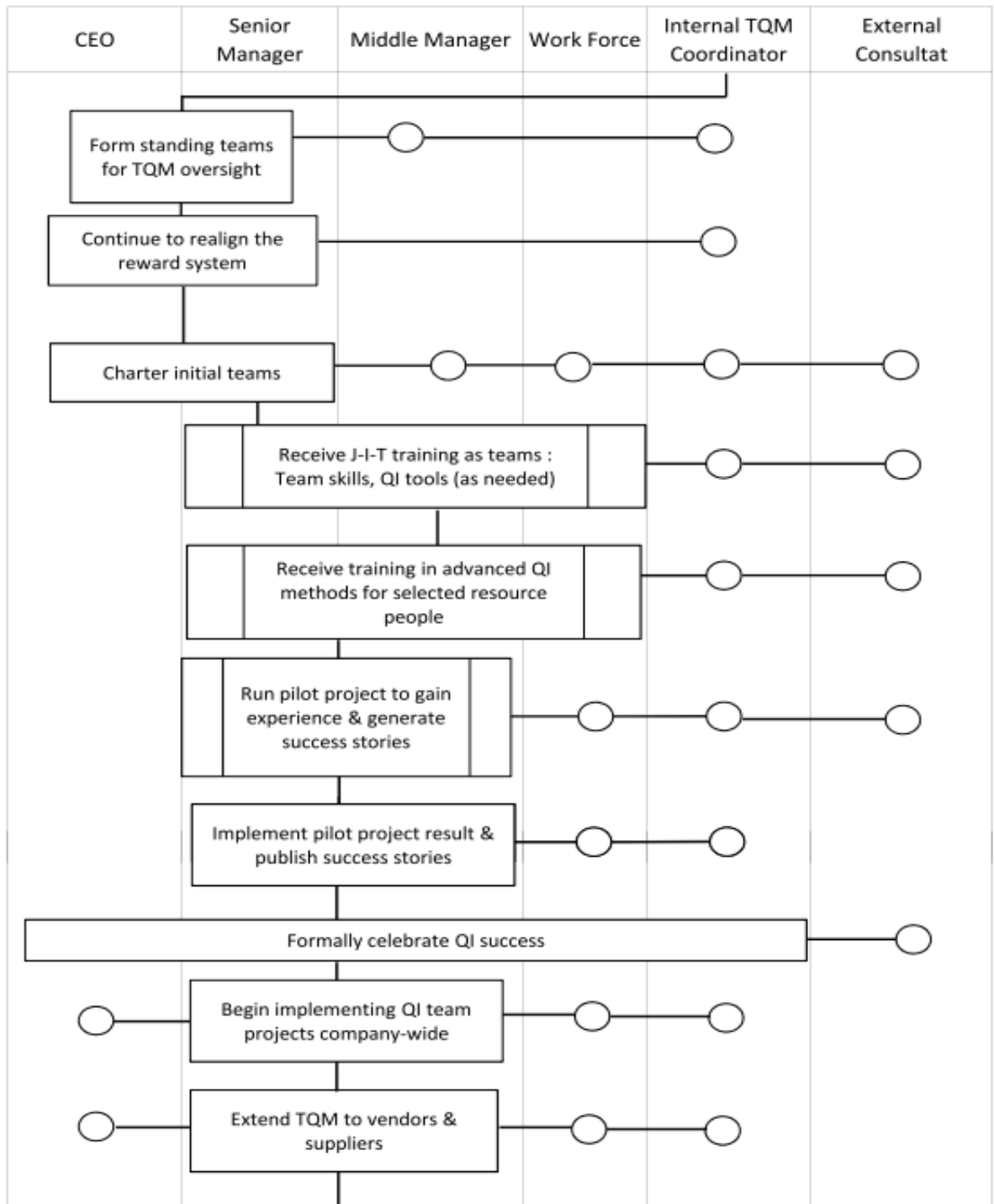together.

CEO	Senior Manager	Middle Manager	Work Force	Internal TQM Coordinator	External Consultat

Form standing teams for TQM oversight

Continue to realign the reward system

Charter initial teams

Receive J-I-T training as teams : Team skills, QI tools (as needed)

Receive training in advanced QI methods for selected resource people

Run pilot project to gain experience & generate success stories

Implement pilot project result & publish success stories

Formally celebrate QI success

Begin implementing QI team projects company-wide

Extend TQM to vendors & suppliers

Figure 3.5 - TQM Road Map : Implementation Phase (Burati and Oswald, 1993)

Pilot projects should be implemented in diverse areas of the organization to achieve wide
visibility and to build credibility. They also should be carefully selected and scoped to assure a
high probability of successful outcomes. When indisputable, positive outcomes can be shown to
have resulted from the pilot activities, there should be a formal roll out of the QI commitment

of the organization, presented by top management and accompanied by appropriate celebration.

4) Sustaining Phase

In sustaining phase (Figure 3.6), The infrastructure is in place, the people are trained, and teams are actively generating improvements to processes and/or corrective actions for problems. This part of the endless journey is characterized more by prevailing conditions than by a progression of discrete events. Therefore the activities in Fig.xx are not connected by vertical lines.
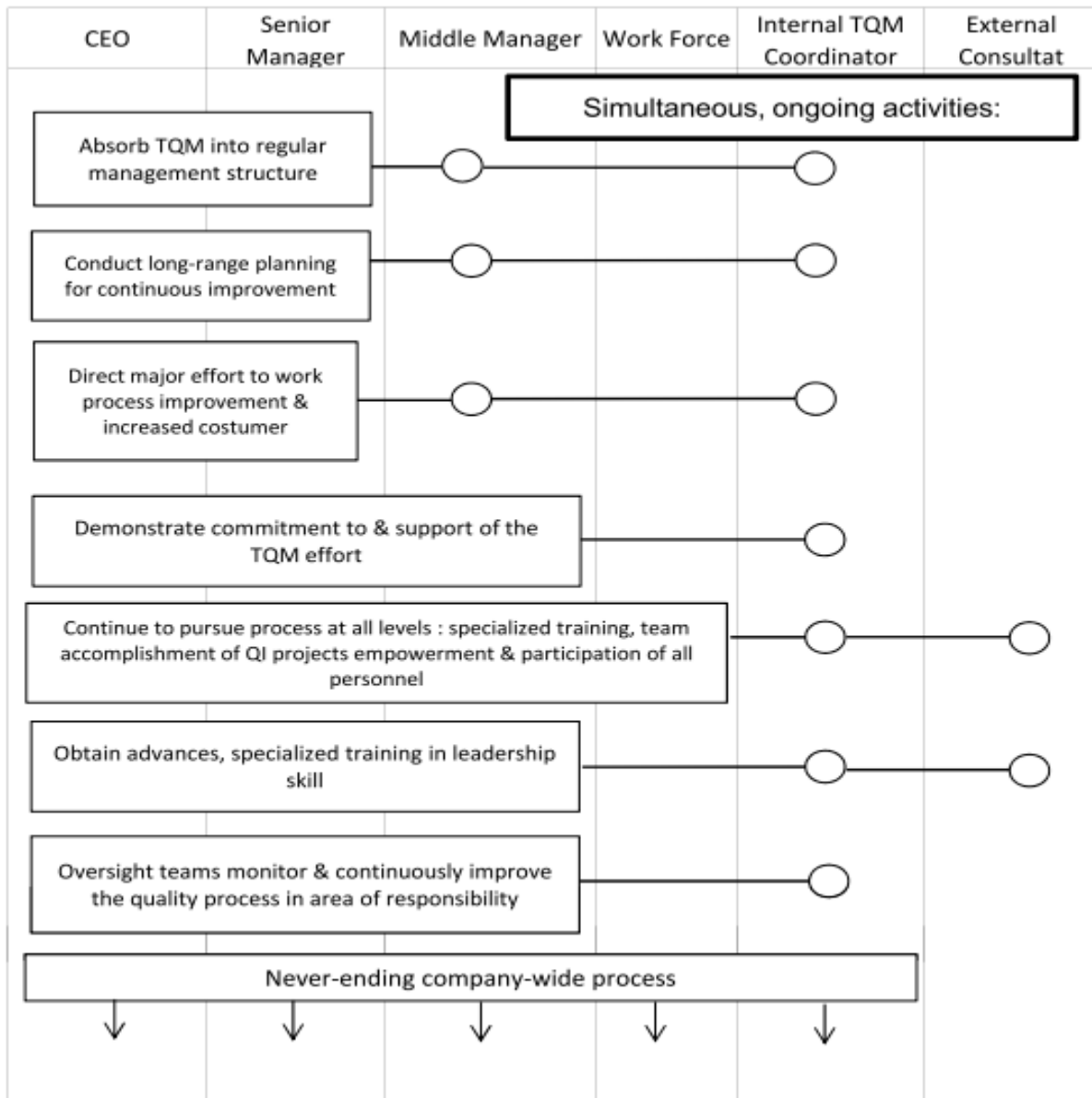

Figure 3.6 - TQM Road Map : Sustaining Phase (Burati and Oswald, 1993)

Some of the conditions prevailing in the sustaining phase are:
- Integrating the specially created TQM infrastructure features (organizational elements, processes, etc.) into the normal management processes of the business.
- Continuing planning for long-term quality improvement

- Continuing and intensifying focus on the improvement of the work processes of the organization, with the objective of increasing customer satisfaction
- Continuing management commitment to the internal workings of the process, as clearly evidenced by its (management's) attitudes and its behavior
- Continuing action in the training, team work, empowerment, and participation of the work force across the full spectrum of TQM activities
- Continuing study and implementation of advanced training and leadership practices
- Continuing, active oversight by management of the TQM process, as opposed to "just letting it run itself"

Management's Role

With infrastructure, methods, and training in place, top management should concentrate its own long-term efforts on the improvement of the key work processes of the organization, specifically as their improvement will result in ever-higher levels of customer satisfaction.

For the internal engine of TQM to run continuously, management must never let down in its commitment to the process. This requires visible signs of personal involvement and the continuing provision of the time and resources needed by management and work force to carry out their part of the organizational commitment. As the TQM culture matures, there should be increasing levels of empowerment of lower management and the general work force, to take informed action in response to problems and improvement opportunities.

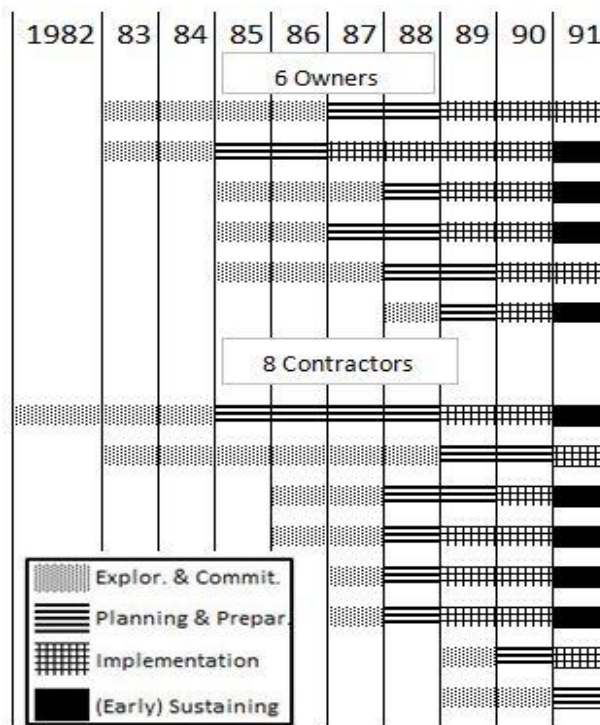**Approximate Duration of Phases**

Figure 3.7 - Approximate duration of TQM Histories (Burati and Oswald, 1993)

According to Burati and Oswald (1993), Fig. 6 illustrates, approximately, the chronologies of 14 companies over the first three phases of the TQM implementation journey, and the early stages of the fourth stage (the sustaining phase). The chart represents the six owners, and eight of the nine contractors, from the 15 companies contributing to the composite road map. The ninth

contractor, while contributing discrete items to the road map, had a TQM chronology that was not directly comparable with those of the other 14 companies.

The longer phase durations for the companies having the longest TQM histories reflect the lack of knowledge of TQM that existed, and the experimentation and/or false starts that occurred, as E&C companies first became aware of TQM's possibilities.

3.2 Determinants of TQM

This section will discuss the TQM implementation by understanding the determinants of TQM and how translate the values inside the construction firm. After reviewing several journals related TQM implementation in construction firm (see appendix) there are similarities between them. Based on the literature review, this report will discuss ten factors to achieve successful TQM implementation in construction firm. A discussion about the determinants factors of TQM is given below :

1) Top management commitment

All implementations should begin with leadership and management commitment. They are absolutely essential for the success of any TQM program. Prior to management commitment, management should have a strong understanding of TQM. This commitment must be coupled with support to make it happen. Once management is committed to TQM, it will provide the necessary resources of time and money to permit improvement (Harrington and Voehl, 2012).

Harrington and Voehl (2012) also state that Senior management, in the form of a Quality Steering Committee, might need to draft a vision and mission statements, which summarizes the organization's philosophy with emphasis upon customer satisfaction and quality. An advisory committee is responsible for establishing and developing the policies and procedures for the TQM implementation process. The committee members should be capable of determining the needs of the organization, opportunities for improvement, and goals for improvement initiatives.

The same argument from Arditi and Gunaydin (1997), The success of a TQM program first of all depends on management practices. TQM is a culture and philosophy that must permeate an organization as the method of management It can thrive only under a senior management that establishes TQM as a top priority.

According to Arditi and Gunaydin (1997), the usual method of management practice in construction industry is management by control. All managers, beginning at the top, are given certain goals for the next year. They, in turn, set goals and impose controls on each of their subordinates. In construction terms, cost, schedule, and possibly quality goals are established for each project. Project managers are rewarded on the basis of meeting these goals. This method has been somewhat successful. It is simple, logical, and consistent. But there are problems when the work gets displaced by the controls themselves Also, competition to meet short-term goals can lead to internal conflict, adversarial relationships, reduced communication, accusations when goals are not achieved, and even fabricated reports of conformity. Management by control encourages an organization to look inward rather than outward to the customer and the customer's needs.

Culp (1993) support the statement of Arditi and Gunaydin (1997), stating that TQM requires employees to do things differently; therefore, participation by management is essential. To achieve

the changed behavior of the staff and improve quality, it is very important to change the organizational environment. Without these fundamental cultural changes, an organization's attempt at TQM will fail. This fundamental change cannot be achieved unless management has a long-term obsession with quality work and continued improvement

According to Chase (1993) states that upper management, starting with the CEO, has the responsibility to : Learn about quality along with others; Endorse the concept of TQM; Assist in the development of corporate quality policies and goals, Actively lead the way by participating in the activities of the quality steering committee and company training; Provide the necessary resources of time and money to permit improvement (this makes some people nervous because of the initial investment in training, without immediate visible results); Provide suitable recognition for those who contribute to the quality mission; "Walk the talk," i.e., demonstrate through their behavior that quality is indeed the top priority for the company.

2) <u>Costumer and Shareholder Focus</u>

The main objective of TQM is to achieve customer satisfaction whether the customer is internal (e.g. department in the same organization) or external (e.g. final product recipient). The first step in achieving customer satisfaction is to define the customer's needs and wants and then translate these needs and wants into standards.

Harrington and Voehl (2012) argue that Customer satisfaction in the construction industry can be achieved by implementing the following steps:

a) make the customer (internal and external) aware of the organization's quality management initiative;
b) determine customer expectations;
c) measure the customer's degree of satisfaction; and
d) take action to improve satisfaction.

Arditi and Gunaydin (1997) have argument in broader way, by stating; The construction project should be considered as a process where all customers must be satisfied. These customers include internal customers (employees, units, departments within an organization) and external customers (owner, designer, contractor, etc.).

The requirements of the owner must be clearly defined at the beginning of the project and be agreed to by both the owner and design firm. The more time and effort are spent at the beginning in defining requirements, the more smoothly the project will progress. Objective setting is important because it provides a focus for scope definition, guides the design process, controls the construction process, and influences the motivation of the project team.

3) <u>Employees empowerment and Involvement</u>

The aim of empowerment as defined through Deming's (1994) theory of management is to increase joy in work and pride in the outcome for all employees. Top management also plays an important role to encourage employees empowerment and involvement. As stated by Arditi and Gunaydin (1997), Top management applies participative management practice which encourages employees to contribute ideas towards identifying and setting organizational-goals, problem solving, and other

decisions that may directly affect them. Participative management encourages an organization to look outward to the costumer and the costumer's needs.

The same argument by Harrington and Voehl (2012), Management should encourage suggestions and make the open working environment, so honest comments can be made without fear of punishment. More specifically, management should implement a procedure for taking action on those suggestions. Failure of management to act on suggestions within a reasonable time will discourage employees from spending time in preparing their suggestions.

In order to enhance level of involvement, Harrington and Voehl (2012) also suggest to eliminate fear, which also in line with one of Deming's point. Fear makes employees reluctant to voice their opinions or question policies, procedures, and decisions. In other words, fear prevents employees from being involved.

4) Sub-contractor and Vendor Involvement

One of deterministic factor that influence the final outcome of the construction project is the vendors and sub-contractors. Sub-contractors and their workers are critical to the main contractor's quality initiatives. They are the ones who actually undertake the on-site work. While the vendor's product and service determine the on-time and the quality the installed items on-site.

To maintain relation with sub-contractors Pheng and Ke-Wei (1996) stated that by breaking down the barriers to communications and making subcontractors understand that TQM is in their best interest as well as the main contractor's, they can both achieve cost savings in their construction works and thereby increase profits. To achieve this the main contractor must first have his own house in order, meaning a top-to-bottom commitment to quality management. Second, communicating TQM to subcontractors requires a translation into "field friendly" language and practices. It has to be understandable in their world.

While to maintain relation with vendors / suppliers, Harrington and Voehl (2012) suggest to s. Maintain close and long-term relationships with suppliers results in achieving the best economy and quality. Having close working relationships with a small number of suppliers means that each supplier can be given larger orders, which helps win their loyalty. Conducting frequent and routine visits and other communications can help to enhance the relationship between the supplier and the organization. Maintaining a close relationship and open communication with the suppliers help them to have a good understanding and a feel for their customers' requirements. This can result in better products satisfying the needs of the organization.

5) Cost of Quality

According to Arditi and Gunaydin (1997), the cost of quality is considered by both Crosby and Juran to be the primary tool for measuring quality. In their approach, it is used to track the effectiveness of the TQM process, select quality improvement projects, and provide cost justification to doubters. By bringing together these easily assembled costs of review, inspection, testing, scrap, and rework, one can convince management and others of the need for quality improvement. It is effective in its intended purpose of raising awareness about quality and communicating to management the benefits of TQM in terms of dollars.

Quality costs consist of the cost of prevention, the cost of appraisal, and the cost of deviation. Prevention costs are those resulting from activities used to avoid deviations or errors, while appraisal costs consist of costs incurred from activities used to determine whether a product, process, or service conforms to established requirements.

The study undertaken by the BRE (Building Research Establishment, 1982) demonstrates that cost benefits can be achieved following the introduction of quality. As shown in Figure 3.8, at least 15 percent savings on total costs of construction can be achieved through eliminating re-work and wasted work. This is accomplished by increased attention or concern for prevention of rejects or wastes on remedial works.
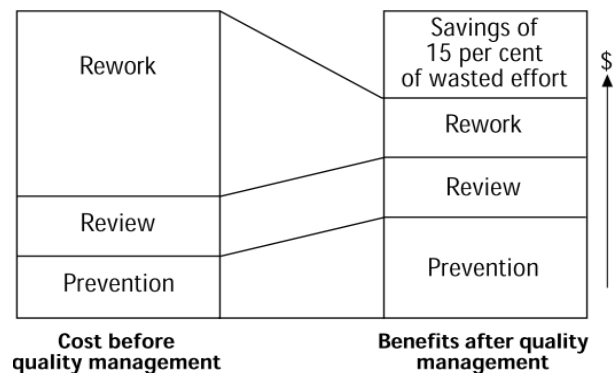

Figure 3.8 - Costs and benefits of quality management (BRE, 1982)

6) Process Improvement

Process improvement is referred to as statistical methods or statistical process control because measurement and analysis of data are very important for process improvement. Accurate data are very important for both employees and management to make better decisions regarding process improvement. Quality improvement teams can be formed in any organization to examine the processes. The quality improvement team should consist of a representative from each area that might be involved in a process improvement. The tools include histograms, cause-and-effect diagrams, check sheets, Pareto diagrams, graphs, control charts, and scatter diagrams (Harrington and Voehl, 2012).

The use of statistical methods was found to be in Gunaydin's survey (1995) the least important factor that affects quality in the construction process and ranked at the very bottom of the importance lists in the design and construction phases by designers, constructors, and construction managers. It can be concluded that all the professionals involved in this study agree that the use of statistical methods has relatively very little effect on the quality of the construction project.

7) Continuous Improvement

In the words of Oswald and Burati (1992), "Total Quality Management is often termed a journey, not a destination." This is because of its nature as a collection of improvement-centered processes and techniques, which are performed in a transformed management environment. The concept of "continuous improvement" holds that this environment must prevail for the life of the enterprise, and that the methods will become routinely used on a regular, recurring basis.

Major shifts in the levels of performance can be achieved through innovation. Deming's (2000) "plan-do-check-act" (PDCA) cycle is a systematic procedure for improving methods and procedures by focussing on correcting and preventing defects. Avoiding defects by building in quality is usually less costly than the typical approach of attempting after the fact to determine defects through inspections. The PDCA cycle can maintain any improvement and prevent deterioration (Harrington and Voehl, 2012).

According to Pheng and Ke-Wei (1996), the keys to continuous improvement in the construction process are:
• Learn to work smoothly in teams, i.e. respect the principle of internal supplier to internal customer chains.
• Be proactive to sense reasonable future change and be prepared. Do not wait until you are pressured into change or to act.
• Aim process improvement at the singular goal of meeting clients' expectations.
• Set benchmark at above average incremental process improvement to systems or subsystems and implement/monitor programmes.
• Look for root causes when diagnosing the system malfunction or project process bottlenecks.
• Recognize the integrated and interdependent nature of project system and its parts.

It is only from this fundamental mindset, commited posture and attitude shift that real progress will emerge. The end results will boost productivity immensely as well as concurrently cut waste and save costs arising from doing it right first time (DRIFT).

8) Training

The importance is recognized by every quality expert. Under TQM, quality becomes everyone's responsibility and the training must be targeted for every level of the company. There should be customized training plans for management, engineers, technicians, home and field office staff, support personnel and field labor (Smith, 1988).

Any training program should include an orientation to the basic concepts and procedures of TQM. This provides employees with a fundamental knowledge which can later be linked to more advanced topics. TQM requires a participative, disciplined, and organized approach to improving the process, thus team training is also very important. The training program should cover topics as cause-and-effect analysis, team problem solving, interpersonal communication and interaction, rudimentary statistical methods, cost of quality measurement, and the collection and evaluation of quantitative information (Harrington and Voehl, 2012).

9) Vision, mission, and guiding principles

The vision is a written statement stating what the company ultimately intends to become. The mission states what a company is in business to do. Goals are broad targets that stem from the vision and mission. There can be goals in many areas, such as safety, customer satisfaction, business growth, and worker satisfaction. Guiding principles are general statements that reflect in broad terms the company's value system and approach to quality. They address issues such as :

• What are the company views and attitudes toward quality?
• How does the company want to relate to the customer?

- How is the company to treat subcontractors and suppliers?
- How does the company want to relate to its employees?
- What are company views toward professional and technical competence?

Each company needs these clearly defined statements of vision, mission, goals, and policies. These are normally written, disseminated to, understood by, and bought-into by management and the work force (Chase, 1993).

10) Quality control policy

According to Kubal (1994), the concept of quality control should be changed from "controlling quality" to "controlling management for quality". This would result in using an integrated quality standard, based upon current industry-wide experience, to define policies and organization to manage quality. Policies are defined for the quality, for the control of quality, and for management of the quality control system.

The organization created to implement quality control policies must have well-defined responsibilities and authority. In construction, failure can result from malfunction on the part of constructor, designer, or even owner. In most cases, however, it is the result of a combination of actions by several or all of these parties. The quality management organization must, therefore, have the ability to deal effectively with all parties involved. A quality flow chart (Figure 3.9) demonstrates the following characteristics for a properly organized quality control program in the construction industry.

- The quality standard is derived from a current database created through feedback from previous projects, providing a more uniform and comprehensive standard.
- Quality management in the planning and design, construction, and operation and maintenance phases is integrated through the construction management project delivery system.
- Defects are identified and corrected early.
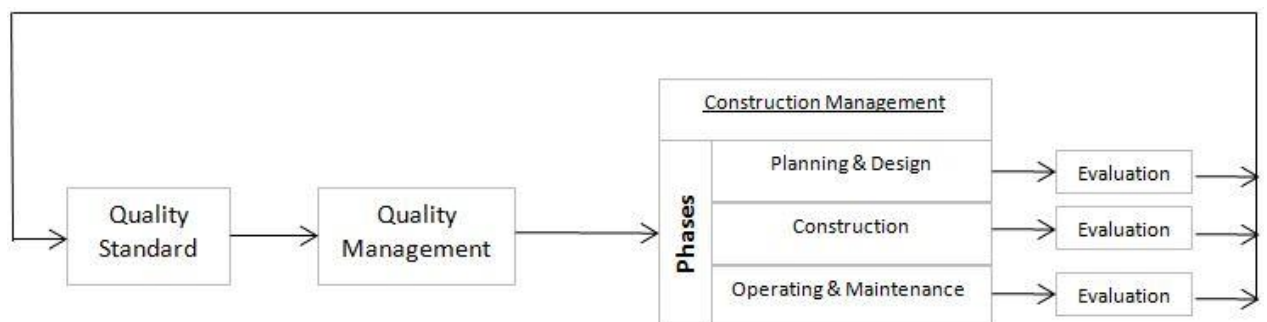- Feedback expands the quality data base to eliminate repetition of the identified defects.

Figure 3.9 - Total quality flow chart (Arditi & Gunaydin, 1997)

IV. COMPREHENSIVE REFERENCE MODEL

Analysis on literatures from previous section has allowed us propose a reference model For TQM implementation in construction firm. The proposed framework is shown in figure 4.1.
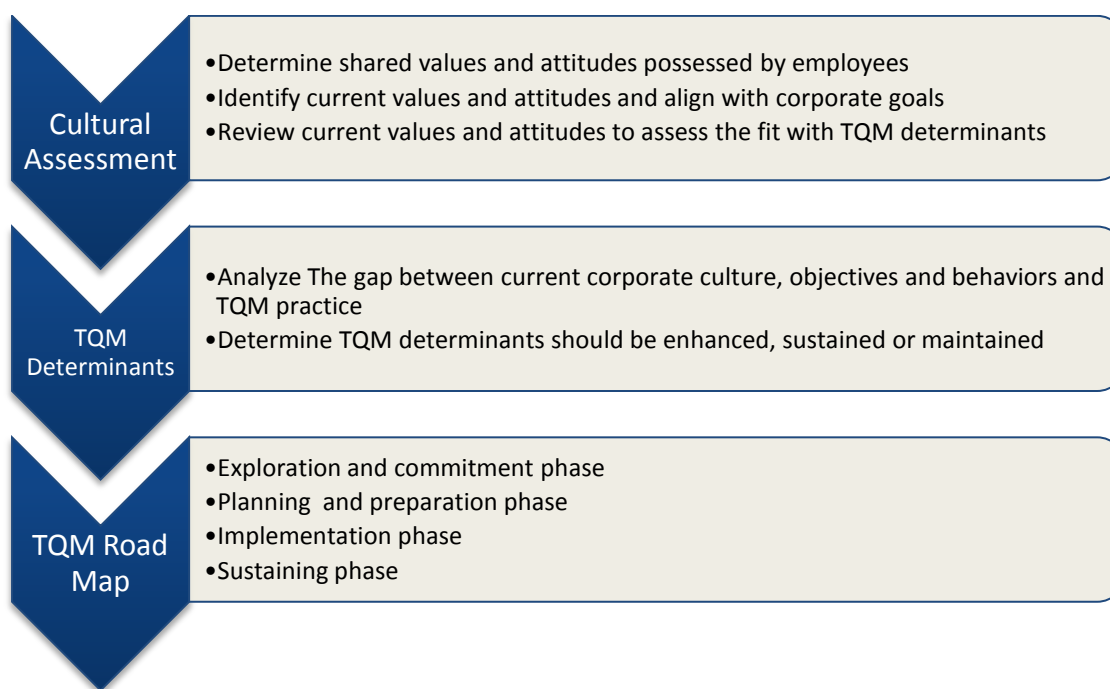
Cultural Assessment
- Determine shared values and attitudes possessed by employees
- Identify current values and attitudes and align with corporate goals
- Review current values and attitudes to assess the fit with TQM determinants

TQM Determinants
- Analyze The gap between current corporate culture, objectives and behaviors and TQM practice
- Determine TQM determinants should be enhanced, sustained or maintained

TQM Road Map
- Exploration and commitment phase
- Planning and preparation phase
- Implementation phase
- Sustaining phase

Figure 4.1 - Reference Model : TQM Implementation for Construction Firm

A TQM program requires changes to structures and systems that demand new behaviors by individuals and groups (Holt et al., 2000b; Low and Chan, 1998). According to Beer et al. (1990) for TQM to be successful, it must be accompanied by the development of leadership, human skills and shared values that are consistent with the purpose of structures and systems that are introduced.

Before implementing TQM, management must determine whether a change in culture, or a change in the behavior of the organization's employees, is needed. For many organizations, behavioral change may be considered sufficient. However, sustained commitment is more likely if employees share the same mental models of quality in the organization. A cultural audit can enable senior management leadership to identify assets as well as liabilities in their culture (Bardoel and Sohal, 1999; Glover et al., 1994). Given a set of corporate objectives and behaviors that a company would want its employees to exhibit, a process for achieving effective TQM implementation based on (Glover et al., 1994) cultural assets profiles is presented in Figure 3.1 and it is described in the previous section of this report (Love et al, 2004).

The gap between current corporate culture, objectives and behaviors and TQM practices, as a result of a cultural audit process, will be the input to develop most effective and efficient TQM implementation for the company by referring to ten determinants of TQM as discussed in the third section. Analysis of the gap will provide information which TQM determinants should be enhanced, sustained or maintained.

The gap analysis can be included in TQM road map proposed by Burati and Oswald (1993), starting in exploration and commitment phase. The result of gap analysis will be useful to develop company-wide training plan, and it will be more valueable in planning and preparation phase. By knowing which TQM determinants should be enhance, sustain or maintain, strategic quality deployment can be developed in most efficient way.

The strategic quality deployment process is the heart of a successful TQM program. It is the means by which the quality improvement efforts are aligned with the corporate mission, vision, goals, and objectives. The process provides not only the framework for achieving this alignment, but also overall measures of effectiveness. The placement The placement of the process at this point on the road map, as the first step taken by management after it affirms its TQM commitment, is a key ingredient for success.

On Implementaion phase, the later stage of TQM road map of Burati and Oswald (1993), after run multiple trainings the company launch a pilot TQM project to provide visible evidence that TQM is successfully running in company. At the end of this phase company will begin implementing TQM company wide.

Continuous improvement is one of the principle of TQM, therefore in the final phase of the road map Burati and Oswald (1993) use sustaining phase to ensure that TQM implementation will be continuously implement in the company. this environment must prevail for the life of the enterprise, and that the methods will become routinely used on a regular, recurring basis. The improvement process never ends, therefore no true destination is ever reached.

V. CONCLUSION

5.1 Key Finding

Teixeira (1999) concluded his paper by stating: The fact that TQM does not have a universal definition leaves a great amount of freedom to those developing solutions under its main guidelines. As solutions are not directly transferable, each organization must develop its own framework and each manager his mindset of Quality Management (QM) and any tentative desire to theorize QM must take this into account.

The Teixeira's statement above indicates that although there are some methods using a step-by-step approach in TQM implementation, including the one proposed by Burati and Oswald (1993), these models were only guidelines for TQM implementations. Considering the TQM implementation will be differ for every company. Therefore researches conducted by Arditi and Gunaydin (1997) and Harrington and Voehl (2012) explain that TQM implementation for construction firm is started with the basic concept of TQM itself. However, research conducted by Burati and Oswald (1993) presents an account of successful practices to date in the interviewed companies, and that the implementation road map has no end point. It is likely that improvements are continuously being made in the process of TQM implementation in a construction firm.

Considering TQM implementation will cause cultural changing and each company has its own culture, methodology of TQM implementation will differ from one company to another. As suggested by Love *et al* (2004), the company should perform a cultural audit before implementing TQM so that corporate objectives and behaviors can be aligned to the goal of the TQM program and establish proper TQM implementation methodology for the company.

5.2 Strength and Innovative Aspect

The key journals used by this report based on actual case study and some of them able to provide evidence of their successful implementation of their proposed theory. Our literature review based on the combination and extraction of those journals which are enable us to develop the model that could be applicable in real life practice.

5.3 Reasearch Limitation

- There is no survey or interview conducted during this research, since the research based on the existing scientific journal. The proposed model in this report never been tested in real organizations.
- TQM implementation requires company-wide cultural change which may trigger the resistance from internal organization. The research does not discuss how to deal with the resistance.
- The report only discuss TQM implementation on a corporate level, which means it doesn't cover TQM implementation in construction project execution. Even though TQM implementation on corporate level will affect the behavior of project execution.

5.4 Future Research

- It is necessary to conduct a survey in companies who are adopting TQM philosophy to provide actual evidence about applicability of the proposed model in this report and suggest more applicable model if necessary
- Further research may consider the role of current ICT (information and communications technology).
- Further research may consider internal resistance in TQM implementation.
- Further research may investigate the impact of external factors such as government rules and regulations.

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management involvement	management commitment	Leadership management commitment	Top management commitment	-	Senior executive commitment	Top management commitment	Leadership	Leadership	Top management leadership	Top management commitment	Management participation
Focus on costumer	Costumer Service	Costumer Satisfaction	Costumer Involvement & satisfaction	-	costumer requirements orientation	Client focus	-	Costumer Satisfaction	Costumer management	-	Costumer satisfaction orientation
Work environment, Communication & Teamwork	Teamwork	Employee empowerment, Communication & Teamwork	Employee empowerment & involvement	-	Company-wide employee involvement	Empowerment, involvement & participation	Employee relation	Teamwork & Empowerment	People management	-	Open culture
Helping suppliers and subcont. improve	Supplier involvement	Supplier involvement	Costumer - supplier relationship	Subcontractors' participation	-	supplier quality management	Costumer - supplier relationship	-	Supplier management	Contract party relation	-
-	Cost of quality	-	-	Cost of quality	-	-	-	-	-	-	-
Formalized process improvement techniques	Statistical methods	Process Improvement	Process Improvement	-	-	-	Product/ process management	-	Process & quality info. Management	Quality tools and techniques	Quality data and reporting
Striving for continuous improvement.	-	Continuous improvement, TQ and Measurement	-	Continuous improvement	-	-	-	Continuous improvement	Continuous improvement	-	Continuous improvement
Training	Training	Training	Training	-	Personal development	Education and training	-	-	Learning	Training	Education and training
Vision, mission, and guiding principles	-	-	-	-	-	-	-	-	-	-	-
-	Quality control policies	-	-	-	-	-	-	-	-	-	-