

# The Effect of ISO 9001 on TQM Implementation in SME in Trinidad

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*This paper examines empirically the priority weightings to which the criteria and respective objectives of total quality management (TQM) have been implemented in four ISO 9001 certified SME operating Trinidad and Tobago. It pays special attention to the soft objectives since TQM stresses the organization wide involvement of its people. It employs the Analytic Hierarchy Process approach in determining and comparing the percent weightings of the soft and hard criteria and objectives which comprise TQM. The findings suggest that in ISO 9000 certified SME the soft objectives of TQM represent areas of least implementation. This can be addressed by implementation programs designed in alignment with the prevailing culture of the organization. Because of the ethnographic nature of the study, it was possible to obtain data from only four SME. Despite this, the findings may be applied to design, implement and continually improve SME' quality management systems. As such, this paper makes a contribution to the body quality management in a region where such work is limited. It adds value by empirically measuring TQM implementation in ISO 9001 certified SME.*

**Keywords:** TQM, AHP, ISO 9001, SME, Culture, Trinidad and Tobago

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## 1. Introduction

Ever since it was introduced in 1987, small and medium enterprises (SME) worldwide have increasingly adopted the ISO 9001 Standard as their preferred quality management system. Since this standard has tailored its compliance around the principles of total quality management (TQM), many researchers have sought to determine the extent to which certified organizations are able to attain its many criteria and objectives

The need for the development of SME is being recognized as the means for economic survival in the developing and transitional economies. As such, Trinidad and Tobago (T&T) has been placing

increasing emphasis on the development of entrepreneurship and micro and small enterprises, which is being seen as a way of alleviating poverty and creating wealth.

Many studies have found that total quality management (TQM) could be used by SME with considerable success (Ghobadian and Galleary, 1997). Despite this, knowledge of the impact of TQM practices in SME in developing countries is very limited (Temtime and Solomon, 2002). This is in line with the findings of Sila and Ebrahimpour (2002) who found that there is a lack of information about the nature and stages of TQM implementation endemic to specific regions of the world. To address this, this study seeks to determine areas of

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strengths and weaknesses of TQM criteria and their respective objectives in SME operating in T&T that have been certified to the ISO 9001:2000. It does this by empirically determining the effect ISO 9001:2000 implementation has on the soft and hard objectives of TQM

Many authors have sought to distinguish between these objectives. The soft objectives such as leadership, human resource management, suppliers' relations and customer focus are long-term issues and cannot be switched on and off. On the other hand, the hard objectives are tools and systems that lend support to the implementation of the soft objectives (Black and Porter, 1995; Oakland, 2000; Quazi and Padibjo, 1998).

There is evidence that the inherent characteristics of the Caribbean's entrepreneurs and people are not well suited when it comes to the culture needed for TQM implementation in SME. Studies show that many Caribbean organizations are characterized by authoritarian management styles, weak labour/management relations, low employee morale and productivity, rigid bureaucracy and hierarchical control (Foundation for International Training, 1988; Charles, 1992; CMDT, 1995).

SME must therefore strategize in order to overcome these obstacles. This study aims to address these by empirically determining the extent to which the soft objectives have been successfully implemented in four ISO 9001:2000 certified SME. In this way areas of strengths and weaknesses are highlighted. Scarce resources could be parsimoniously allocated to areas of weaknesses.

The analytical hierarchy process (AHP) methodology was adopted for facilitating the study and analysis of findings. This method was chosen as it offers a means to quantify decision makers' subjective judgments by assigning

corresponding numerical values based on the relative importance of objectives under consideration. The goal with its associated criteria and objectives of TQM were determined from the literature and arranged in an AHP model for analysis.

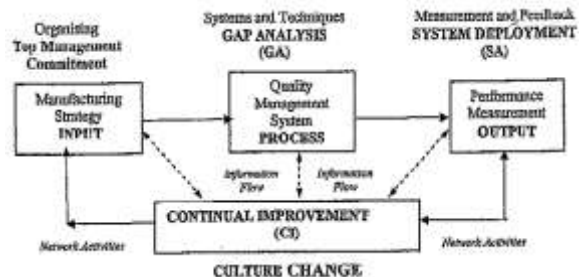
## 2. Criteria and objectives of ISO 9000

In practice, the words criteria and objectives are used interchangeably. A criterion is a principle or a standard that an idea or objective is judged by, whereas an objective is something that is sought after or aimed at. (Decision Support Software, 2000). This study breaks down the criteria of TQM into two levels of objectives for its empirical analysis.

In order to provide a complete analysis of the criteria and objectives of TQM, this study builds on the integrated Manufacturing Strategy (MS)/Total Quality Management (TQM)/Performance Measurement (PM) model advocated by Lalla et al. (2003).

This model is well suited to TQM implementation in SME because it recognizes that a key element for efficiency and effectiveness is changing the building culture or making it more conducive to continual improvement (Dale, 1999).

The integrated MS/TQM/PM model consists of four sections, namely the MS inputs, the TQM process; the PM outputs and continual performance improvement. These sections together with their association with culture change are illustrated in Figure 1.



**FIGURE 1:** Integrated System Model MS/TQM/PM

In order to consider all the criteria that comprise these sections, this study matches each with the following: Criteria 1: Top Management Commitment (TMC) which corresponds to Input, MS and Organizing ; Criteria 2: Gap Analysis (GA) which corresponds to Process, the TQM process and Systems and Techniques; Criteria 3: System Deployment (SD) which corresponds to Output , PM and Measurement and

Feedback; and Criteria 4 Continual improvement (CI) which corresponds Culture Change and Continual Performance Improvement.

Table I depicts the breakdown of Criteria 1, 2, 3 and 4 into its Level 1 and Level II objectives for analysis. The analytical framework for the AHP analysis is illustrated in Figure II with the goal being to determine the “Effectiveness of TQM implementation through ISO 9001:2000 in SME”.

**TABLE 1:** Criteria And Objectives of TQM

Criteria	Level I Objectives	Level II Objectives
1) Top Management Commitment (TMC)	1. Strategy Finalisation (STF)	1 Assessment of Structure and Infrastructure (ASSI)
		2 Policy Formulation (POLF)
	2. Resource-based Strategy (RBS)	3 Policy Deployment (POLD)
		4 Education and Training in Quality (ETIQ)
		5 Workforce Development Activities (WKDA)
		6 Reward and Recognition (REWR)
		7 New Technologies (NTEC)
	3. Environmental Focus (ENF)	8 Rate of Change of Products and Services (RCPS)
		9 Rate of Innovation of Products and Services (RIPS)
		10 Rate of Innovation of Processes (RIPR)
	4. Quality Culture (QUC)	11 Tastes and Preference of Customers (TPCU)
		12 Management Involvement (MINV)
		13 Employee Involvement (EINV)
		14 Internal and External Customer (IECU)
		15 Managing Organisational Change (MOCH)
	2) Gap analysis (GA)	5. Process Approach (PAP)
17 Analytical (ANLY)		
6. System Approach to Management (SAM)		18 Cross Functional (CFUN)
		19 Automate and Integrate Processes (AIPR)
		20 Share Data and Practices (SDPR)
7. Strategic Quality Process (SQP)		21 Produce and Access Data in Real-time (PADR)
		22 Strategy Formulation (STRF)
		23 Strategy Deployment (STRD)
		24 Strategy Implementation (STRI)
		25 Strategy Audits (STRA)
8. Culture Change (CCH)		26 Identify Organisational Culture (IOCU)
		27 Align Culture with TQM Programme (ACUP)
	28 Monitor Culture Change (MCUC)	
3) System Deployment (SD)	9. Self-assessment (SFA)	29 Auditing Process (AUPR)
		30 Apply Best Practice (ABPR)
	10. Performance Management (PFM)	31 Conduct Measurement (CMEA)
		32 Promote Involvement (PINV)
		33 Performance Measures (PMEA)
	11. Internal and External Cooperation (IEC)	34 Analysis and Reporting (AREP)
		35 Communication (COMM)
	12. Quality-related Learning (QUL)	36 Cross Functional Teams (CFIM)
		37 Suppliers Conformance (SUPC)
		38 Suppliers Eager to Solve Problems (SESP)
4) Continual Improvement (CI)	13. Improvement of Processes (IMP)	39 Internal Knowledge Compilation (INKC)
		40 External Knowledge Compilation (EXKC)
		41 Information Sharing (INFS)
	14. Improvement of Product and Service (IPS)	42 Inspection (INSP)
		43 Responsibility and Authority (RAUT)
		44 Resources (RESC)
	15. Improvement of People (IPE)	45 Network (NTWK)
		46 Product/Service Performance (PFPM)
		47 Product/Service Reliability (PREL)
		48 Product/Service Conformance (PCON)
		49 Product/Service Durability (PDUR)
		50 Perceived Managerial Support (PMSU)
		51 Extent of Linkage/Status to Company Goals (ELCG)
		52 Perceived Culture Change (PCCH)
		53 Degree of Participation (DPAR)

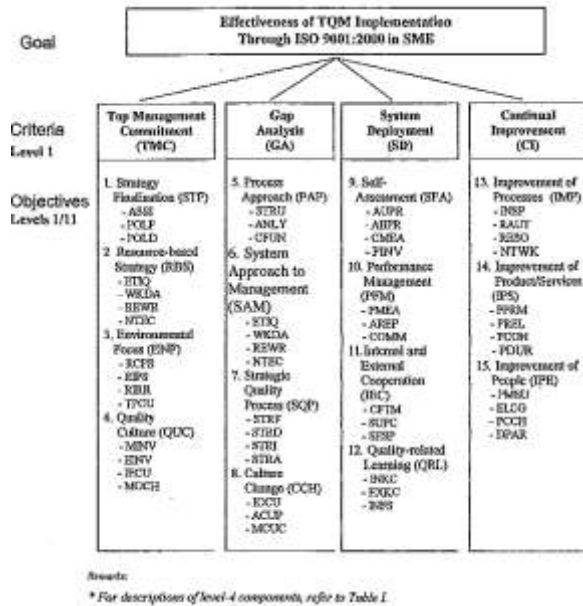


FIGURE 2: An Analytical Framework for AHP Analysis

## 2.1 Objectives of Top management commitment

TMC plays the role in shaping the direction and rigor of TQM efforts. Nowadays, managers would play at least three types of roles, 1) as designers of policies, and structures to make them customer-focused (Stalk et al., 1992); 2) as teachers to help employees to attain the vision of TQM efforts (Ahire and Shaughnessy, 1998); and 3) as stewards to focus their own and employee's attention on serving the customer (Pun et al., 2000). This becomes critical for top management not only to recognize the critical nature of their role but to be clear on content and process. The Level 1 objectives of TMC are therefore strategy finalization (STF) resource-based strategy (RBS), environmental focus (ENF), and quality culture (QUC).

### 2.1.1 Strategy finalization

STF manages the quality dimension of an organization through the formulation of strategies, setting goals and objectives, developing action plans, implementing plans, and using control systems for

monitoring feedback and taking corrective actions (Calingo, 1996). Any plan for TQM implementation in SME must include STF which assesses the SME's structure and infrastructure. Policies are then formulated and deployed. The STF Level II objectives include Assessment of Structure and Infrastructure (ASSI), Policy Formulation (POLF) and Policy Deployment (POLD)

### 2.1.2 Resource-based strategy

RBS suggests that firms develop physical, organizational and human capital resources in pursuit of a sustained competitive advantage. SME must exploit "unique resources and capabilities in ways that generate more value than when initially acquired" (Barney, 1991). Top management could use this strategy to create a "sustained" competitive advantage if their resources (or capabilities) are valuable, rare among competitors, imperfectly imitable and not easily substitutable. RBS can be achieved through 1) Education and Training in Quality (ETIQ); 2) Workforce Development Activities (WKDA); 3) Reward and Recognition for employees (REWR) and 4) development of New Technologies (NTEC).

### 2.1.3 Environmental focus

The concept of ENF has been a central construct in many research initiatives that focused on the features of the association between a firm and its surroundings (Dale, 1999; Rumelt, 1996). With the continuing rise in environmental dynamism and complexity, the environment in which businesses operate will also become increasingly uncertain. The management of uncertainty therefore would continue to be a main task of top management involving the development of mechanisms to reduce, absorb, counter, or avoid it completely. Finally, strategies must be such that they adapt, responds to or shape the environment.

The ENF Level II objectives would include: 1) Rate of Change of Products and Services ( RCPS); 2) Rate of Innovation of Products and Services (RIPS); 3) Rate of Innovation of Processes(RIPR); and 4) Tastes and Preferences of Customers ( TPCU)

### **2.1.5 Quality culture**

Culture is something collective in a corporation and therefore not a characteristic of individuals within it. It is seen as a tool in determining organisational performance (Sinclair and Collins, 1994). Through QUC, employees can interactively create and preserve a social order within the company. It provides the company with some measure of control over the business processes.

The ISO 9001:2000 promotes the concept of the internal and external customer. In this way, the employees themselves would become more involved and the management would be able to manage the organizational change. The core QUC components are: 1) top Management Involvement (MINV), 2) Employee Involvement (EINV); 3) Internal and External Customer (IECU); and 4) Managing Organizational Change (MOCH). These constitute the Level II objectives

## **2.2 Objectives of Gap Analysis**

GA continually evaluates the ability of SME to consistently design, produce, and deliver quality products and services. This would be achieved in three ways 1) continually evaluating the intent and degree of implementation, and the effectiveness of TQM implementation with respect to process and system management; 2) continually assessing the achievement of process objectives to achieve policy finalization, deployment, monitoring and change; and 3) involving employees in the strategy formation, deployment, monitoring and change process (Dale, 1999; Sohal and Morison, 1995). To achieve some of the

above, the requirements of the ISO 9000 Standard provide the systems and techniques for TQM implementation. GA is composed of several core Level 1 objectives 1) process approach (PAP), 2) system approach to management (SAM), 3) strategic quality process (SQP), and 4) culture change (CCH).

### **2.2.1 Process approach**

Zaire (1997) advocates the PAP to analyze and continually improve fundamental activities, such as manufacturing, marketing, communications and other major elements of a company's operations. For SME, the key processes are identified and analyzed in terms of its inputs, process and output requirements. DeToro and McCabe (1997) suggest that these processes are linked across the organization, which is how the work gets done. Policy and direction would be set from the top, but the authority should also examine work methods delegated to cross-functional teams. As such the Level II objectives for PAP are: 1) Structure (STRU); 2) Analytical (ANLY); and 3) Cross Functional (CFUN).

### **2.2.2 System approach to management**

SAM requires that the processes be documented, to ensure discipline, consistency, and repeatability of quality performance (Zairi, 1997). This approach would stress several components, such as 1) Automate and Integrate Processes (AIPR); 2) Share Data and Practices (SDPR); and 3) Produce and Access Data in Real-time (PADR). These attributes combine to form the Level II objectives and enable a company to manage the efficient and effective use of its resources (e.g. materials, human, finances) by providing an integrated solution for the organization's information processing needs.

### **2.2.3 Strategic quality process**

SQP is concerned with the strategic implications of quality and quality management practices in organizations (Ahire et al., 1996; Calingo, 1996; Obert and Spencer, 1996). Processes should be identified, each with its owner, supplier and customer. Moreover, as quality management improves, organizational performance, new opportunities and strategies are likely to emerge (Lee and Zhou, 2000). Determining SQP would enhance quality management and strategies, leading to positive changes in business practices and performance of the organization (Ahire et al., 1996; Obert and Spencer, 1996). The Level II objectives of SQP are Strategy Formulation (STRF); Strategy Deployment (STRI) and Strategy Audits (STRA).

### **2.2.4 Culture change**

CCH provides the process by which organizational culture is evaluated in relation to TQM implementation. This helps management to monitor the organization's values and norms, and determine how to reflect a commitment to satisfy customer needs (Dale, 1999; Sinclair and Collins, 1994). The changes should be aligned with the prevailing culture perspective, and accomplish the realization of strategic objectives and people management and the management of change. CCH would have Level II objectives focusing on 1) Identification of Organizational Culture (IOCU); 2) Alignment of Culture with TQM Programmes (ACUP), and 3) Monitoring of Culture Change (MCUC).

### **2.3 Objectives of System Deployment**

SD ensures that the required resources are provided to implement and maintain the QMS and meet customer requirements (Dale 1999). The required infrastructure and work environment would achieve conformity to product requirements through the sequence

and interaction of the QMS processes. A sound inter- and intra-communication should be in place, and customer feedback obtained. In addition, personnel performing work affecting product quality should be competent on the basis of appropriate education, training, skills and experience. The design and development of quality products and processes should be monitored; and appropriate records should be established and maintained. Therefore, proper SD would rely significantly on the Level 1 objectives of Self-Assessment (SFA), Performance Management (PFM), Internal and External Cooperation (IEC), and Quality-Related Learning (QUL).

#### **2.3.1 Self-assessment**

In this study, SA is accomplished through the respective compliance requirements of the ISO 9001:2000 framework. It includes as part of its requirements, the condition that the organization shall conduct internal audits at planned intervals to determine whether the QMS: a) conforms to the planned requirements of the Standard and to those established by the organization and b) is effectively implemented and maintained. SA is represented by Level II objectives of Audit Process (APS); Applying Best Practice (ABP); Measurement (MEA) and Involvement (INVMT).

#### **2.3.2 Performance management**

Procurement Executives' Association (1999) defines PFM as "the use of performance measurement information to effect positive change in organizational culture, systems and processes, by helping to set agreed-upon performance goals, allocating and prioritizing resources, informing managers to either confirm or change current policy or programme directions to meet those goals, and sharing results of performance in pursuing those goals". Based on the above, the Level II objectives of PFM are:

Performance Measures (PMEA); Analysis and Reporting (AREP); and Communication (COMM).

### **2.3.3 Internal and external cooperation**

Internal and external cooperation (IEC) reflects the propensity of employees to work cooperatively toward the collective goal of improving quality (Ahire and Ravichandran, 2001). This is most likely to be achieved by cross-functional teams. Proponents argue that organizations do not operate as isolated entities, and would depend on and constantly interact with their environment. Their dependence necessitates integration of the external entities (such as suppliers) within organizational processes for successful execution of these processes. For instance, suppliers would play a key role in determining the product quality, their cooperation is indicative of productive supplier relations (Mudambi and Helper, 1998). The Level II objectives for IEC are therefore Suppliers Conform (SUC) and Suppliers Eager to Solve Problems (SUETSP).

### **2.3.4 Quality-related learning**

QUL involves systematic compilation of information both from within and outside the firm (Ahire and Ravichandran, 2001). One objective Internal Knowledge Compilation (INKC) relates to efforts that are aimed at measuring and tracking the quality of processes and products. (Grandzol and Golsar, 1993). The same applies to another objective, External Knowledge Compilation (EXKC) but with knowledge gained from customer feedback focused on their needs. In addition, Information Sharing (INFS) would measure the extent to which employees seek, have access to, and share specific quality-related knowledge both from within and from outside sources. INKC, EXKC, and INFS therefore represents the Level II objectives of QUL

## **2.4 Objectives of Continual Improvement**

According to ISO (2000a, b), CI refers to “recurring activity to increase the ability to fulfill requirements”. CI should therefore specify a means and not merely the ends (Jha et al., 1996). Top management must create a culture that involves people actively seeking opportunities for performance improvement, and continually seeking to increase their effectiveness and efficiency rather than waiting for a problem to reveal opportunities for improvement (ISO, 2000b). This reflects the continual assimilation of the quality philosophy and use of quality-oriented techniques and methods to attain continual Improvement of Processes (IMP), Improvement of products and services (IPS) and the Improvement of People (IPE). IMP, IPS and IPE are therefore the Level 1 objectives of CI.

### **2.4.1 Continual Improvement of Processes**

IMP must be a collection of activities that constitute a process intended to primarily involve simplification of production processes, chiefly through the elimination of waste (Dale, 1999). The common IMP Level II objectives are 1) Inspection (INSP): employees inspect the quality of their work; 2) Responsibility and authority (RAUT): employees are encouraged to fix problems they find; 3) Resources (RESO): employees are trained or have technical assistance available to correct quality problems they find; and 4) Network (NTWK): a problem solving network is available to employees in solving quality-related problems.

### **2.4.2 Improvement of products and services**

Product quality has been defined in different ways in different context (Dale, 1999; Reeves and Bednar, 1994). Performance, reliability, conformance and durability are

four important dimensions of product/service quality, leading to the IPS. Performance (PPFM) is the extent to which a product/service meets and/or exceeds its functional expectations, whereas conformance (PCON) is the adherence of the product/service to engineering specifications. Reliability (PREL) is linked to the probability of failure of the product/service when in use; and lastly, durability (PDUR) is the useful life of the product/service. These constitute the Level II objectives of IPS.

### **2.4.3 Continual Improvement of People**

Sohal and Morrison (1995) argue that learning is an output of effectively implemented TQM programmes, and the willingness to learn must be diffused throughout the organization. It is because leadership is no longer merely top-down, it can be experienced indirectly, from the bottom up and horizontally (Coad and Berry, 1998). Effective communication is thus necessary for different phases of the change process (Abraham et al., 1999).

This could be achieved through IPE, addressing the Level II objectives of 1) perceived managerial support (PMSU); 2) extent of linkage/status to company goals (ELCG); 3) Perceived culture change (PCCH); and 4) degree of participation (DPAR).

### **3. AHP study of the criteria and objectives of TQM**

The AHP approach involves the decomposition of a complex problem into a multi-level hierarchical structure of criteria and objectives with the last hierarchical level constituting the decision alternatives. These alternatives are compared to determine the objectives of the problem (Crowe et al., 1998, Saaty, 1996). The objective and subjective judgments of TM from four personnel from each of four SME

were involved in order to make a trade-off and to determine priorities.

After the AHP goal had been established, relevant and important performance criteria and objectives were structured into a hierarchy descending from the overall goal. Organizing in a hierarchy serves two purposes: 1) it provides an overall view of the complex relationship inherent in the situation; and 2) it helps decision makers assess whether the issues in each level are of the same order of magnitude, so homogeneity in comparisons is preserved (Yang and Shi, 2002). Saaty (1990) suggests the guidelines for selection of the different levels and construction of the hierarchy. These are: 1) representing the problem as thoroughly as possible; 2) considering the environment surrounding the problem; 3) identifying the issues or attributes that contribute to the solution; and 4) clarifying the necessary participants associated with the problem.

### **3.1 The AHP framework**

An AHP framework was developed for facilitating the study, as depicted in Figure 2. The framework consists the goal and two levels. The two levels consist of TQM criteria (level 1) and their respective objectives (Level 2). The goal was to assess the effectiveness of QMP implementation in ISO 9001 certified SME. Each stage represents a QMP criterion that comprises several objectives and benefits towards the attainment of ISO 9000 certification.

Empirical information and data was obtained through the combined judgments of four evaluators each from four specially chosen SME in Trinidad and Tobago. Invited evaluators in each SME under study were asked to carefully evaluate the criteria of each hierarchy level by assigning relative scales in a pair-wise fashion with respect to the goal of the model. With a set of semi-structured questions, the interviewees were



asked to assess a pair-wise comparison among the criteria and objectives of TQM implementation. A nine-point scale was used to assign the relative scales and priority of weights of criteria (Saaty, 2000).

Experience has confirmed that the scaling mechanism reflects the degree to which one could distinguish the intensity of relationships among the levels of decision criteria and elements (Saaty, 1996, 2000). Pair-wise comparison is a key step in an AHP model to determine priority weights of objectives and provide a rating for alternatives based on qualitative objectives (Saaty, 2000; Yang and Shi, 2002). After the acquisition of evaluators' views the normalised weight priorities of the different hierarchies of criteria of the AHP model were computed. This was done using computer software, Expert Choice (Decision Support Software, 2000).

The relative importance of each factor was rated on a measurement to provide numerical judgments corresponding to verbal judgments. Priority means the relative importance or strength of influence of a criterion in relation to another criteria that is place above it in the hierarchy. The normalised eignenvalues method is recommended when the data is not entirely consistent (Crowe et al, 1998; Saaty, 1996).

Both local priorities (i.e. relative to the parent elements) and global priorities (i.e. relative to the goal) were generated. These were represented by total and sub-total of priority scores each set of comparative judgments would be entered into a separate matrix to derive the 'local priority' (i.e. the preferences with respect to the specific criterion). The weights of the criteria and its sub-criteria would be derived in a similar fashion. The process would continue until all comparison judgment matrices were obtained. All acquired data and information were then computed and analyzed using the computer software, Expert

Choice (Decision Support Software, 2000).

#### **4. Results and analysis**

Four SME hiring less than 100 people and operating in Trinidad and Tobago were selected for this study. Table II depicts the characteristics of four SME (i.e. Companies A, B, C and D) that were analyzed against a list of 25 selection criteria based largely on Ghobadian and Galler (1997). These criteria were chosen and grouped to reflect the unique characteristics of SME, in terms of their structure, procedures, behavior, culture, processes, people and contacts endemic to T&T. A "Y" means that the company possesses the characteristic, while an "N" means that it does not. Among the four SME, one company was less than 5 years old, two between 5 and 10, and the last greater than 15 years. Three of these companies operated as a job shop with one being a service company. Two companies were family owned, while the other two had sole proprietary. None of them had previous knowledge of quality management systems. In total, interviews with sixteen senior executives (e.g. the Chief Executive Officers, directors) or their representatives (e.g. production managers, quality managers and customer service managers) were conducted. These personnel are responsible for and/or involved in quality management practices and performance measures in their organizations. Their views provide a wide spectrum of experience and expertise across various industry sectors in the manufacturing sector in Trinidad and Tobago.

The overall percent priority of TQM effectiveness among four SME is given in Table III. It was found that the effectiveness status of TQM implementation among SME was ranging from 58.2% (Company C) the highest to 68.0% (Company D) the lowest. The mean weight of overall effectiveness

was 64.9%. This reflects the level of achievements among these SME towards the level-1 goal of effective TQM implementation through ISO 9001:2000 (see Figure 1). The inconsistency indices of the AHP analysis for Companies A, B, C and D were 0.09, 0.09, 0.05 and 0.05, respectively. These fall within the acceptable level of 0.10 as recommended by Saaty (1996), which indicated that the evaluators assigned their weights consistently on examining the priorities of decision criteria and assessing the effectiveness of TQM implementation.

The local and global percent priorities of the different levels of criteria are depicted in Table IV. The criteria of each level are implemented to varying degrees at certification. At this stage, an independent certified auditor from an internationally recognized body determined

that the compliance requirements of the Standard have been effectively implemented. This would be represented by the TQM criteria with the highest percent parity. Similarly, those with low percent priority would represent the levels of TQM criteria which have not been properly implemented. The AHP findings show the extent to which each criteria, sub-criteria and components of TQM is implemented in studied SME at the onset of certification to the ISO 9001:2000 Standard. It was found that system deployment (SD) and continual improvement (CI) are the leading level-2 criteria, with the means weights (i.e. percent parity) of 40.7% and 25.0%, respectively. Top management commitment (i.e. TMC = 15.4% priority) and Gap analysis (i.e. GA = 16.4% priority) are the least effective TQM criteria in the studied SME.

**TABLE 2:** Selection Of SME For The Study

No.	Lists of Selection Items	Company			
		A	B	C	D
	<b>Resources</b>				
1	Willingness and resources available to implement ISO 9001	Y	Y	Y	Y
2	Had little prior knowledge of quality management systems	Y	Y	Y	Y
3	Require upgrade from ISO 9001:1994 to ISO 9001:2000	N	N	N	N
	<b>Profile</b>				
4	Number of employees less than 100	Y	Y	Y	Y
5	Company less than 5 years old	N	Y	N	N
6	Company between 5 and 15 years old	Y	N	N	Y
7	Company greater than 15 years old	N	N	Y	N
8	Job shop type	N	Y	Y	Y
9	Batch production type	Y	N	N	N
10	Continuous flow	N	N	N	N
11	Service	N	N	N	S
12	Project type	N	Y	Y	Y
13	Certified at present	Y	Y	Y	Y
14	HSEQ requirements	N	Y	Y	Y
	<b>Ownership</b>				
15	Family owned	Y	N	Y	N
16	Government owned	N	N	N	N
17	Sole proprietary	N	Y	N	Y
18	Public company	N	N	N	N
19	Division	N	N	Y	N
20	Skilled based	N	Y	Y	Y
21	Established by entrepreneur	Y	Y	Y	Y
	<b>Location</b>				
22	Based in an industrialized area	N	Y	N	N
23	Based in the East West Corridor	Y	N	N	N
24	Based in Central	N	N	Y	N
25	Based in South	N	N	N	Y

Remarks: Y = Yes; N = No

TABLE 3: Overall Percent Priority Of TQM Effectiveness Among SME

Company	Effective	Not Effective	Inconsistency Indices
A	66.0	34.0	0.09
B	67.4	32.6	0.09
C	58.2	41.8	0.05
D	68.0	32.0	0.05
Mean Weights (%)	<b>64.9</b>	<b>35.1</b>	

TABLE 4: Priority Weights of TQM Criteria And Objectives From Evaluators

Criteria	Level I Objectives	Level II Objectives	Hard (H) vs Soft (S)	Company				Mean Weight	
				A	B	C	D		
Top Management Commitment (TMC)	1 Strategy Finalisation (STF)	1 ASSI	H	2.6	2.9	1.9	0.9	2.1	
		2 POLF	H	2.6	0.7	0.8	0.3	1.1	
		3 POLD	S	0.9	0.5	0.5	0.4	0.6	
	Sub-Total:				6.1	4.1	3.2	1.6	3.8
	2 Resource-based Strategy (RBS)	4 ICTO	S	0.4	0.6	0.6	0.5	0.5	
		5 WKDA	S	0.7	0.6	1.5	0.8	0.9	
		6 REWR	S	0.4	2.5	0.5	1.1	1.1	
		7 NTBC	H	1.5	1.5	1.6	1.2	1.5	
	Sub-Total:				3.0	5.2	4.2	3.6	4.0
	3 Environment Focus (ENF)	8 RCPS	H	0.8	0.4	1.2	0.9	0.8	
		9 RIPS	S	1.6	0.8	1.5	1.0	1.2	
		10 ROIPS	S	1.6	0.4	1.1	1.7	1.2	
		11 TPCU	S	1.6	0.8	1.2	2.4	1.5	
	Sub-Total:				5.6	2.4	5.0	6	4.8
	4 Quality Culture (QUC)	12 MINV	S	0.7	3.1	0.3	0.3	1.1	
13 EINV		S	0.3	0.9	0.6	0.6	0.6		
14 IRECU		S	0.5	1.3	0.3	1.1	0.8		
15 MOCH		S	0.3	0.6	0.3	0.3	0.4		
Sub-Total:				1.8	5.9	1.5	2.3	2.9	
<b>Total:</b>				<b>16.5</b>	<b>17.6</b>	<b>13.9</b>	<b>13.5</b>	<b>15.4</b>	
Gap Analysis (GA)	5 Process Approach (PPA)	16 STRU	H	2.1	1.3	4.0	2.4	2.5	
		17 ANLY	H	1.0	0.5	2.3	2.4	1.6	
		18 CFUN	S	2.1	1.3	7.3	2.4	3.3	
	Sub-Total:				5.2	3.1	13.6	7.2	7.3
	6 System Approach to Management (SAM)	19 AIPR	H	0.9	1.2	2.9	1.7	1.7	
		20 SDRP	H	0.8	0.4	1.2	1.7	1.0	
		21 PADR	H	1.2	1.3	1.8	1.7	1.5	
	Sub-Total:				2.9	2.9	5.9	5.1	4.2
	7 Strategic Quality Process (SQP)	22 STRF	S	0.2	0.3	0.6	0.4	0.4	
		23 STRD	S	0.3	0.1	1.8	0.9	0.8	
		24 STRI	S	0.7	0.4	2.0	1.3	1.1	
		25 STRA	H	0.3	0.1	0.8	1.0	0.6	
Sub-Total:				1.5	0.9	5.2	3.6	2.8	
8 Culture Change (CCF)	26 IOCU	S	0.2	0.2	0.7	0.6	0.4		
	27 ACUP	S	0.6	0.6	1.3	1.5	1.1		
	28 MCUC	S	0.3	0.2	0.7	0.4	0.4		
Sub-Total:				1.1	1.0	2.9	2.5	1.9	
<b>Total:</b>				<b>10.7</b>	<b>7.9</b>	<b>27.6</b>	<b>18.4</b>	<b>16.2</b>	
System Deployment (SD)	9 Self-assessment (SPA)	29 AUPR	H	1.0	2.5	0.8	4.9	2.3	
		30 ABPR	H	2.4	1.2	2.3	3.1	2.3	
		31 CMEA	H	2.4	2.3	2.0	2.1	2.2	
		32 FINV	S	1.5	4.4	1.2	1.6	2.2	
	Sub-Total:				7.3	10.4	6.3	11.7	8.9
	10 Performance Management (PFM)	33 PMEA	H	0.4	3.9	2.4	3.5	2.6	
		34 AREP	H	5.2	2.5	4.8	1.8	3.6	
		35 COMM	S	5.2	0.8	2.4	1.8	2.6	
	Sub-Total:				10.8	7.2	9.6	7.1	8.7
	11 Internal & External Cooperation (IEC)	36 CFTM	H	1.8	3.6	2.4	3.1	2.7	
		37 SUPC	S	4.6	7.1	8.9	8.1	7.2	
		38 SESP	S	2.9	7.1	5.6	7.1	5.7	
Sub-Total:				9.3	17.8	16.9	18.3	15.6	
12 Quality-related Learning (QRL)	39 INKC	H	3.3	5.1	3.7	1.5	3.4		
	40 IEXKC	H	2.9	3.3	1.2	3.1	2.6		
	41 INFS	H	1.2	2.0	1.2	1.5	1.5		
Sub-Total:				7.4	10.4	6.1	6.1	7.5	
<b>Total:</b>				<b>34.8</b>	<b>43.8</b>	<b>38.9</b>	<b>43.2</b>	<b>40.7</b>	
Continual Improvement (CI)	13 Improvement of Process (IMP)	42 INSP	H	5.4	4.8	1.5	3.3	3.8	
		43 RAUT	H	2.2	2.0	0.6	1.6	1.6	
		44 RESO	H	2.4	4.3	0.9	5.9	3.4	
		45 NFWK	H	2.4	2.8	1.8	2.1	2.3	
	Sub-Total:				12.4	13.9	4.8	12.9	11.0
	14 Improvement of Products and Services (IPS)	46 PPM	H	3.6	1.6	2.8	2.8	2.7	
		47 PREL	H	2.0	1.1	2.9	1.2	1.8	
		48 PCON	H	2.6	2.3	2.4	2.3	2.4	
		49 PDUR	H	2.6	0.5	3.5	2.0	2.2	
	Sub-Total:				10.8	5.5	11.6	8.3	9.1
15 Improvement of People (IPE)	50 PMSU	S	2.0	2.9	0.4	0.5	1.5		
	51 ELCG	S	1.1	1.7	0.9	0.9	1.2		
	52 PCCH	S	0.7	1.2	1.2	0.6	0.9		
	53 DPAR	S	0.8	2.9	0.5	1.3	1.4		
Sub-Total:				4.6	8.7	3.0	3.3	4.9	
<b>Total:</b>				<b>27.8</b>	<b>28.1</b>	<b>19.4</b>	<b>24.5</b>	<b>25.0</b>	

Remarks:  
\* For descriptions of level-4 components, refer to Table 1.

Table V ranks the ‘soft’ and ‘hard’ sub-criteria and components in levels 3 and 4 analysis, while Table VI gives the overall ranking in terms of the percent priority of these sub-criteria and components. The AHP analysis showed that the hard sub-criteria accounted for 65.1% priority whereas the soft sub-criteria 34.9%. The top five level-3 sub-criteria were internal and external cooperation (i.e. IEC = 15.6%), improvement of processes (i.e. IMP = 11.0%), improvement of products and services (i.e. IPS = 9.1%), self-assessment (i.e. SFA = 9.0%), and performance management (i.e. PFM = 8.7%). Only IEC was a soft sub-criterion, the other four were hard sub-criteria. In other words, SME has implemented the ‘soft’ sub-criteria of TQM to a lesser extent than the ‘hard’ sub-criteria of TQM for attaining their ISO 9000 certification.

inspection (i.e. INSP = 3.8%), analysis and reporting (i.e. AREP = 3.6%), internal knowledge compilation (i.e. INKC = 3.4%) and resource (i.e. RESO = 3.4%). Top management had efficient methods to monitor the external environment. This was usually done outside the QMS. SME were able to effectively implement systems for the inspection, analysis and reporting of data for use in the formulation of objectives. On the other hand, the least implemented ‘hard’ components of TQM at the certification stage were strategy audit (i.e. STRA = 0.6%), rate of change of products and services (i.e. RIPS = 0.8%), share data and practices (i.e. SDPR = 1.0%), and rate of innovation of processes (i.e. RIPR = 1.2%). The first and second may explain a major weakness which was experienced in the studied SME. This was in the area of measurement, analysis and improvement. Although data was being collected in the area of product and service provision, the analysis required for trending and the formulation of objectives was not being conducted. There initially existed no fixed methodology of policy formulation, deployment, implementation and monitoring.

TABLE 5: Overall Ranking Of TQM Objectives

Level I Objectives *				Level II Objectives *			
Hard	% Parity	Soft	% Parity	Hard	% Parity	Soft	% Parity
IEC	15.6	IEPI	4.9	SUPC	7.2	SESP	5.7
IMP	11.0	RBV	4.0	INSP	3.8	CFTM	2.7
IPS	9.1	STP	3.8	AREP	3.6	COMM	2.6
SFA	9.0	QUC	2.9	INKC	3.4	PINV	2.2
PFM	8.7	SQP	2.8	RESO	3.4	TPCU	1.5
QRI	7.5	CCH	1.9	CFUN	3.3	INFS	1.5
PPA	7.3			PPFM	2.7	PMSU	1.5
BNF	4.8			PMEA	2.6	BLOG	1.4
SAM	4.2			EXKC	2.6	DFAR	1.2
Total	65.1		34.9	STRU	2.5	POLF	1.1
				PCOR	2.4	REWR	1.1
				AUFR	2.3	MINV	1.1
				ABPR	2.3	STRI	1.1
				NTWK	2.3	ACUP	1.1
				CMBA	2.2	WKDA	0.9
				PDUR	2.2	PCCH	0.9
				ASSI	1.8	IECU	0.8
				FREL	1.7	STRD	0.8
				AIER	1.7	FOLD	0.6
				ANLY	1.6	BINV	0.6
				RAUT	1.5	ETDQ	0.5
				NTEC	1.5	MOCH	0.4
				PAER	1.5	STRE	0.4
				REPS	1.5	ICCU	0.4
				RIPR	1.2	MCAC	0.4
				SDPR	1.0		
				RCPS	0.8		
				STRA	0.6		
				Total	65.1		34.9

A closer examination at the percent priority in the third level helped identify specific areas of strengths and weaknesses in SME. The areas of strength with respect to the level 4 ‘hard’ components were suppliers’ conformance (i.e. SUPC = 7.2%),

The areas of strengths with respect to the level 4 ‘soft’ components were suppliers eager to solve problems (SESP = 5.7%), cross-functional teams (i.e. CFTM = 2.7%), communication (i.e. COMM = 2.6%), and promoting involvement (i.e. PINV = 2.2%). This accurately reflects the situation in that the case studies had very good relationships with their suppliers in which top management had direct lines of communication. This had the effect of policy and associated strategies being formulated based mainly on market/supplier feedback with employees playing little or no part. Regarding the weakest areas of ‘soft’ components, these included monitoring cultural change (i.e. MCUC = 0.4%),

identifying organisational culture (i.e. IOCU = 0.4%), strategy formulation (i.e. STRF = 0.4%), managing organisational change (i.e. MOCH = 0.4%), and education and training in quality (i.e. ETIQ = 0.5%). These weaknesses reflect the fact that there are no compliance requirements that address the issue of culture and its alignment with the QMS programme. This may explain why these studied SME experienced barriers to TQM implementation that could be categorized as 1) lack of TMC due to weak comprehension of quality management; 2) inability to manage change efficiently due to ad hoc alignment of the companies culture with that required for TQM; and 3) lack of a systems for strategic quality planning.

## 5. Conclusions

Nowadays, many SME have accepted the ISO 9000 Standards as the most practical method for establishing, developing and implementing QMS. However, despite continued efforts by responsible bodies to update and modify the ISO 9000 Standards, recent studies have shown that adopting the Standard would still not be comprehensive for safeguarding organisations to attain excellence. TQM has been accepted as one of the most prominent management approaches for maximising organisational performance in terms of improving products, processes and people. In order to identify areas of weaknesses that SME may face in attaining TQM through implementation of the ISO 9001:2000, this study has attempted to empirically determining the percent priority among the criteria of TQM and the compliance requirements of the Standard.

Using the AHP methodology, the levels of TQM criteria are arranged and assessed based on the implementation to certification of four SME in Trinidad and Tobago. The AHP analysis showed that at certification the SME implemented on average 65% of the criteria of TQM. The

proportion of priority for 'hard' criteria was approximately 65% and for 'soft' criteria approximately 35%. Evidence shows that system deployment (SD) and continual improvement (CI) are the most important TQM criteria. Internal and external cooperation (IEC) and improvement of processes (IMP) are the leading sub-criteria, whereas suppliers eager to solve problems (SESP) and cross-functional teams (CFTM) are the top components. The studied SME would manage 'hard' criteria better as they could be more easily quantified than 'soft' criteria. A direct consequence of this was that employees did not have complete 'buy in' to the QMS. This was as a direct result of top management not having spent adequate time at the start of implementation to fully understand what a QMS entails. It was only after top management had a good working knowledge and saw the QMS in operation did they become directly involved. This had a direct influence in achieving employee acceptance of the QMS.

Because there is a higher percent priority that address the 'hard' criteria of TQM, SME in T&T at the point of certification, may be lacking in some of the softer criteria of TQM. This is evident in the finding that approximately 65% of TQM criteria are implemented at the point of ISO 9000 certification and that of this approximately two thirds is with respect to the hard criteria. Since the success of TQM depends equally on the 'soft' criteria, SME that implement ISO 9000 may not be able to reap the maximum benefits of TQM. Therefore, it is concluded that addressing the need of aligning quality culture and top management involvement would be one of focal compliance requirements for future revisions of ISO 9000 Standard. Although exploratory in nature, this study shows that the critical criteria that determine the effectiveness of TQM implementation in Trinidad and Tobago organisations are

similar to those found in the literature. SME can however use these criteria in assessing the maturity of implementation of the Standard.

Future research could validate the 'soft' and 'hard' criteria identified for SME of different operational natures. In order to reveal sector-specific characteristics, case studies and comparative evaluations of TQM implementation should be conducted in SME across various industry sectors.

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