

# Ranking Critical success factors for sustaining Total Quality Management implementation in Sudan

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## ABSTRACT

Sudan is in the process of transforming its industry to be globally competitive. One of the efforts needed is in enhancing its quality programs through continuous improvement and total quality approach. This study aims to rank the several critical success factors (CSF's) for sustaining TQM implementation in Sudan. The main objective is to identify major criteria to be considered in sustaining of total quality management implementation among Sudanese companies. In this study a comprehensive literature review was done to determine the critical success factors and to develop initial CSFs hierarchy model for sustaining total quality management implementation in Sudan. Analytic Hierarchy Process (AHP) is used for evaluating and ranking the determined CSF's. The findings of study highlight some key barriers affecting the sustainability of TQM implementation and proposes conceptual model using AHP approach for sustaining TQM implementation in Sudan.

**Keywords:** Total Quality Management; Critical Success Factors; AHP; Sudan

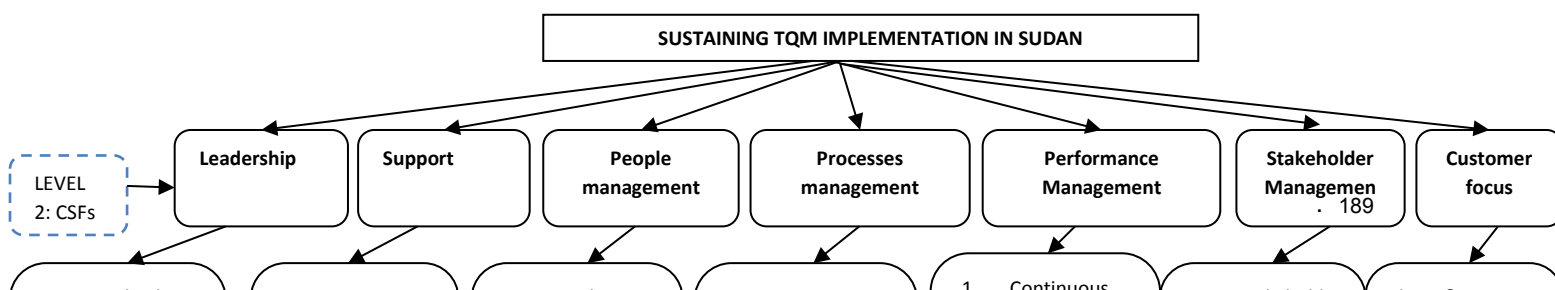
## 1. Introduction

Total quality management (TQM) is a management philosophy that empowers every member of the organization. TQM encourage each individual to participate, contribute and offers to present suggestions for improvement. It is intended to promote continuous and sustained improvement in quality and performance, and develops an attitude of quality culture (Talib *et al.*, 2012). TQM address overall organizational performance and recognizes the importance of processes (Seetharaman *et al.*, 2006). For TQM to be successfully adopted by an organization there needs to be a perceived need for change in that organization. From past few decades, TQM has been extensively discussed in the literature and can be seen as a management philosophy characterized by its principles, practices, and strategies that emphasizes upon continuous improvement in quality, increased involvement of employees, commitment of top management, employee empowerment, teamwork, benchmarking, leadership, rewards and recognitions, feedback and relationship with suppliers (Dean and Bowen, 1994; Rönnbäck and Witell, 2008).

TQM has been studied by a few researchers in Sudan. Most of the research in Sudan has focused on describing the implementation, importance, and effect of TQM in various sectors. Faysal Bashir (2010), attempt to investigate the impact of implementing quality management system (ISO 9001) on the improvement of institutional performance in Sudan Customs Authority through the examining the nature of relation between the application of quality management system and the improvement of institutional performance, the study proves the positive relationship between QMS implementation and institutional performance. Omer Abd Allan (2013), conduct study on QMS in Holy Quran and Sunnah and its Implementation using a case study views and opinions of staff members in Sudanese Universities. There is a lack of study relating to the critical success factors effecting the effectiveness and continuous improvement of TQM implementation in Sudan. Critical success factors (CSFs) are those few things that must go well to ensure success, those areas in an organization which help to provide satisfactory results and ensure the organizational competitive performance, (Zmud and Pun et al 1984, Joyce and Green, 2006 ). According to Horng and Huarng, (2002) CSFs are those key factors that must be analyzed by the organization or those areas that will help to yield greatest competitive influence. Specification and measurement of the critical factors of quality management permit managers to obtain a better understanding of quality management practices and allow researchers to proceed with the task of developing and testing theories of quality management, and to examine certain hypotheses concerning quality management. (Badri and Masood A, 1995).

Although some surveys, group discussion events and official reports conducted by some Sudanese companies and quality and excellence experts have identified barriers and critical success factors facing implementation and continual improvement of TQM in Sudanese companies there is no existing research taking a holistic view to determine, prioritize and ranking the critical success factors for sustaining TQM implementation in Sudan. This study aims to rank the several critical success factors (CSF's) for sustaining TQM implementation in Sudan. The main objective is to identify major criteria to be considered in sustaining of total quality management implementation among Sudanese companies. figure.1 illustrates all the factors and sub factors identified by the comprehensive literature review for sustaining TQM implementation in Sudan.

**Figure.1** The factors and sub factors for TQM in Sudan.



## 2. Methodology

There are currently three major research paradigms in education (and in the social and behavioral sciences). They are quantitative research, qualitative research, and mixed research (Tashakkori and Teddlie, 2003). The difference between qualitative and quantitative methods is generally described in terms of the type of data collection: the quantitative method involves numerical data and statistical analysis while the qualitative method collects descriptive data for interpretation analysis. The qualitative method focuses on patterns of inter-relationships between a previously unspecified set of concepts, while the quantitative way narrowly looks through a specified set of variables (Brannen, 1992). Mixed method studies combine qualitative and quantitative approaches within different phases of the research process. It would neutralize the biases of any single method, provide insight into different levels or units of analysis enhance the research validity since it provides the opportunity to corroborate findings from different perspectives (Tashakkori and Teddlie, 1998, Denscombe, 2003). The qualitative method will direct the quantitative method and the quantitative method gives the feedback into the qualitative discussions for further validity improvement. The research process in this study therefore included mixed method studies for qualitative and quantitative approaches within different phases to ensure the accurate and precise research process. Table 1. outlines the research process.

**Table 1:** The Research Process

Research Activities	Research process	Research method(s)
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1. To determine critical success factors and barriers for sustaining total quality management implementation in Sudan.	Phase 1	<ul style="list-style-type: none"> <li>• Literature studies</li> <li>• Content analysis</li> <li>• Related Print media</li> <li>• Academic and trade journal,</li> <li>• Delphi Technique (Round one and two)</li> </ul>
2. To identify major criteria to be considered in sustaining of total quality management implementation in Sudan	Phase 2	<ul style="list-style-type: none"> <li>• Delphi Technique (Round three) AHP</li> </ul>

This study involved reviewing and understanding the concept of continuous improvement, and identifying critical success factors, through a study of theories and research in this area. The author employed various methods in an attempt to determine CSFs and continuous improvement methodologies. Literature review was employed and questionnaires was developed and Delphi method was used to collect empirical information and data and to obtain experts judgment by consulted experts therefore the experts from different fields from Sudan were selected.

The Delphi process is a ‘structured process for collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback’ (Ziglio, 1996, p.3). A key characteristic of the method is its use of experts, whose responses remain anonymous throughout a series of iterative questionnaire rounds. The controlled feedback during these rounds includes details of the collective group opinion, and it allows experts to either retain or amend their earlier opinions in light of information about other experts’ views. McKenna (1994) describes Delphi as a multi-stage process, built around iterations. Van Zolingen and Klaasen (2003) discuss that through iteration, data collection and feedback continue until a stability of responses has been reached. Brockoff (1975) reports that whilst the number of rounds is variable, Delphi studies seldom go beyond two iterations (3 rounds).

AHP is a multi-criteria decision-making method that uses a hierarchical structure to solve complicated, unstructured decision problems, especially in situations where there are important qualitative aspects that must be considered in conjunction with various measurable quantitative factors, AHP has been applied in different fields such as management, engineering, industry, education, etc. (Kamal and Al-Harbi, 2001). (AHP) proposed for the first time by Thomas L. Saaty in 1970. This method is based on the pair-wise comparisons and is capable to examine different conditions. Since AHP is simple and comprehensive, it is the subject of current research and development efforts (Saaty, 1991). Analytic Hierarchy Process (AHP), since its development, has been a tool at the hands of decision makers and researchers; and it is one of the most widely used multiple criteria decision-making tools. Many outstanding works have been published based on AHP: they include applications of AHP in different fields such as planning, selecting a best alternative, resource allocation, resolving conflict, optimization, and numerical extensions of AHP (Vargas, 1990).

In this study, DHP, which have commonly been used to mean the same class of models, is the chosen approach, because CSFs is a discrete decision, where there is a discrete set of alternatives and in which each can be described by some criteria. Thus, a DHP for selecting CSFs and CI methodologies would attempt to develop an integrated framework for continual improvement by providing a step-by-step process. Table 2 show the previous researches using DHP

**Table 2:** The previous researches using DHP

Authors	Focus Area	Approach	Purpose of the study
Sarathy, (2013)	TQM	Questionnaire survey and AHP methodologies	Determining the important factors that influence the TQM practice in real estate industry.
Koilakuntla <i>et al.</i> , (2012)	TQM	Analytical Hierarchy Process (AHP)	Estimation of TQM factor ratings.
Chan and Chen, (2009)	TQM	Analytical Hierarchy Process (AHP)	This study aimed to develop TQM measurement model for the biotechnology industry in Taiwan to enact quality improvement.
Manish Kumar Sagar and Amit Singh Tomar, (2014)	TQM	Delphi/AHP	The purpose of the paper is to rank and review the various critical success factors (CSF's) of total quality management (TQM) in favor of Indian manufacturing industries for improving product and process quality.
Alireza Yazdani, Mohammad Ali Soukhakian, Mohammad Reza Mozaffari (2013)	Total Quality Management	Delphi/AHP	The research aims to answer two main questions:  1. What critical success factors in the implementation of Total Quality Management are proposed in Pars Oil and Gas Company?  2. What is the priority of critical success factors in the implementation of Total Quality Management based on different levels of management's perspective?
Nilda Tri Putri, Sha'ri Mohd. Yusof and Dradjad Irianto, (2011)	Quality Engineering	Delphi/AHP	The paper aims to present the critical success factors (CSFs) and to develop a self assessment tool of quality engineering (QE) implementation for Malaysia and Indonesia automotive industries based on the CSFs identified.

### 3. Ranking the Critical Success Factors

The DHP processes used in this study consists of three rounds of survey conducted with nine industrial and academic experts consisting of practitioners and academics with more than six years of working experience and research in TQM field. In the first round the panel of experts was asked to validate the factors of the preliminary theoretical framework of CSFs which attained from literature review in order to obtain further study by expert’s panel. Semi- structured interview was conducted with selected experts. This interview aims to collect data for round 1 DHP method. The main objective of the second round of Delphi technique is to obtain the consensus amongst the experts in terms of the final AHP model of CSFs for effective implementation of TQM and continuous improvement. The experts panel were asked to review the revised AHP model, after adjustments and changes were made to the model (figure 1), using e-mail and visit with interview. All the experts participated in this round and agreed with the revised hierarchy model of critical success factors for effective implementation of TQM and continuous improvement.

In the last round of Delphi technique, the expert panel were asked to determine the relative scales of a given list of critical factors and sub factors affecting the implementation and continuous improvement of TQM in Sudan in a pair-wise fashion. The pair-wise was constructed by using Saaty (1988), point scale and score. All expert panel members were participated in this round. The participants assessed the pairwise comparison among seven CSF and related thirty-one factors as output of Delphi round one and two, and lastly a series of judgment matrices for the critical factors and sub factors were attained. To conduct Delphi round three, the importance weight or relative weights to critical factors and sub factors were calculated. A pair wise comparison matrix was developed to calculate “weights” which involved the relative significance among the criteria in the second level of the hierarchy. Expert choice software used to determine the ranking of critical factors and sub factors. By using this software, the researcher can obtain the local and global priority weight. The local priority weight is relative to the parent elements, whereas global priority weight is relative the goal. The local weight is the priority of an element related to the preceding element and it is first calculated. Meanwhile, the global weight of each element related to the goal of sustaining TQM implementation in Sudan was calculated by multiplying the local weight of an element by the weight of its preceding element. Tables 2 shows the normalized local weights of judgment and ranking for criteria and sub criteria form expert panel. After that the consistency ratio (CR) was calculated to measure how consistent was the judgment given by experts panel. CR indicates how consistently respondents compared criteria. According to Saaty (1987) who developed the AHP, a CR of .10 or less is considered acceptable. As illustrated in Table 4.4, overall pairwise comparisons were consistent (CR= .044). This means that the overall consistency of evaluator judgments falls within the Saaty (1988) suggested ratio of 0.10

**Table 2:** Normalized Local Weights of Judgment and Ranking for Criteria

<b>TQM implementation and continuous improvement (CR= 0.044)</b>	<b>Weights</b>	<b>Ranking</b>
Leadership	0.386	1
Support	0.036	7
People Management	0.083	5
Process Management	0.158	3
Performance Management	0.208	2
Stakeholder Management	0.047	6

Customer Focus	0.083	4
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Table 3 summarizes the priorities of criteria for categories and sub-categories. The geometric mean was then used to synthesize the assessment of each evaluator. The results form geometric mean of evaluators was combined into judgment matrixes of pair wise comparison. Appendix C shows the judgment matrices and evaluation results. As per findings, the consistency ratio for these matrices falls under 0.10, which means that the results are within the acceptable level of 0.10 according to the consistency ratio.

**Tables 3:** Normalized Local Weights of Judgment and Ranking for Criteria and Sub Criteria Form Expert Panel

Level 1	Weights	Level 2	Weights	Ranking
Leadership	0.386	- Leadership Commitment	0.479	1
		- System Thinking	0.165	2
		- Roles, Resp. and Authorities	0.130	4
		- Sustainability	0.084	5
		- strategic alignment	0.142	3
Support	0.036	- Resources provision	0.068	5
		- work environment	0.107	4
		- Information and Knowledge	0.291	2
		- Training and Awareness	0.387	1
		- Communication	0.146	3
People Management	0.083	- Employee involvement	0.487	1
		- Employee empowerment	0.065	4
		- Team Working	0.283	2
		- Reward and recognition	0.165	3
Process Management	0.158	- Process measurement	0.252	2
		- Process improvement	0.292	1
		- Process Re-engineering	0.058	5
		- Statistical process control	0.252	3
		- Standard Operating procedure (SOP)	0.145	4
	0.208	- Continuous improvement approach	0.439	1
		- Measurement and monitoring	0.111	4
		- Data analysis	0.074	5
		- Benchmarking	0.133	3

Performance management		- Learning and Innovation	0.242	2
Stakeholder Management	0.047	- Stakeholders Engagement	0.684	1
		- Supplier relationship	0.205	2
		- Corporate Social Responsibilities	0.111	3
Customer Focus	0.083	- Customer satisfaction	0.399	2
		- Customer Voice	0.405	1
		- Customer Relationship Management	0.119	3
		- Product quality design	0.077	4

The following section discusses relative weights of each criterion for categories and sub-categories based on priorities calculated. Table 4.6 shows the ranking of the critical factors based on local weights.

**Level Two:** For main categories of CSFs, Leadership (0.386), is the most important factor, followed by Performance Management (0.208), Process Management (0.158), Customer Focus (0.083), People Management (0.083), and Stakeholder Management (0.036) based on global weights calculation the results show that the most important sub factors effecting the implementation and continuous improvement of TQM in Sudanese companies were Leadership, Performance Management and Process Management. It is observed that Customer Focus (0.083), People Management (0.083), get same weights and placed at the fourth and fifth rank, This may indicate that evaluators do not agree with which one is more important than the other, followed by Stakeholder Management (0.047). Meanwhile the least influential factor is Support (0.036).

**Table 4:** The Ranking of the Critical Factors Based On Local Weights

Criteria	Weights	Ranking
1. Leadership	(0.386)	1
2. Performance Management	(0.208)	2
3. Process Management	(0.158)	3
4. Customer Focus	(0.083)	4
5. People Management	(0.083)	5
6. Stakeholder Management	(0.047)	6
7. Support	(0.036)	7

**Leadership:** Leadership commitment was the most important criterion, the next most important criterion for leadership is, system thinking, followed closely by strategic alignment and roles, responsibilities and authorities, sustainability was least important.

**Measurement, Analysis and Improvement:** For measurement, analysis and improvement, continuous improvement approach was the most important criterion followed by learning and innovation. Benchmarking, measurement and monitoring received the next highest importance ratings. data analysis was least important for.



**Process Management:** With regard to process management, Process improvement is the most important sub factor. Process measurement, Statistical process control were the next most important criteria with their priorities similar to each other. This indicates that relative importances of these two criteria for process management are similar. Followed by Standard Operating procedure (SOP). Process Re-engineering was least important.

**Customer Focus:** For the customer focus category, customer voice and customer satisfaction were two major criteria for customer satisfaction, subsequently customer relationship management and followed by product quality design.

**People Management:** With respect to people management, employee involvement is the most important sub factor. Followed by team working and reward and recognition, employee empowerment was least important.

**Stakeholders Management:** For stakeholder management, stakeholders engagement, is the most important sub factor, followed by supplier relationship and corporate social responsibilities.

**Support:** Regarding to support, Training and Awareness and Information and Knowledge are the most important two sub factor, the priorities of Communication and work environment indicate that these criteria were less important for support, compared to other criteria. Resources provision was relatively unimportant compared to other criteria in the support category. Table 5. shows the summary of ranking from 31 sub factors based on local weights.

**Table 5:** Summary of Ranking from 31 Sub Factors Based on Local Weights

<b>Criteria</b>	<b>Priority</b>
<b>Leadership (CR= 0.027)</b>	
1. Leadership Commitment	0.479
2. System Thinking	0.165
3. strategic alignment	0.142
4. Roles, Responsibilities. and Authorities	0.130
5. Sustainability	0.084
<b>Performance Management (CR= 0.011)</b>	
1. Continuous improvement approach	0.439
2. Learning and Innovation	0.242
3. Benchmarking	0.133
4. Measurement and monitoring	0.111
5. Data analysis	0.074
<b>Process Management (CR= 0.015)</b>	
1. Process improvement	0.292
2. Process measurement	0.252
3. Statistical process control	0.252
4. Standard Operating procedure (SOP)	0.145
5. Process Re-engineering	0.058
<b>Customer Focus (CR= 0.017)</b>	

1. Customer Voice	0.405
2. Customer satisfaction	0.399
3. Customer Relationship Management	0.119
4. Product quality design	0.077
<b>People Management (CR= 0.034)</b>	
1. Employee involvement	0.487
2. Team Working	0.283
3. Reward and recognition	0.165
4. Employee empowerment	0.065
<b>Stakeholder Management (CR= 0.017)</b>	
1. Stakeholders Engagement	0.684
2. Supplier relationship	0.205
3. Corporate Social Responsibilities	0.111
<b>Support (CR= 0.017)</b>	
1. Training and Awareness	0.387
2. Information and Knowledge	0.291
3. Communication	0.146
4. work environment	0.107
5. Resources provision	0.068

The results of global weights calculation for 31 sub factors in Table 6 show that the ten most important sub factors are leadership commitment, continuous improvement approach, system thinking, strategic alignment, learning and innovation, roles, responsibilities and authorities, process improvement, employee involvement, process measurement and statistical process control.

**Table 6:** The Ranking of the Sub Factors on Global Weights

Sub Factors	Global Weights	Ranking
Leadership Commitment	0.185	1
Continuous Improvement Approach	0.091	2
System Thinking	0.064	3
Strategic Alignment	0.055	4
Learning and Innovation	0.050	5
Roles, Resp. And Authorities	0.050	6
Process Improvement	0.046	7
Employee Involvement	0.040	8
Process Measurement	0.040	9
Statistical Process Control	0.040	10

#### 4. Discussions

After the validation through Delphi hierarchy process methodology, the seven factors and thirty-one sub factors have been proposed to be critical to the effectiveness, continuous improvement and sustaining in Sudan. Based on all experts the three most critical factors to achieve effective and continuous improve TQM implementations in Sudan are:

**1. Leadership** (with its sub factors i.e. Leadership Commitment, system Thinking, strategic alignment, roles, responsibilities and authorities and sustainability),

**2. Performance Management** (with its sub factors i.e. continuous improvement approach, learning and Innovation, benchmarking, measurement and monitoring and data analysis),

**3. Process Management** (with its sub factors i.e. Process improvement, process measurement, statistical process control, standard operating procedure (SOP) and process re-engineering).

In this study, comprehensive CSFs criteria for sustaining TQM implementation in Sudan were collected and structured into a AHP criteria model in the form of a hierarchy, based on judgement of panel of industrial and academic Sudanese experts. The top level of the proposed hierarchical structure was Sustaining TQM implementation in Sudan, which is to provide effective and successful implementation and improvement of TQM in Sudan.

At the next level there were seven main factors which are: 1) leadership, 2) Support 3) people management, 4) process management, 5) performance management, 6) stakeholder's management, and 7) customer focus. Based on AHP, relative priorities of factors, sub-factors, and criteria were determined using a pairwise comparison. Leadership was the most important factor in achieving sustained TQM implementation goal, followed by performance management and process management. Hence these three factors must be considered as a main element of proposed framework for sustaining TQM implementation in Sudan. People management and customer focus get the same ranking at fourth rank there for people and customer involvement can be considered vital factors for supporting TQM suitability in Sudan. Unexpectedly the support gets the least ranking and under the supporting the work environment and resources provision get the lowest ranking based on global weight calculation, this indicates that the provision of required resources has little or no effect in sustaining TQM implementation.

In the third level there are sub-factors for every main factor. Under Leadership there are leadership commitment, system thinking, roles, resp. and authorities, sustainability and strategic alignment. By using the AHP methodology it was found that the leadership commitment is the most important sub-factor in sustaining TQM implementation in Sudan under the leadership category, system thinking and strategic alignment.

The results also show that the four most critical sub factors to sustain TQM implementation in Sudan are leadership commitment, continuous improvement approach, system thinking, strategic alignment. Based on the result we can conclude that the leadership commitment, measurement and monitoring, continuous improvement, system thinking and learning and innovation can play an important role in sustaining TQM in Sudan. This supports the opinions of experts that the lack of measurement, monitoring and simple and practical approach is one of the key barriers affecting the sustaining of TQM implementation in Sudan. Meanwhile corporate social responsibilities, work environment and resources provision were the three least important factors for sustaining TQM Implementation in Sudan. It also indicates the importance of focusing on continuous improvement projects and events that support the strategic alignment and achieving sustainable excellence. This is supported by Process

improvement, Process measurement and Statistical process control which were most important for process management.

Customer Voice and Customer satisfaction was the most important criterion under the customer focus. Employee involvement and Team Working was the most important criterion under the people management. Stakeholders engagement is important sub-factor under stakeholder's management. All These results reflect the importance of listening to customer voice, involving of people and engaging of stakeholders in sustaining TQM implementation in Sudan.

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