Quality Management Practices: A Study of South Gujarat Industries

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Abstract –

Industries of South Gujarat region viz. General Managers, Quality Managers, Human Resource Managers, Production Managers and Engineers etc. Using the Statistical Package for Social Science (SPSS) software The purpose of this paper is to empirically study quality management practices in industries in South Gujarat. "Questionnaire" is prepared using five-point Likert-type scale. The Questionnaire is sent to people at various, an internal consistency analysis has been performed separately for each of the performance factors. The reliability and validity test is also performed to check the validity of instrument.

On the basis of survey, the relationship between the success factors of Quality Management and performance measurement factors is determined. Then Quality Management Implementation Model for performance improvement of process equipment in South Gujarat Industries is generated. This model will provide useful guidelines to any size and type of industries to successfully implement Quality Management program in their organizations.

Keywords – Quality Management, CSF_S, PF_S, Survey

1. INTRODUCTION

Quality management systems (QMS) have been widely applied successfully by many manufacturing companies to improve their process, increase profits and organizational performance. The most applied of the quality programs are ISO 9001, Kaizen, Five S, Total Quality Management (TQM), Just-In-time (JIT), Quality circle, Lean Management and Six Sigma. Quality management practices can be described as best ways in which organizations and their employees undertake business activities in all key processes. These practices have a positive impact on business results in manufacturing and service industries.

The paper makes several contributions to the literature. Firstly talks about quality and quality management. It also provides the research proposal and the research work. Secondly literature survey find out the Critical success factors and organizational performance measurement factors. Third is all about research objectives, methodology of the proposed study. Forth is explained the process of data collection, questionnaire design, data analysis using statistical tools. Quality Management implementation model is developed and presented.

2. LITERATURE REVIEW

Literature Review of quality management and various critical success factors, Organizational performance measure factors, factors affecting QM implementation and understanding QM dealt by expert researchers who have been involved in methodologies, analysis and various investigation works is presented.

The extensive literature reviews were carried out from the papers of last decade's (1994 to 2012), which are related to Quality Management Practices. The literature review includes the major databases available since 1994-2012. The nearly 44 papers were selected related to Quality Management Practices and from that study the various Success Factors of Quality Management & Organizational Performance Measurement Factors are found out.

Success Factors of Quality Management

Role of Quality Department
Work Culture
Quality Data and Quality Cost
Senior Management Commitment
Continual Improvement
Statistical Process Control (SPC) Usage
Recognition and Rewards
Benchmarking
Understanding of QM Philosophy
Product/Service Design
Managerial Process
Project Selection, Prioritization and Project Management

Performance Measurement Factors

Customer satisfaction
Cost of Quality
Operating Performance impact
Capital productivity
Financial performance impact
Reward for Quality
Product Quality
Employee suggestions
Cost of product
Product Reliability
Maintenance performance

3. METHODOLOGY

Objectives of Research Study

- To identify critical success factors of quality management for Industry.
- To identify the Organization's Performance measurement factors for Industry.
- To study the relationship between critical success factors of quality management and the performance measurement factors for Industry.
- To study the association between basic profile of the organization and success factors of quality management and performance measurement factors.
- To develop a model for CSF_S of quality management and PF_S for South Gujarat Industries.

Research Hypothesis: The main Hypothesis for this study is shown below

Hypothesis: QualityManagement organizational performance factors are positively related with Quality Management critical success factors. The main hypothesis will be sub divided into sub hypothesis based upon the number of factors obtained after factor analysis.

Hypothesis testing: The Research Hypothesis will be converted into the statistical hypothesis and tested through, Regression analysis.

Design of Questionnaire

The questionnaire consists of a number of questions typed in a definite order on a form or set of forms. The questionnaire is developed by using combination of open format questions, multiple choice questions, single response

question, alternative questions, importance questions, Likert questions as well as dichotomous questions. Likert – type Scale (or summated scale) is employed in the questionnaire in which the respondent is asked to respond to each of the statements in terms of five degrees of importance. The Likert – type scale consist of a number of statements which express either a favorable and unfavorable attitude towards the given object to which the respondent is asked to react. Ratings such as "strongly disagree", "disagree", "moderate", "agree", and "strongly agree" or "not important" "least important", "neutral", "important" and "very important" are employed. There is no specific rule whether to use a two-point scale, three-point scale or scale with still more points. In practice, three to seven points' scales are generally used for the simple reason that more points on a scale provide an opportunity for greater sensitivity of measurement.

PILOT QUESTIONNAIRE

1	2	3	4	5
Strongly disagree	Disagree	Moderate	Agree	Strongly agree
		OR		
Not Important	Least Important	Neutral	Important	Very Important

Research Process diagram for Quality Management Model for South Gujarat

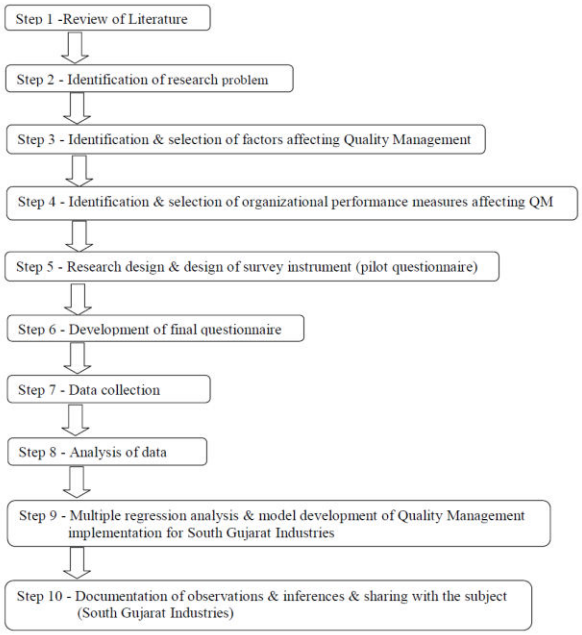

Fig.1: Research Process diagram for Quality Management Model for South Gujarat Industries

Analysis of Data

Data are the basic input to any decision making process in a business. The processing of data gives statistics of importance of study. The data after collection are processed and analyzed in accordance with the outline laid down for the purpose at the time of developing research problem /objective of research.

Following tasks are carried out in the analysis of data:-

1. Computation of statistics, viz. mean, median, mode, standard deviation, etc.
2. Designing regression equation for estimating response variable as a function of set of.
3. Independent variables.
4. Performing correlation analysis.
5. Testing different hypothesis relating to various issues of the research.
6. Factor analysis- Here the main objective of research is to identify critical success factors of Quality Management and organization's performance measures from the recognized variables. For this objective Factor Analysis is carried out through Statistical Package for Social Sciences (SPSS) Software Version 17.

A Statistical Package for Social Sciences (SPSS)

SPSS is a Statistical data modeling tool used by academics, government and commercial organizations to solve research and business problems. SPSS technology has made difficult analytical tasks easier through advances in usability and data access, enabling more people to benefit from the use of quantitative techniques in making decisions. It enables to uncover key facts, patterns and trends. SPSS is among the most widely used programs for statistical analysis in social science. Proficiency with statistical software packages is indispensable for research in the sciences. It covers a broad range of statistical procedures that allows:-

- to summarize data
- compute means and standard deviations
- determine whether the difference between groups or statistically significant or not (e.g. t-test, analysis of variance)
- examine relationship among variables (e.g. correlation, multiple regression), and
- Graphs (e.g. bar charts, line graphs).

SPSS also contains several tools for manipulating data, including functions for recording data and computing new variables as well as merging and aggregating data sets.
In this study following analysis is carried out through SPSS Software:-

1. Descriptive Statistics: This includes frequency tabulation, arithmetic mean, standard deviation, minimum and maximum values of variables, etc.
2. Prediction for identifying groups: This includes factor analysis for Quality Management success factors and performance measurement factors.
3. Prediction for numerical outcomes: This includes multiple regression analysis.
   Test for significance between more than two groups: This includes Analysis of variance (ANOVA).

Internal Consistency Analysis

Reliability and detailed item analysis are used to refine the measures of factors of quality management. In particular, measurement items are evaluated and, if shown to detract from the reliability of the instrument, are eliminated.

Four methods are used to assess the reliability of empirical measurements: (1) the retest method, (2) the alternative form method, (3) the split-halves method, and (4) the internal consistency method. Of these, the first three have major limitations (particularly for field studies) such as requiring two independent administrations of the instrument on the same group of people or requiring two alternate forms of the measuring instrument. In contrast, the internal consistency method works quite well in field studies because it requires only one administration. Further, it is the most general form of reliability estimation. Hence, this method is chosen for this study.

The internal consistency of a set of measurement items refers to the degree to which items in the set are homogeneous. Internal consistency can be estimated using a reliability coefficient such as Cronbach's alpha.

Using the SPSS reliability program, an internal consistency analysis is performed separately for the items of each factor of Six Sigma quality management. The analysis revealed that maximization of the alpha coefficient would require eliminating some items for each factor. Table 3.2 reports the original sets of measurement items associated with the factors, the items dropped from the original sets to achieve maximization of alpha, and the reliability coefficients associated with the resulting scales. Maximization of the Cronbach value improved the reliability of the variables.

Sample Size

The formula can be written as:

$$N = \left(\frac{Z_{\alpha}}{E}\right)^2$$

where E is the "margin of error" (half the width, W). As an approximation, for 95% confidence, use the value of 2 for zα (instead of 1.96) –

$$N = \left(\frac{2S}{E}\right)^2$$

That is "twice the standard deviation over the margin of error, all squared". Now the standard deviation S is not available , hence it can be estimated, a rough approximation can be made using the six-sigma rule for bell-shaped distributions; the standard deviation is approximately the range (maximum minus minimum) divided by six.

$$S = \left(\frac{5-1}{6}\right) = 0.66$$

E is the error in prediction. It depends upon the how much error the researcher is willing to accept. In this case, I have fixed the value of E as .15 (15 %). Substituting all values in sample size equation

$$N = \left(\frac{2 \times 0.66}{0.15}\right)^2 = 77.44$$

Hence substituting all values, N = 77.44

To reduce the sampling errors, the researcher has chosen a sample size of 92 respondents.

4. DATA ANALYSIS AND RESULTS

Demographic Information

The Majority of the respondents are from top management. The designations include Manager, General Manager, Quality Manager and Director. The majority of the respondents have a very good length of services. The detail is given below.

Table 1: Job Position and Length of Service of Respondent

Sr. No	Minimum	Maximum	Avg.	Std.Dev
1	3	26	14.26	0.78

The average length of service is 14.26 years with a standard deviation of 0.78 years. The minimum length of service is 3 years and maximum length of service is 26 years.

Table 2: Analysis – Industry Category

	Frequency	Percent	Valid Percent	Cumulative Percent
Chemical Based	18	19.6	19.6	19.6
Engineering	9	9.8	9.8	29.3
Electrical/Electronics	2	2.2	2.2	31.5
Fertilizers	1	1.1	1.1	32.6
Manufacturing	56	60.9	60.9	93.5
Petrochemicals	1	1.1	1.1	94.6
Textile	4	4.3	4.3	98.9
Others	1	1.1	1.1	100.0
Total	92	100.0	100.0	

Internal Consistency Analysis Results for Success Factors of QM

Table 3: Internal Consistency Analysis Results for Success Factors of QM

Sr. no	Critical Success Factor of Quality Management	Number of items	Items deleted by numbers	Cronbach's Alfa α Value
Reliability Analysis : Critical Success factor – Quality Management				
1	Senior Executive/Top Management Commitment	07		0.855
2	Managerial process	02		0.765
3	TQM project selection, prioritization and project management	03		0.750
4	Knowledge, education and training	05	01 (Item no 5)	0.635 0.701(After deletion)
5	Role of the Quality Department	03		0.848
6	Product/Service Design	05	01 (Item no 5)	0.583 0.626(After deletion)
7	Customer satisfaction	03		0.828
8	Statistical product control (SPC) usage	05	01 (Item no 1)	0.559 0.641(After deletion)
9	Process Management	03		0.841
10	Quality data and reporting	02		0.828
11	Quality Cost	04		0.90
12	Benchmarking	02		0.892
13	Work Culture	03	01 (Item no 1)	0.526 0.818(After Deletion)

Table 4: Internal Consistency Analysis Results for Performance Factors of Quality Management

Sr. no	Performance factors of Quality Management	Number of items	Items deleted by numbers	Cronbach's Alfa α Value
Reliability Analysis : Performance Factors - Quality Management				
1	Customer Satisfaction	03	01 (Item no 2)	0.290 0.450 (After deletion)
2	Quality of product	03		0.801
3	Financial performance impact	07		0.738
4	Operating performance impact	06		0.768
5	Human Resource	05		0.378

Reliability Test

Reliability Analysis for Success Factors of Quality Management

To measure the reliability of items loading into one factor, cronbach's Alpha were calculated and shows table. For majority (except one) factor, the cronbach's Alpha value is more than 0.60 indicating that the factors are consistent and reliable. The factor no 11 has very poor alpha value and is not considered to be reliable. Hence it is neglected.

Table 5: Reliability Analysis for Success factors of Quality Management

Reliability Analysis		
Factors	**Cronbach's Alp**	**No. Of Item**
1	0.795	04
2	0.768	03
3	0.667	04
4	0.765	03
5	0.610	03
6	0.601	03
7	0.711	03
8	0.925	02
9	0.636	03
10	0.619	03
11	0.670	02

Reliability Analysis for Performance Measurement Factors

Relationship between Success Factors of Quality Management and Organizational Performance Measurement Factors

- Table shows the relationship between Success factors of quality management and organizational performance measurement factors after eleven multiple regression analysis.

To measure the reliability of items loading into one factor, cronbach's Alpha were calculated and shows table.

Table 6: Reliability Analysis for Performance Measurement Factors

Reliability Analysis		
Factors	**Cronbach's Alp**	**No. Of Item**
1	0.712	04
2	0.73	02
3	0.726	03
4	0.640	02
5	0.603	03
6	0.610	02
7	0.609	04
8	0.688	02
9	0.688	02
10	0.38	02
11	0.64	02

For majority of the factor, the cronbach's Alpha value is more than 0.60 indicating that the factors are consistent and highly reliable. The cronbach alpha value for factor 10 is 0.38 which is very poor indicating that the factor is not consistent.

Independent Variables	Dependent Variables Organizational Performan factors										
Success Factors	PF1	PF2	PF3	PF4	PF5	PF6	PF7	PF8	PF9	PF10	PF11
SF1	0.011	0.031	0.021	0.077	0.046	0.019	0.749	0.474	0.038	0.465	0.170
SF2	0.333	0.006	0.015	0.031	0.862	0.012	0.046	0.182	0.213	0.524	0.903
SF3	0.014	0.000	0.031	0.558	0.659	0.010	0.143	0.043	0.403	0.008	0.193
SF4	0.302	0.180	0.828	0.574	0.043	0.545	0.289	0.130	0.022	0.014	0.885
SF5	0.025	0.143	0.227	0.068	0.034	0.164	0.013	0.244	0.001	0.770	0.074
SF6	0.02	0.023	0.217	0.026	0.033	0.028	0.013	0.265	0.598	0.029	0.172
SF7	0.541	0.135	0.045	0.947	0.020	0.794	0.555	0.552	0.029	0.391	0.030
SF8	0.119	0.269	0.842	0.040	0.024	0.208	0.196	0.502	0.634	0.132	0.394
SF9	0.022	0.006	0.051	0.021	0.037	0.882	0.022	0.049	0.209	0.554	0.268
SF10	0.247	0.979	0.026	0.035	0.998	0.026	0.256	0.037	0.210	0.012	0.068
SF11	0.026	0.324	0.583	0.770	0.406	0.164	0.038	0.021	0.019	0.602	0.089
SF12	0.531	0.003	0.292	0.047	0.047	0.380	0.025	0.024	0.560	0.105	0.074

Table 7: Relationship between Success Factors of Quality Management and Organizational Performance Measurement Factors

Development of Quality Management Implementation Model for Performance Improvement of Process Equipment in South Gujarat Industries

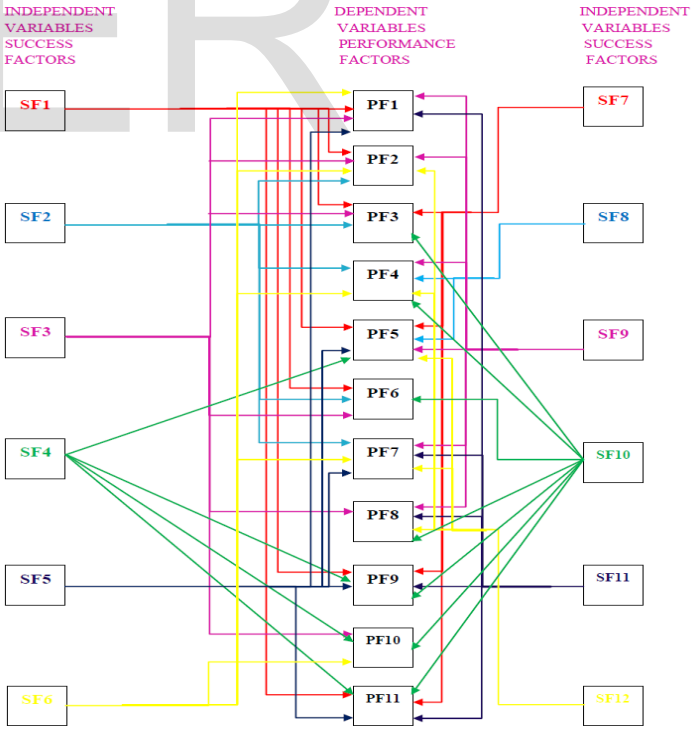

Figure 2: "Development of Quality Management Implementation Model for Performance Improvement of Process Equipment in South Gujarat Industries"

Predictive Ability of the Model

Since in Regression analysis, R^2 has been used as an indicator of predictive ability of the model. The developed model has a range of $R^2$4. starting from 0.321 to 0.567. Hence this model has a maximum predictive ability of 55 %. If industry adopts this model, then it can give predictive power of 35 to55 %.

Proposed Benefits of the Study

Through this research study following industries and academic benefits are expected

1. Critical Success Factors (CSFs) or success ingredients for Quality Management implementation for South Gujarat industries are discovered. In the context of Quality Management, it is essential that the organizations identify a few critical success factors, which should be given special attention for ensuring successful implementation of Quality Management program. Integration of the Critical Success Factors for Quality Management implementation will lead to improved organizational performance and thereby increased profitability and competitive position of the organization.
2. Performance Measures (Measurement Factors) for South Gujarat industries are discovered. The investment in quality must also translate into business results. For this, it is essential to evade a performance measurement system in line with Quality Management philosophy. There must be provisions of easily measurable and understandable performance indicators for both functional and cross-functional requirements at various levels. Simple and easy-to-understand, cross-functional performance indicators will help to integrate quality, productivity, responsiveness and flexibility in terms of cost and fully address customers' satisfaction.
3. South Gujarat Industries will be made aware of the breakthrough improvement capacity of Quality Management methodology by providing them Quality Management Performance Model. Consequently, it will help larger group of South Gujarat industries to utilize Quality Management to its full potential and bring organizational excellence for global competitiveness.

The results of this research will provide to South Gujarat Industries better understanding of Quality Management benefits and outcomes, insight into the Quality Management strategies, principles, tools and techniques and Quality Management key success factors as well. Based on these findings South Gujarat Industries management will be able to guide business and production processes in right directions with minimizing inputs, maximizing outputs and satisfy owners, employees and customers.

Conclusion

- Development of Quality Management Implementation Model for performance improvement of process equipment in South Gujarat Industries.
- It will provide useful guidelines to any size and type of industries to successfully implement Quality Management program in their organizations.
- The set of critical dimensions of Quality Management and performance measures of the organization are derived based on actual practices followed by South Gujarat Industries based on a statistically validated instrument and factor analysis.
- The South Gujarat Industries desirous of improving their Customer satisfaction, Cost of Quality, Operating Performance impact, Capital productivity, Financial performance impact, Reward for Quality, Product Quality, Employee suggestions, Cost of product, Product Reliability, Maintenance performance need to concentrate on critical success factors (CSFs) or core elements of Quality Management drive such as Role of Quality Department, Work Culture, Quality Data and Quality Cost, Senior Management Commitment, Statistical Process Control (SPC) Usage, Recognition and Rewards, Managerial Process, Project Selection, Prioritization and Project Management, Understanding of Quality Management

Philosophy, Product/Service Design, Benchmarking, Continual Improvement.

Future Scope of the Research

- Further research can be carried out regarding the contribution for the quality management organization in successful implementation of quality management drive in organization.
- The derive model can be tested in the other industries such as IT, Services etc.
- Further research can be carried out regarding the practices of Quality Management in different regions of the country and the results of the such study can be compared.
- Further study can be carried out regarding the involvement of the Top management, senior management and managers in successful implementation of Quality Management program.
- There is no standard method or model available for Quality Management deployment. Different Quality Management philosophies/practices help to organization's performance in different way. A study can be carried out regarding the all Quality Management aspects to improve the organizational performance.

Limitations of the Research

Following limitations may be considered during the research study

- Accuracy of the data depends upon the respondents. If they give their biased opinion then it can affect the result of the research study.
- The questionnaire responses received from Manufacturing, Chemical, Textile, Electricals/ Electronics, Petrochemicals and Fertilizers industries. So the limitation of this study was about to get the responses from the industries.
- Statistical methods have some limitations and these limitations applied to this study.

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