DEVELOPING AN ASSESSMENT TOOL FOR MEASURING TOTAL QUALITY MANAGEMENT: A CASE STUDY

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ABSTRACT

Many attempts were made in the past to measure the success or failure of total quality management (TQM) in organizations. Although there are many quality management theories and models in existence, all are imperfect, i.e. each has its own advantages and disadvantages. This paper aims at developing an assessment tool for measuring Total Quality Management (TQM) in the Power Generating Unit of an Oil Producing Company in Nigeria. Based on thorough review of some of the existing literatures in the field of TQM, this paper has identified nine TQM principles. A tool for measuring TQM in the Power Generating Unit of an Oil Producing Company in Nigeria has also been proposed, illustrating the relationship between the various identified TQM principles. Data was collected from managers, employees and customers of the company. The hypotheses stated have been tested using the Chi-square statistical tool. The findings of this paper revealed that employee involvement and empowerment coupled with teamwork is necessary in order for organizations to achieve their goals and quality programs, which includes customer focus and satisfaction. It is suggested that a formal TQM programme be established in the company and more principles of TQM that affects the Power Generation Unit be identified and further research work be done on the application of the proposed tool for other process industries.

1.0   Introduction

Today every organization has to study what is customer demand? Who is our customer? How to delight customers? What do customers wish to experience when dealing with you? What do customers frame in their memory about us? All these questions should be taken into consideration for, it is the customer who defines quality. Customer satisfaction is the motto of business. Cost, quality (incremental innovation), delivery and after sales service are heading towards parity across organizations.

Quality is becoming an essential aspect and in the coming years, it would be an essential requirement for the survival of an organization. Quality needs to be nurtured through positive attitude and culture in an organization.

Total Quality Management (TQM) is an enhancement to the traditional way of doing business. It is a proven technique to guarantee survival in world-class competition. Only by

changing the actions of management will the culture and actions of an entire organization be transformed (www.slideshare.net). TQM is simply applying common sense to management.

Total = Made up of the whole
Quality = Degree of excellence a product or service provides
Management = Act, art or manner of handling, controlling and directing, and so on.
Therefore, TQM can simply be thought of as managing the processes involved in an organization to achieve excellence.

1.1   TQM Principles
The principles of TQM create the foundation for developing an organization's system for planning, controlling and improving quality (Waldman, 1994). Research has shown that there are many TQM principles commonly found in TQM literatures (Vouzas and Psychogios, 2007). However, for the purpose of this paper, nine key TQM principles have been identified and used to formulate our assessment tool. These principles are:
- Total employee involvement
- Continuous improvement
- Continuous training
- Teamwork
- Employee empowerment
- Top-management commitment
- Participative management style
- Customer satisfaction
- Culture change

1.2   Aim and Objectives of the Study

The main aim of this paper is to develop an assessment tool for measuring Total Quality Management.

The primary objectives of this study include to:

1. Develop an assessment tool for measuring TQM in the Power Generation Unit of an Oil Producing Company in Nigeria.

2. Create a better employee awareness of TQM.

3. Improve the level of TQM implementation in the power generation unit of the Oil Producing Company.

2.0   Methodology

2.1   Population of the Study
The target population is a finite population, with fixed boundaries, described by time, geography and the characteristics of the individual members composing it, as well as the nature of the variables being studied (Ezeoguzie, 2005). For the purpose of this paper, the target population has been identified as the Power Generation Unit of an Oil Producing Company in Nigeria. This will serve as the case study.

TQM involves managers, employees and customers. For this reason and also for the fact that sampling the whole company's managers, employees and customers will be cumbersome, the sampled population will be some of the company's managers, employees and customers randomly selected to represent the general characteristic of the case study site. Table 1 below shows the sampled population under survey.

Table 1: Population survey

Category	Managers	Employees	Customers	Total
Population	20	20	20	60

2.2   Types of Data and Sources

The data used in this paper can be classified into primary and secondary data, Primary data are data that were collected in the fieldwork and survey at the unit of enquiry. This primary data are otherwise called raw data and are processed during data presentation and analysis stage. Secondary data are statistical data or information, which were not initiated during the research work, but were collected from other published records such as gazettes, books, journals, seminars, workshops, and so on. The sources of data used in this paper work can be classified into two broad categories according to the distinction of primary and secondary data.

2.3   Method of Data Collection

The method of data collection is divided into collection of primary data and collection of secondary data.

2.3.1   Primary Data Collection

The methods of collection of primary data in this paper work are:

a) **Questionnaire:**
In this paper, questionnaires were distributed and collected. This is the main source of data used in the analysis. The questionnaires were distributed to managers, technicians, artisans, apprentices and customers of the Oil Producing Company. For each statement, the respondents were requested to select only one position among a scale that has four categories (1 = not satisfactory,   2 = somewhat satisfactory, 3 = satisfactory,   4 = very satisfactory). A copy of the questionnaire is attached in Appendix 1 in the main work.

b) **Observations and Unstructured Interviews:**
Unstructured interviews and one-on-one interviews were conducted on the issue of TQM in the company with members of staff and other stakeholders on the subject. This is a vital source of the perceptions of managers and employees.

c) **Internet:** the internet was consulted for information.

2.3.2   Secondary Data Collection

For the purpose of this paper, some textbooks, journals, seminar papers, dictionary, publications and some unpublished materials, and so on were consulted.

2.4   Contingency Table

A contingency table can be defined as an array of natural numbers in matrix form where those natural numbers represent counts or frequencies (Ezeoguzie, 2005). The frequency table is presented as Table 2 below:

Table 2: Cell frequencies

Row	1	2	Column j		Total
1	X_{11}	X_{12}	X_{ij}	X_{1c}	X_1
2	X_{21}	X_{22}	$X2$	X_{2c}	X_2
:	:	:	:	:	:
1	X_{i1}	X_{i2}	X_{ij}	X_{rc}	X_i
:	:	:	:	:	:
References	X_{r1}	X_{r2}	X_{rj}	X_{rc}	X_r
Total	X.1	X.2	X.J	X.C	Xn.n

where X_i = frequency total from i^{th} row

X_j = frequency total from j^{th} row

The expected frequency is calculated from the formula:

$$Xij = \frac{n\{xi\}\{xj\}}{\{n\}\{n\}} = \frac{xi\,xj}{n} \qquad (1)$$

2.5   Chi-Square Test

The Chi-square denoted by the Greek letter X^2 is often used to test hypothesis concerning the difference between a set of observed frequencies of a sample and its corresponding set of expected or theoretical frequencies. A value is calculated from the data using chi-square procedure (this value is called the calculated Chi-square denoted by X^2_{cal}) and then compared to a critical value from a chi-square table (this value is called the tabulated Chi-square denoted as X^2_{tab}) at the chosen level of significance and degree of freedom. The formula used in evaluation of data using chi-square method is given as:

$$\mathbf{X^2}_{cal} = \sum_{i=1}^{n} \frac{(X - \bar{X})^2}{\bar{X}} \qquad (2)$$

where, X^2 = calculated Chi-square
n = total number of observation
X = observed value
$\bar{X}$ = expected value

The Chi-square distribution table from which the value of X^2_{tab} is determined is given in Appendix 2 of the main research work.

2.6 Calculation of the Expected Value

From the frequency table given above (Table 2), the value of the expected value (X_2) is calculated as follows:

$$\bar{X}_{ij} = \frac{Xi \times Xj}{X\ n.n} \qquad (3)$$

where $\bar{X}_{ij}$ expected value for i^{th} row and j^{th} column,

X_i = frequency total from i^{th} row

X_j = frequency total from j^{th} column

For example, to determine the value of X_2 for row 1 column 1, we have;

$$\bar{X}_{11} = \frac{X1 \times X1}{X\ n.n} \qquad (4)$$

while for row 1 column 2, we have;

$$\bar{X}_{11} = \frac{X1 \times X2}{X\ n.n} \qquad (5)$$

2.7 Degree of freedom

The degree of freedom (df) *is* used to get the expected frequency and is given by the fomular;

$$df = \text{degree of freedom} = (r-1)\,(c-1) \qquad (6)$$

where:

r = number of rows

c = number of columns

2.8 Decision Rule or Test of Hypothesis

Test for hypothesis is the test performed in order to verify whether a hypothesis is true or false. The Null hypothesis is the hypothesis that is being tested and it is denoted as H_0. The hypothesis that we are willing to accept if we reject the null hypothesis is the Alternative hypothesis denoted as H_A. The decision rule states that H_0 is accepted if X^2_{cal} is less than X^2_{tab}. Otherwise, H_A is accepted mathematically.

$X^2_{cal} < X^2_{tab}$ ---------------- accept H_0

$X^2_{cal} > X^2_{tab}$ ---------------- reject H_0

2.9 Data Gathering and Analysis

The final questionnaires were made up of forty-five (45) questions. Six (6) questions for top management commitment, three (3) questions for employee involvement, five (5) questions for continuous training, four (4) questions for employee empowerment, seven (7) questions for teamwork, four (4) questions for culture change, four (4) questions for continuous improvement, six (6) questions for employee satisfaction and six (6) questions for customer focus and satisfaction. The analysis of the investigation was carried out with Chi-square and decision rule.

2.10   Summary of Methodology:

- In order to understand what TQM is all about, the first step was to expound the theory and concepts that underlie TQM concept. This was done through an extensive review of the literature and subsequent identification of the critical factor that it is intended to measure.
- An assessment tool was carefully developed in form of a questionnaire incorporating the 9 TQM principles discussed.
- A total of 20 managers, 20 employees and 20 customers were approached from whom 19 managers, 20 employees and 18 customers correctly completed questionnaires have been received, yielding a response rate of 95%.
- For the data derived from the administered questionnaire, the contingency table and chi-square were used. The data gathered was summarized in a frequency table. Five (5) hypotheses were developed and Chi-square was used to test the hypotheses.

3.0   Results and Discussion

A total of 20 managers, 20 employees and 20 customers have been approached from whom 19 managers, 20 employees and 18 customers correctly completed questionnaires have been received, yielding a response rate of 95%. Table 3 shows the number of managers, employees and customers and the corresponding number of respondents who have participated in the study.

Table 3: Distribution of respondents

Category	Managers	Employees	Customers	Total
Number of People	20	20	20	60
Number of Respondents	19	20	18	57

In this analysis, five hypotheses are drawn based on the TQM principles incorporated in the Oil Producing Company's vision statement which includes employee involvement, employee empowerment, teamwork, continuous improvement, customer focus and satisfaction. The hypotheses are:

Hypothesis One
Ho: Employees should be involved in the company's quality programmes.

Hypothesis Two
Ho: Employees should be fully empowered in the company.

Hypothesis Three
Ho: Teamwork is necessary for achieving the company's organizational goals

Hypothesis Four
Ho: Continuous improvement is promoted at all levels of the company.

Hypothesis Five

Ho: Customer focus is a driving force behind day-to-day operations in the company.

3.1   Response Analysis

This section gives a summary of the responses to the questions in the survey. For each section, that is, the nine TQM principles, the number of respondents and the percentage of responses to each question are given. The percentage of response is calculated from the formula:

$$Percentage\ Rating = \frac{No.\ of\ Response}{Response\ Count} \times 100\% \qquad (7)$$

The rating average is calculated by dividing the summation of the number of responses multiplied by the ranking in each likert scale by the response count. The full response summary for the 57 correct responses is also attached as Appendix 3 of the main research work.

3.2   Chi-Square Analysis of Data and Test of Hypothesis

In line with the data presented above from response received, the evaluation and analysis of data and test of significance begins. The Chi-square model will be used.

3.2.1   Test of Hypothesis One

To test this hypothesis, question 1 on employee involvement is used. The response from managers, employees and customers to question 1 of employee involvement is shown graphically in Figure 1.

Ho: Employees should be involved in EGTL quality programmes.
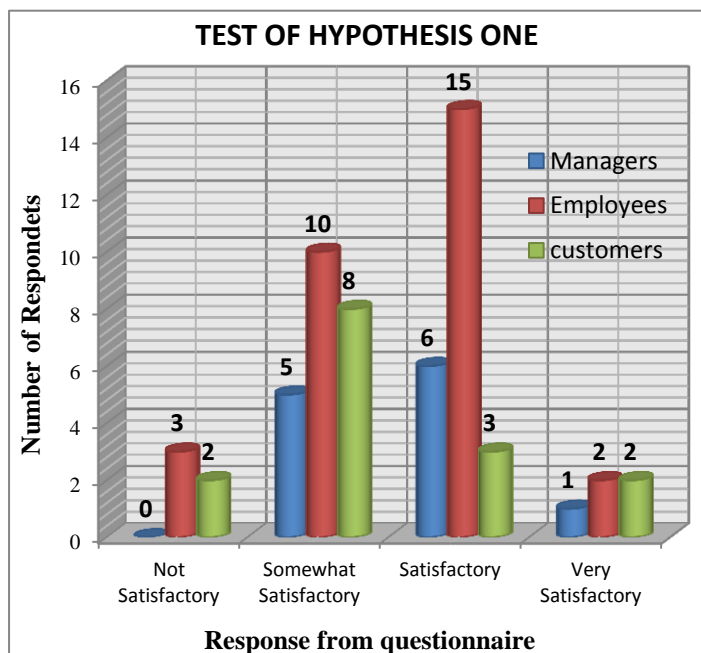H_A: Employees should not be involved in EGTL quality programmes.

Figure 1: Graphical presentation of the respondents to Hypothesis One

From evaluation of hypothesis one, X^2_{tab} is higher than X^2_{cal}, that is, $12.592 > 5.32$, we accept the null hypothesis (Ho) and conclude that employees should be involved in the company's quality programs.

3.2.2 Test of Hypothesis Two

To test this hypothesis, question 1 on employee empowerment is used. The response from managers, employees and customers to question 1 of employee empowerment is summarized in Figure 2.

Ho: Employees should be fully empowered in the company.
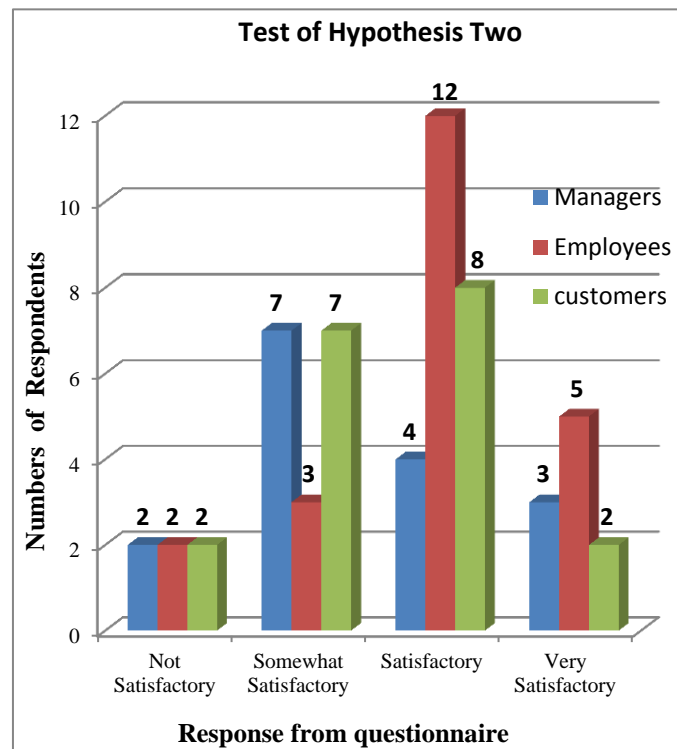H_A: Employees should not be empowered in the company.

Figure 2: Graphical presentation of the respondents to Hypothesis Two.

From evaluation of hypothesis two, X^2_{tab} is higher than X^2_{cal} , that is, $12.592 > 6.18$, we accept the null hypothesis (Ho) and conclude that employees should be fully empowered in the company.

3.2.3 Test of Hypothesis Three

To test this hypothesis, question 5 on teamwork is used. The response from managers, employees and customers to question 5 of teamwork is summarized in Figure 3 and this is used to analyze the hypothesis.

Ho: Teamwork is necessary for achieving the company's organizational goals.
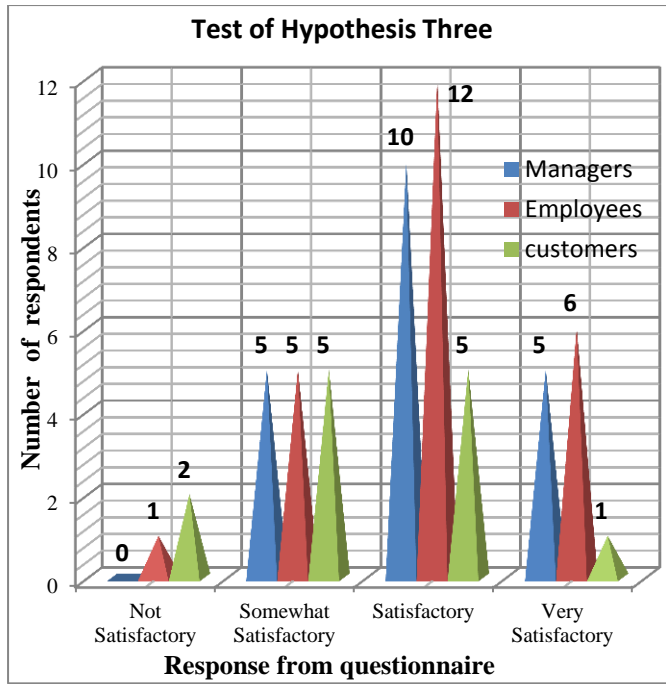H_A: Teamwork is not necessary for achieving the company's organizational goals.

Figure 3: Graphical presentation of the respondents to Hypothesis Three

From evaluation of hypothesis three, X^2_{tab} is higher than X^2_{cal}, that is, $12.592 > 6.39$, we accept the null hypothesis (Ho) and conclude that teamwork is necessary for achieving the company's organizational goals.

3.2.4   Test of Hypothesis Four

To test this hypothesis, question 1 on continuous improvement is used. The response from managers, employees and customers to question 1 of continuous improvement is summarized in Figure 4 and this is used to analyze the hypothesis.

Ho: Continuous improvement is promoted at all levels of the company.
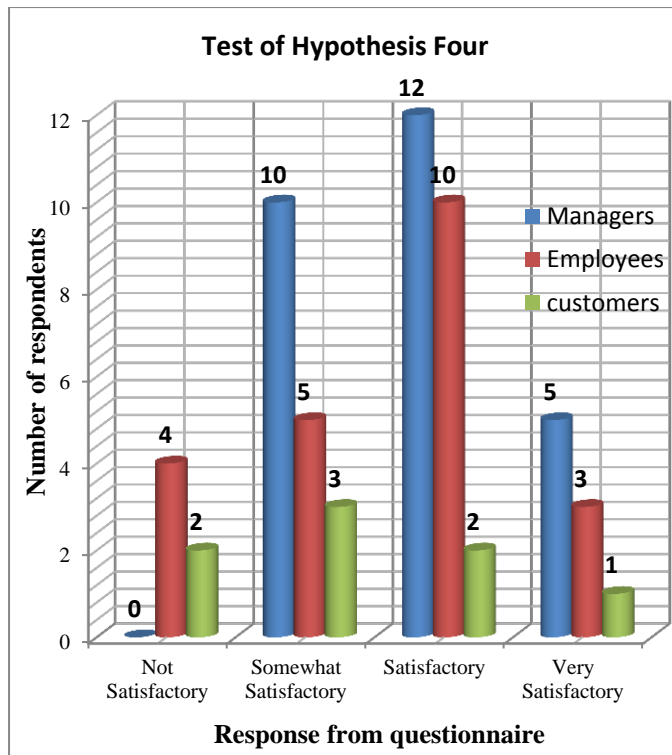H_A: Continuous improvement is not promoted at all levels of the company.

Figure 4: Graphical presentation of the respondents to Hypothesis Four

From evaluation of hypothesis four, X^2_{tab} is higher than X^2_{cal}, that is, 12.592 > 7.44, we accept the null hypothesis (Ho) and conclude that continuous improvement is promoted at all levels of the company.

3.2.5 Test of Hypothesis Five

To test this hypothesis, question 1 on customer focus and satisfaction is used. The response from managers, employees and customers to question I of customer focus and satisfaction is summarized in Figure 5 and this is used to analyze the hypothesis.

Ho: Customer focus is a driving force behind day-to-day operations in the company.
H_A: Customer focus is not a driving force behind day-today operations in the company.
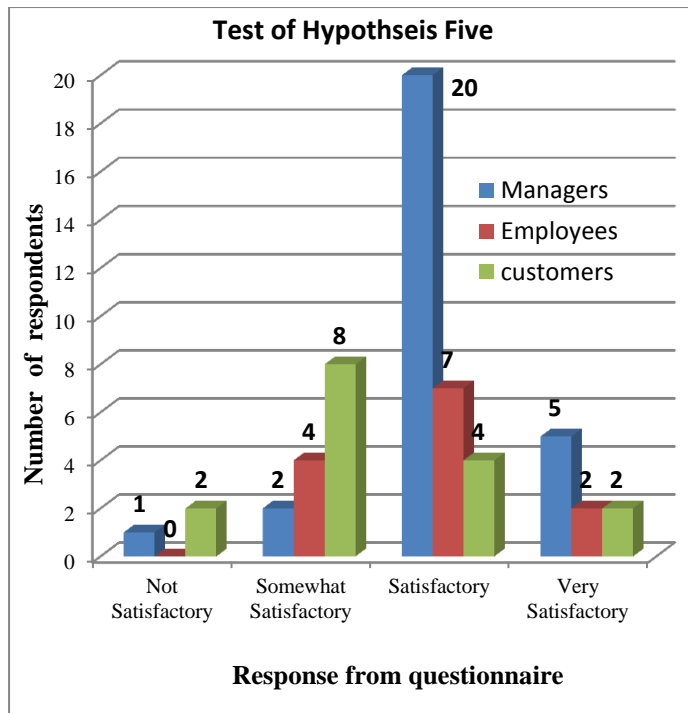
Figure 5: Graphical presentation of the respondents to Hypothesis Five

From evaluation of hypothesis five, X^2_{tab} is higher than X^2_{cal}, that is, $12.592 > 7.38$, we accept the null hypothesis (Ho) and conclude that customer focus is a driving force behind day-to-day operations in the company.

3.3 Discussion of Findings
In view of identified problems, objectives and the research hypothesis of this study, questionnaires were carefully developed and administered to the sample population to support the investigation. The response scores from the sample population were analyzed with a vision to empirical discoveries.

The five hypotheses linked some of the identified principles of TQM with the case study company. Hypothesis one looks at employee involvement. There is low level of employee awareness of TQM in the company which reduces their involvement in the company's quality programmes. This is validated by the data analysis, which establishes hypothesis one of this paper.

The result of data analysis of hypothesis two indicates that X^2_{tab} is greater than X^2_{cal} which indicates employees should be fully empowered in the company. Wherever TQM operates, staff should be actively involved and empowered in managing quality and playing an important part in management decision-making. Without staff involvement and empowerment, TQM will become ineffective and will grind to a halt (Ezeoguzie, 2005).

Hypothesis three concludes that teamwork is necessary for achieving the company's organizational goals, while hypothesis four concludes that continuous improvement is promoted at all levels of the company. Hypothesis five finally concludes that customer focus and satisfaction is a driving force behind the day-to-day operations in the company.

The implications of the findings of this paper to the company is that with customer satisfaction being the main objective of the organization and the culture of continuous improvement being imbibed, employees should be more involved and better empowered in order for the company to gain a competitive advantage over her competitors.

4.0   Conclusion

A comprehensive TQM assessment tool with specific focus on the power generation unit of the oil producing company in Nigeria has been developed and validated based on data collected from managers, employees and customers of EGTL. This assessment tool (with due modifications depending on the specific industry) could effectively be used by researchers and practitioners to measure the level of TQM implementation in other process industries.

Employee involvement and empowerment, amongst others, are aspects of TQM that has been lacking in the company. There is also lack of employee awareness of the concept of TQM. This research has helped in creating better employee awareness as more employees now have a better knowledge of what TQM is all about. Finally, this paper attempts to add value to the literature by contributing to the establishment of a tool for assessing TQM.

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