

# Application of Total Quality Management (TQM) and Statistical Process Control (SPC) in Improving Business Competitiveness for Manufacturing Organizations

Ignatio Madanhire, and Charles Mbohwa

**Abstract**---The success of TQM and SPC as a boost to business competitiveness has had its own share of controversies. Many organizations all over the world have embarked on the TQM journey, with their process under statistical control, to achieve increased competitiveness, some recorded success while others regretted ever embarking on such a journey. The purpose of this research study is to determine if the myth of TQM and SPC in enhancing business competitiveness is true for Zimbabwean manufacturing organizations.

**Keywords**--Quality, competitiveness, TQM, manufacturing, SPC

## I. INTRODUCTION

ORGANIZATIONS all over the world have embarked on use of TQM to beat competitive forces in terms of business aspects. Quality award recipients have shown better results than comparable 'average companies', Eriksson and Hansson (2003), thus making TQM an efficient means of navigating the increasing competitiveness of a borderless world. With the ever increasing business world competition, survival and existence depends on how organizations are set to increase and sustain their competitive advantage. Some of the ways of achieving competition advantage include, but not limited to, cost reductions, shortening of process and marketing response times, maintenance of good cordial relationships with suppliers and the continuous improvement of both products and processes.

## II. LITERATURE REVIEW

With high exposure to the global markets, the consumer of today is thus exerting intense demand for high quality goods at low prices. In order to survive in such markets it is therefore rational for any manufacturing company that wishes to be competitive in the globalized market place to focus on production that is of consistently accepted high quality, offered at competitive pricing level. Hence, the manufacturing firms seek to adopt and implement a set of tried and tested business management practices.

Ignatio Madanhire is with Dept of Mechanical, Faculty of Engineering of Engineering, University of Zimbabwe, Harare, Zimbabwe (Phone: +263 712 453 451, email: [imadhanire@eng.uz.ac.zw](mailto:imadhanire@eng.uz.ac.zw))

Charles Mbohwa is with Dept of Quality and Operations Management, Faculty of Engineering and The Built Environment, University of Johannesburg, Auckland Park 2006, South Africa (Phone: +27 782071516, email: [cmbohwa@uj.ac.za](mailto:cmbohwa@uj.ac.za))

One form of operation management practices is TQM which has received great attention in the last decades (Jung and Wang, cited in Salaheldin, 2009).

TQM has become a pervasive element of business strategy, allowing companies to accurately monitor, control, analyse, manage and improve their processes, in real time, thus allowing them to make corrective actions which would result in the enhancement of their competitive advantages.

From whatever angle TQM is looked at, the point of emphasis is customer satisfaction through continued improvement of products and services. According to Deming, quality is a continuous quality improvement process towards predictable degree of non variability and dependability (Oakland, 2003:4). Juran defined quality as "fitness for use." meaning "every person in the organization must be involved in the effort to make products or services that are fit for use" (Oakland, 2003:4). Crosby defined quality as conformance to requirements (Oakland, 2003:4). His focus has been on zero defects and doing it right the first time. Ishikawa also emphasized importance of total quality control to improve organizational performance, this meant, quality does not only mean the quality of products, but also of after sales service, quality of management, the company itself and the human life. Feigenbaum defined total quality as a continuous work processes, starting with customer requirements and ending with customer's satisfaction. (Oakland, 2003:4).

The creation of the total quality management philosophy is generally attributed to Dr. W. Edwards Deming (1900-1993). Together with Shewhart, a statistician, Deming came up and introduced a statistically controlled management into the Japanese ailing manufacturing sector. Statistical process control (SPC) provided a way of determining when variations exist in a process, thus triggering process intervention. In Japan many manufacturing companies embraced the technique of SPC with great success for tackling quality related problems, thus allowing the country to become an influential force in world trade by the 1980s. The Fig. 1 below, adopted from Mason and Antony, 2000, shows where SPC fits into the TQM competitiveness scenario.

To achieve competitiveness through TQM, three hard management necessities are required, a good management system, tools such as SPC and teamwork. From Fig. 1, underneath the umbrella of TQM, SPC, plays a crucial role of controlling and managing a process through the use of statistical methods (Dale, 1994 cited in Antony, Balbontin and Taner, 2000). The key purpose of SPC is not really about

statistics or control, it is about improving business competitiveness, by eliminating causes of process variation.

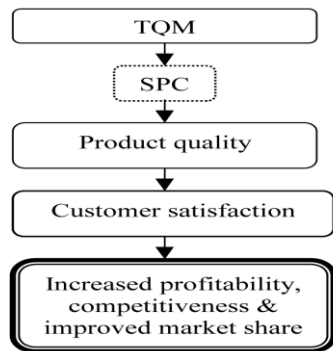


Fig. 1 SPC and TQM relationship to competitiveness

SPC is a strategy for reducing variability, the cause of most quality problems (Oakland 2003). SPC is a statistical technique that is widely used to ensure that the process meet standards (Heizer and Render, 2008:222). To be able to predict performance and determine the process ability to meet customer expectations, the process is first expected to be brought into statistical control by detecting and eliminating assignable causes of variation. Process control is vital and SPC should form a vital component part of a company-wide adoption of 'total quality' and act as the focal point of never-ending improvement in business performance (Oakland 2003:16). Kanji (2002), says "it is difficult to measure the performance of an organization, nevertheless it is crucial for an organization". Kanji (2002) further pointed out that, "we must measure, to be able to take the right actions". What is important to an organization should be measured, with both hard and soft measurements (Kanji, 2002:7). According to Bourne, Neely, Mills and Platts (cited Franco-Santos, Kennerly, Micheli, Martinez, Marr, Bernard, Gray and Neely 2007), BPM refers to the use of a multi-dimensional set of performance measures for the planning and management of a business". Maisel (cited in Franco- Santos et al, 2007) stated that a BPM system enables an enterprise to plan, measure, and control its performance and helps ensure that business activities are aligned with business strategies to achieve desired business result. Traditionally business performance measures have been derived from cost accounting information often based on outdated and arbitrary principles (Oakland, 2004: 136). This had little motivation to support quality management and, in some cases, actually inhibit continuous improvement because they are unable to map onto process performance. BPM measures can be classified as financial or non financial.

### III. JUSTIFICATION OF STUDY

Locally based, Zimbabwe manufacturing entities continue to face viability challenges and competition from cheap imports finding their way into the country through porous borders (CZI report, 2012). Business with better competitive strategies will live to see the next day. Few would argue that meeting both increasing global competition and increased customer demand

have become extremely important challenges facing many manufacturing companies. In an economy faced with high liquidity constraints, lack of long term financing for industrial recapitalization, deteriorating infrastructure, policy inconsistency as well as uncertainty in the business environment (CZI report, 2012).

From the CZI report of 2012, the Zimbabwean manufacturing sector has continued to face problems, and among them is a high production cost emanating from lack of export competitiveness on the international market. The low drive in competitiveness has had a negative impact on capacity utilization. The same report has indicated that failure to meet quality requirements of international buyers, has been one reason why some local manufacturing companies have failed to prevail on the market.

### IV. METHODOLOGY

The population of interest in this study was the manufacturing companies, who had some TQM systems running or those at an advanced stage of quality management systems implementation. A sample of 15 firms, of various sizes, was randomly selected from a total of 28 who were meeting the criterion. The firms were drawn from five major cities of the country. A manager familiar with TQM program and six employees were surveyed in each firm. Primary data was collected through mail using a questionnaire, a discrete five point-scale likert scale with end points of strongly disagree (=1) and strongly agree (=5). Statistical secondary data, as supplied by the sample companies was also used to measure the effectiveness of TQM in achieving business competitiveness for the organisations.

### V. DATA ANALYSIS

For this research, data was analysed for trends and conclusions were also made based on the analysis of numeric data, thus both inferential and descriptive statistics were used in this research.

#### A. Data validity and reliability

The two major types of validity used in this research are, content validity, and construct validity. Content validity was subjectively judged by the researcher. To address content validity in this study, a thorough review of available TQM and SPC literature together with business performance measurement were conducted. Furthermore, the original questionnaire was submitted to business and TQM experts to get an expert opinion on the content of the questionnaire. The construct validity describes how the investigation as an entity can be generalized in an appropriate way. This study was based on a theoretical framework that is built on well-known TQM gurus, thus allowing the work to be generalized.

#### B. Results and discussion

##### Process Optimization

##### i) Production waste

Production waste analysis was done to ascertain how much TQM can contribute to the reduction of production waste, and, how much of raw materials is converted into the final product.

Changes in production wastes were considered to be positively related to changes in quality costs (COQ). The higher the costs the higher were production waste. From the questionnaire results, 21% of the respondents strongly agreed that as a result of TQM production wastes reduced, and some of the responses are as shown in Fig 1.

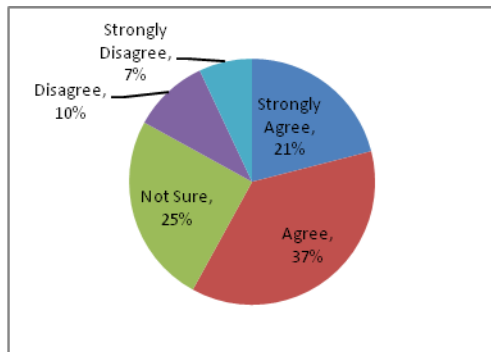


Fig.1 Production waste survey responses

In support of primary data, secondary data results revealed that COQ was, on average, 45 % of sales revenue against a target of 30% in the first year of TQM adoption, and it dropped to 43.5% a year later. A significant reduction to 27% was recorded two years after the inception of TQM. For most of the companies investigated, the fourth year recorded a COQ average of 15.9%, giving an average total reduction, in COQ, of 29% in a period of four years.

ii) *Costs of Production*

Analysing the effects of TQM on costs of production was aimed at determining the effectiveness of TQM in promoting production efficiencies. Forty two percent of the respondents strongly identified TQM, in their systems, with improved efficiencies. Only 4% strongly disagreed of any positive changes on efficiencies as a result of TQM adoption.

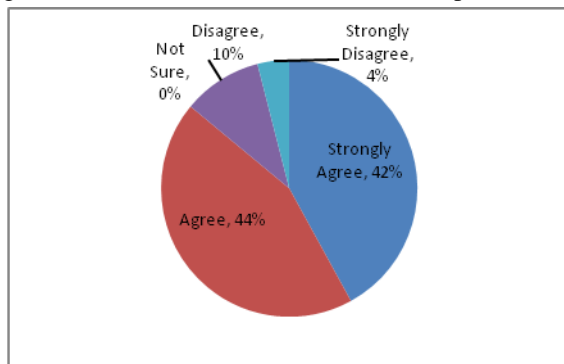


Fig. 2 Costs of production responses

Basing costs of production on the use of a single factor of production, that is labour, secondary data analysis showed a fall in production costs, from 69.2% to 67.8% between the first two years of TQM adoption. A more noticeable decline, of 13.8%, was realized between the second and third years. The fourth year recorded a 49% cost of labour, against an average target of 45%.

iii) *Process Time*

Process time represents the period in which one or more inputs are transformed into a finished product by a manufacturing procedure (Porter, 2011). TQM adoption was aimed at reducing this process time to the minimum possible. As a result of TQM 86% respondents realized some improvements in their processing time.

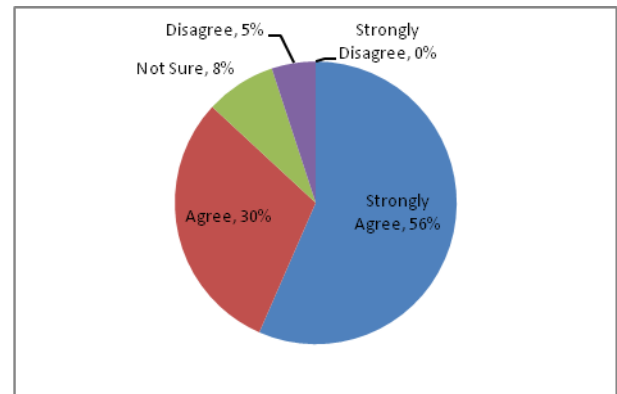


Fig.3 Processes time responses

Secondary data was in consistency with survey results. In one particular case, the first year of TQM adoption recorded a 37 hour time period to complete one batch, the second year recorded an 11 hour drop in processing time, to 26 hours, the fourth year recorded an even lower processing time of 21 hours, a process efficiency improvement of 43%, in a four year period.

*Measuring the Effects of TQM on Product Quality*

i) *Product Quality*

A total of 62% respondents were in total agreement that TQM systems, in their companies, helped in improving product, only 4% strongly disagreed of such effect.

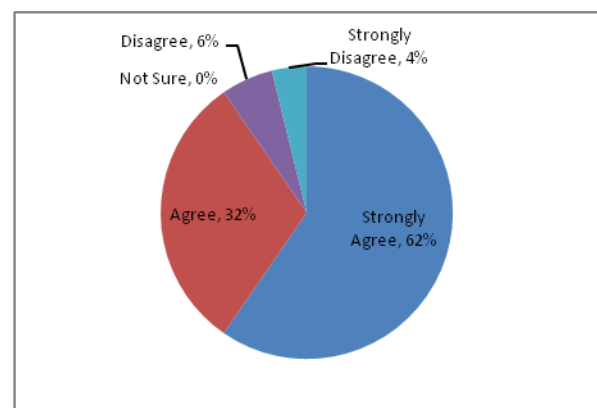


Fig 4 Product quality responses

An analysis of quality records strengthened and supported the positive effects of TQM on product quality. There was a reduction in product defects from, an average of, 18% in the first year of TQM adoption to 6%, of total production, in the fourth year.

ii) *Product Returns*

Low product return signifies high levels of TQM effectiveness. The purpose of this question is to determine if

the results from this study supported previously recognized TQM literature, that TQM improves product quality, thus reducing the rate of product rejection, and the questionnaire results came out as follows;

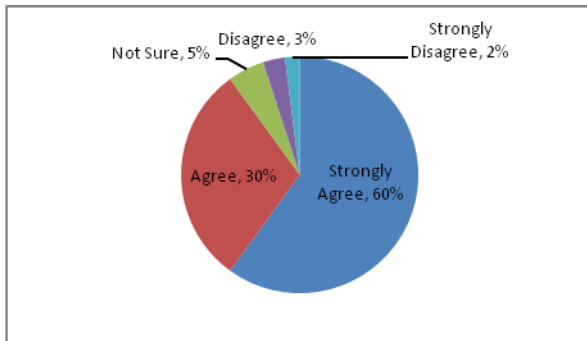


Fig.5 Product returns responses

An analysis of secondary data did confirm the theory and survey results. In the first years of TQM adoption, failure and or rejection rate stood at 2%, the figure fell to 1.6%, 1% and finally to 0.6% in second, third and fourth year respectively. The drop in failure rate was literally translated into improved product quality thus a reduction in product returns.

iii) Levels of reworks

Rework is a cost to the company in terms of labour, material and time. The purpose of measuring the level of reworks is to ascertain the extent to which TQM has helped in rework reduction, thus proving its suitability as a tool in enhancing competitive advantage, through costs reduction. Ninety seven percent of the respondents were positive that their companies were recording a reduction in the levels of rework, with only 3% disagreeing that TQM has brought about a reduction in reworks.

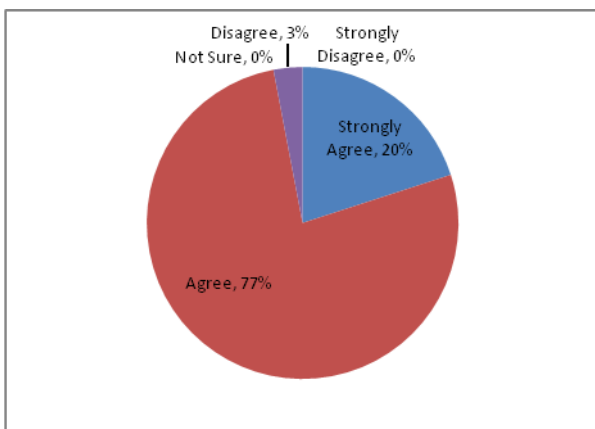


Fig.6 Level of reworks responses

Secondary data, supported survey results, reworks fell substantially from 8% to 7.4 % between the first and second years of TQM inception in company systems. The figure fell, to 5%, between the second and third, was followed by a drastic one in fourth, where reworks were at 2.0% of total production.

iv) Customer Complaints

The purpose of measuring customer complaints was to determine how attractive the business products had become

with the adoption of TQM. The higher the number of complaints the less attractive the business offerings were. Twenty two percent of the respondents strongly agreed that their organizations were recording less, than before, complaints since the adoption of TQM, with 14% strongly disagreeing to this effect. Two percent were however not sure of the effects of TQM towards customer complaints.

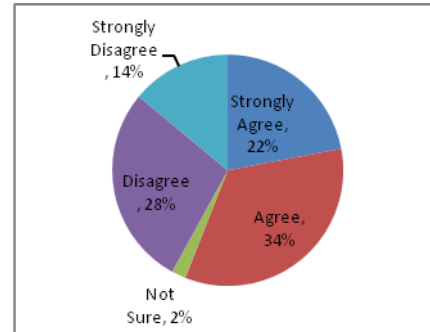


Fig. 7 Customer complaints responses

Secondary data analysis revealed that in the first year of TQM adoption, a total of 108 complaints were recorded, for all the survey companies. Complaints increased to 138, a year after. With the maturing of TQM, complaints fell to 98 in the third year, with the fourth year recording 72 complaints.

Determining the Impact of TQM on Sales

The questionnaire responses on the impact of TQM on sales are as follows;

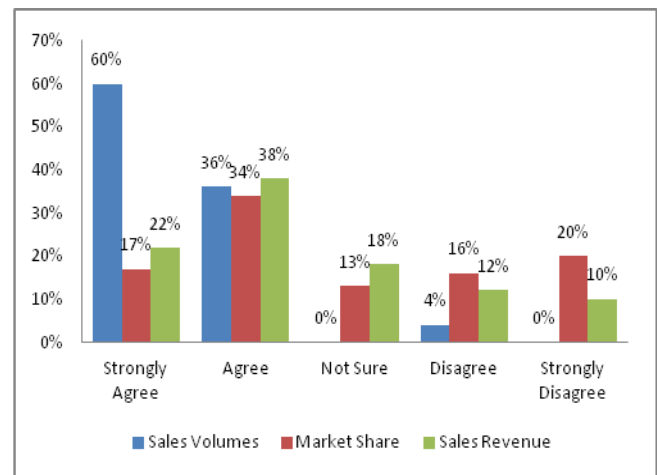


Fig.8 Impact of TQM on sales

In consistency with survey results, secondary data depicts a rapid positive increment in sales market share and a continued improvement in sales revenue. The fall in production costs, improved efficiencies, and improved product quality positively influenced customer satisfaction, thus resulting in increased sales, for TQM was creating an enabling working environment that affected business operations positively. The positive trend, in all performance indices under sales is evidence that with TQM competitiveness is enhanced.

Assessing TQM contribution on stakeholder relationships

An organization's success depends increasingly on the knowledge, skills, innovation, creativity and motivation of its employees and partners (Kanji, 2002: 58). Eight percent of the

respondents are in recognition of the existence of the effects of their TQM systems in building good relations between their companies and all their stakeholders. Eighteen percent have however not managed to realize this effect, with 2% not sure of any contribution that their TQM systems has done in creating good organizational and stakeholder relationships.

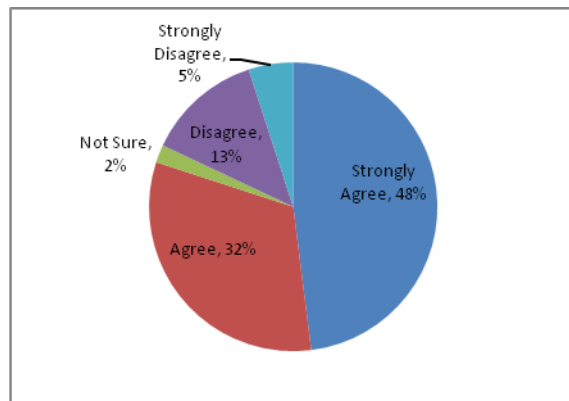


Fig.9 Stakeholder relationship responses

## VI. DISCUSSION

Process optimization, product quality, sales and stakeholder relationship were measured from the feedback of study sample respondents, by means of questionnaire and historical data. From the results, the majority agreed that production waste reduced as a result of TQM. The same is true with costs of production, a majority of 86% supported the point that with TQM costs will reduce. It was also supported by 87% of the respondents that process time reduced as a result of TQM. The same goes for all the other elements measured, defect rate, return and reworks, sales volumes and partner relationships had all above 80% confirmation that they improved as a result of TQM. Areas of concern were noticed on the responses on customer complaints, sales revenues and market share, were positive response average between 50% and 60%. Only quality managers and a few employees responded positively to these elements, thus showing that the questions might have been a challenge to most. Secondary data came in support of literature, and it has thus been concluded that a TQM system statistically controlled is an enabler of competitive advantage to the Zimbabwean manufacturing companies.

## VII. RECOMMENDATIONS

The findings of this study are in consistent with the findings of the previous researches, which supports the point that a combination of TQM and SPC adaptation enhances business competitiveness. It is thus recommended that TQM and SPC guided by performance indices should be adopted for business performance enhancement.

## VIII. CONCLUSION

TQM calls for major organizational commitment, effort and resources and there is need of clear evidence that it enhances business competitiveness. To recognize this success the process needs to be kept under a rigorous statistical control process for continuous monitoring, control and measurement,

thus allowing variation monitoring and controlling. The study combines the Deming, MBNQA and the EQA excellence models to form performance indices of TQM success and putting the whole process under statistical control to determine the effect of TQM on enhancing competitive advantage of the sample manufacturing companies. The main objective, of the study, was to provide empirical evidence on the possible outcomes that may be expected from those companies willing to adopt TQM and SPC. It is concluded that TQM enhances competitiveness through improved process optimization, improved product quality and improved stakeholder relationships.

## REFERENCES

- [1] Antony, J, Balbontin, A and Taner, T ., Key ingredients for the effective implementation of statistical process control, *Business Process Management Journal*, 49 (6) pp. 242-247, 2000.
- [2] Franco-Santo, M, Kennerly, M, Micheli, P, Martinez, V, Mason, S, Marr, B, Gray, D and Neely, A., *Towards a Definition of a Business Performance Measurement System*, *International Journal of Operations and Production Management*, 27(8), pp. 784- 801, 2007
- [3] Heizer, J and Render, B., *Operation Management*. 9th Edition. New Jersey. Pearson Education, 2008.
- [4] Kanji, G.K., *Measuring Business Excellence*. London. Taylor and Francis, 2002.
- [5] Mason, B Jiju Antony, J., *Statistical process control: an essential ingredient for improving service and manufacturing quality*, *Managing Service Quality*, 10 (4) pp. 233 – 238, 2000.
- [6] Oakland, J.S., *Oakland on Quality Management*. United Kingdom. Butterworth Heinemann, 2004.
- [7] Salaheldin, I., *Critical success factors for TQM implementation and their impact on performance of SMEs*, *International Journal of Productivity and Performance Management*, 58 (3) pp. 215 – 237, 2009.
- [8] Oakland, J.S., *Oakland on Quality Management*. United Kingdom. Butterworth Heinemann, 2002.
- [9] Shenawy, E.E., Baker, T. and Lemak, D.J., *A Meta- Analysis of the Effect of TQM on Competitive Advantage*. *International Journal of Quality and Reliability Management*, 24(5),pp. 442- 471, 2007.
- [10]Tan, K.C., "A Comparative Study of 16 National Awards". *Total Quality Magazine*, 14 (3), pp. 165- 167, 2002.