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Role of monitoring and controlling quality in total quality management (TQM)

Abstract

As a result of increasing competition, organizations have realized the importance of using technological advances in bringing about continuous improvement in quality, thereby securing increased customer satisfaction and loyalty as well as sustainable development. This study aims to assess managerial perceptions of the extent and nature of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) that takes place in the organization in efforts to achieve total quality management. Biographical influences on these managerial perceptions are also assessed. A sample of 202 managers (middle, senior, top) was drawn using a stratified random sampling technique. Data was collected using a pre-coded, self-developed questionnaire whose psychometric properties were assessed using Factor Analysis and Cronbach's Coefficient Alpha respectively. Data was analyzed using descriptive and inferential statistics. The findings reflect that managers believe that monitoring and controlling quality takes place at a moderate pace in the organization with the greatest focus being on competitive benchmarking, followed by continuous monitoring of sources of defects and lastly, on statistical quality control. Based on the empirical analysis, since all action plans for monitoring and controlling quality in the organization reflect areas for improvement in bringing about total quality management, a graphical representation is outlined to recommend strategies for enhanced monitoring and controlling of quality and the accomplishment of TQM.

Keywords: monitoring and controlling quality, competitive benchmarking, continuous monitoring of sources of defects, statistical quality control, statistical process control, total quality management.
JEL Classification: L23.

Introduction

The continued recognition of quality and quality control is the core of business leverage, strategic goals and challenges faced by today's competitive work environment. This solution building organizational perspective calls for a review on quality requirements for organizations to secure a place in today's aggressive global markets. Globally, burgeoning literature maps out core and engaging information on managing quality in all spheres of organizational activities. This information flow compels managers to continuously rethink the relevant action plans to monitor and control quality whilst acknowledging that a certain amount of variability is normal. Quality management has set boundaries and, specific building blocks for competitive challenge and continuous improvement. Quality, a determinant of success, is more than a basic either/or proposition of product and service quality needs analysis (Kreitner, 2007). A total quality management (TQM) process is needed to introduce and sustain a quality drive. Inherent in the TQM initiative is change management and culture change and, management practices and behaviors are needed with the new culture. Organizational change can be systematized and embraced by a change program. Change management forces organizations to view employees as internal customers who will be affected by the change and to position itself to optimally address the needs of its external customers. Change can only be strategic if it focuses on, and addresses the needs of, the customer, market, product/service, or technological opportunities and challenges (Evans, 2005). Ultimately, the entire effort needs to focus on enhancing organizational performance and optimizing quality service delivery. To enhance organizational performance and superior service, this study delves into managerial perceptions of the role of monitoring and controlling quality in efforts to achieve total quality management.

The TQM approach with its strategic intent steers organizations to be efficient and effective (Schultz, Bagraim, Potgieter, Viedge & Werner, 2003), and places strong emphasis on collaborations for process improvement and ultimate customer satisfaction. To win a new customer may take five times more than it does to keep a present one but the strategic challenge regarding service is to anticipate and exceed customer expectations (Kreitner, 2007). Customers judge products and services, and will favour the ones that reach high standards (Anyamele, 2005). Hence, the key drivers for monitoring and controlling quality are to block out harmful obstacles which have become symbolic in reflecting how competitive advantage is achieved and how to move into new domains and fuel competitive goals and objectives. Responsibility and accountability for quality processes should be the focus (Dale, van der Wiele & van Iwaarden, 2007).

Employees, considered as assets, deliver quality products or services for organizational performance (Ijaz, Kee & Irfan, 2012). Engaged with these precepts, a spirit of idealism needs to be at the helm to weave commitment and dedication. TQM's key elements entail customer focus, teamwork, continuous improvement through ongoing performance measurement and a reduction of reworks, amongst others (Yang, 2005, cited in Ijaz, Kee & Irfan, 2012). The five distinct service characteristics portrayed by Kreitner (2007) is direct participation with customers in the production process, immediate consumption of service, the provision of services where and when the customer requires, the tendency for services to be labor-intensive, and for services to be intangible. Whilst less waste, faster cycle times and flexibility are avenues for continuous improvement (Kreitner, 2007), monitoring and controlling quality is the centrefold in business activities. Quality control of a service is to watch it unfold whilst simultaneously evaluating it with the consumer's judgement and the validity of the comparison is the satisfaction level of the customer (McGregor, 2004, cited in Kreitner, 2007). Tools such as benchmarking and control charts are evident features of the long-term drive for continuous improvement (Kreitner, 2007).

High levels of productivity and high quality results in a long-term competitive strength. Deming's work draws on "Shewhart's concept of statistical process control" (Kelemen, 2003, p. 25), whose message to the Japanese is that variability is within any process which is due to special causes and common causes. Special causes are assignable, identifiable and solvable, whereas common causes relate to "design and operation and only management can eliminate" (Kelemen, 2003, p. 25). TQM and its interconnected practices of performance measurement, such as "statistical process control (SPC), quality circles, benchmarking and business process re-engineering, and ISO 9000 certification" (Yang, Chang, Niu & Wu, 2008, p. 430) are adopted in many industries.

1. Competitive benchmarking

Benchmarking which involves searching for industry best practices results in superior performance (Belcourt, McBey, Hong & Yap, 2013; Evans & Lindsay, 2005). Benchmarking of processes is as important as the analysis of product and development, and is a strategic organizational tool that accomplishes organizational goals and enhances transparency (Braadbaart, 2007). Its measurement standard for performance and a best-in-class achievement (Punniyamoorthi & Murali, 2006) enables a company to measure its performance against that of the best performing companies in the industry, and assesses how industry leaders accomplish such performance levels. Via benchmarking, the following can be accomplished: a review of processes, practices and systems; motivation for higher performance through targets for improvement; display of comparative data with 'best-in-class organizations' and stimulation of improved ways of operating (Belcourt et al., 2013). A salient point is the focus on 'high-visibility key processes' with the possibility of a high return on investment; hence, the benchmarking practice is encouraged (Dale et al., 2007). With organizational comparisons, improvement opportunities may emerge. With focus on processes instead of people, a culture of blaming others would be removed.

The level of values for organizations is that after data collection and comparison, the gaps will be obvious as the best organization might have metrics, for example a six-week processing time whereas your organization may process in twelve weeks (Belcourt et al., 2013). The gap impedes service providers from delivering quality service and may be of different types: the knowledge gap exists between consumer expectations and management perceptions, the standards gap occur between management perception and service quality specifications, the delivery gap is between service quality specifications and the service delivered, the communications gap takes place between the service delivered and the service promised and the overall gap occurs between the expected service and the experienced service (Chatterjee & Chatterjee, 2005). Such analysis enables a company to assess performance gaps, which serve as a springboard for setting realistic goals and ensuring continuous creativity, innovation and improvement. Hence, competitive benchmarking equips a company to identify its strengths and weaknesses and those of other industry leaders, and to learn how to integrate the best practices into its own operations in terms of setting targets, developing strategies and engaging in implementation. TQM and benchmarking highlight product quality index with follow-up action for evaluation and TQM emphasizes the correction to reduce defect rates (Cheng, 2008). Furthermore, the American Productivity and Quality Center and the European Foundation for Quality Management are explicitly engaged in promoting and training in benchmarking as an essential approach to achieve excellence (Dervitsiotis, 2000).

The benchmarking technique, a 'breakthrough improvement' and the implementation of best practices is often not enough as the best at certain practices are from diverse areas. This technique needs to be instituted into a company's culture to improve continuously (Dale et al., 2007).

2. Monitoring of sources of defects

Performance measurement, a key principle of TQM, is imperative when monitoring sources of defects. A defect is a non-conformance on one of numerous possible quality characteristics of an item that causes customer dissatisfaction and may be categorized as a critical defect, major defect or a minor defect (Evans & Lindsay, 2005; Gitlow, Oppenheim, Oppenheim & Levine, 2005). Zero defects, a performance standard, means mistake-free or error-free (Crosby, 2006), and few quality standards call for perfection. It does not mean that mistakes will not occur, but defects are not acceptable (Crosby, 2006). Crosby's concept of the zero defects theme which is within the framework of his quality absolutes is to 'do it right the first time' by preventing defects instead of finding and fixing them. This concept or performance standard gained popularity (Davies, 2001) and refers to quality as conformance to requirements.

A common occurrence is that without clarity, employees will select the performance standard they think will best suit the leader. Inconsistencies on the performance standard will emerge in the quality of products and services. The zero defects concept must infiltrate organization-wide (Crosby, 2006). Since perfection cannot always be achieved, a popular world-wide business concept to improving quality, namely Six Sigma, measures the extent to which a process varies from perfection (Bank, 2000) and its focus is product quality measurement. It uses a business improvement strategy that aims to find and eliminate causes of defects and errors in manufacturing and service processes by focusing on outputs that are critical to customers and ensure a clear profit for the organization (Evans, 2005; Harry & Schroeder, 2000, cited in Jeffery, 2005). Six Sigma's objectives are to attain reliability and value for customers; hence, all organizations aim to have their processes at a "Six Sigma level of capability" (Evans, 2005, p. 84). Six Sigma has distinct features, such as planned tools and philosophies, cost-reduction, and is organized around creating champions (Foster, 2004). Six Sigma has also increased the imperatives of statistics and with a focus on, for example, measurable results; a structured statistical approach to problem solving makes it a dynamic methodology for the impro-vement process. In service organizations, the application of Six Sigma requires the examination of measures of performance which are accuracy, cycle time, cost and customer satisfaction (Evans, 2005) with tremendous focus on employee participation. Evidently, Six Sigma shows acceptance of a few defects (Crosby, 2006). Whilst critical defects need close observation including monitoring and control, minor defects do not as they are still useable. Where quality improvement is the focus, defect detection and inspection on a mass basis is not good enough. In a TQ environment, the aim is to constantly improve processes so that products and services are within the specification range, are of quality and have zero defects.

Furthermore, quality indicates conformance to requirements and not elegance (Evans, 2005), and task completion follows measurements to determine conformance. Quality begins in functional departments (responsible for problems), and not in quality departments. The quality department's task is to measure conformance, report results, and lead the initiative for a positive quality improvement attitude (Evans, 2005). Non-conformance takes place at the expense of quality and results in added cost, thereby attracting the managers' attention to take corrective action leading to ultimate improvement and recognition of achievement.

The experts use measurement in different ways. With Crosby and Juran the cost of quality is viewed as the "focus of measurement", whereas Deming emphasizes quantitative methods and statistical methods as a means of analyzing and improving the production process. Deming uses measurements of process variation to establish whether processes are stable. Juran's definition of quality is 'fitness for use'. Many scholars corroborate to the concepts and principles of zero defects. It is critical to align product features and products free from deficiencies and to instil this culture into employees. Meeting customer expectations is Juran's strong viewpoint (Suarez, 1992). Juran and Deming argue that it is futile, if not hypocritical, to exhort a line worker to produce perfection because the extremely large amounts of imperfections are linked to poorly designed manufacturing systems which is beyond the workers' control (Evans, 2005).

The priorities to reach zero defects include: performing to the leader's standards, conforming to the requirements, quality as an absolute, clear quality standards with products and services, ensuring proper attitudes to prevent errors, having the required ability and timeously finding solutions to problems in the work environment, quality as the employer's responsibility, and the performance standard must be adopted and made known (Crosby, 2006). Crosby (2006) emphasizes further that zero defects are sound and it always works, and managers need to adopt and publicize this organization-wide.

3. Statistical quality control and statistical process control techniques

A certain amount of variability will always exist with production processes and this may emerge because of assignable causes (can be discovered and eliminated) or chance causes (cannot be eliminated) (Lakshmi & Ramesh, 2012). The utilization of statistical techniques determines the presence of assignable cause and signals to make a process adjustment to avoid out-of-control situations (Lakshmi & Ramesh, 2012). The authors deduce that in some instances the control chart techniques were not successful which may be due to technical reasons but the non-conformance of normality is the main one. The non-parametric methods (easier to conduct) seem more applicable. In their study, Lakshmi & Ramesh (2012) use sign test and run test for application in quality control. They concluded that the non-parametric test can be a hand for a layman before deploying the traditional statistical techniques for the control of quality of materials produced.

Quality control techniques are important in all sectors, including the service industry. Bin Jumah, Burt & Buttram (2012) believe that using Lean Six Sigma in, for example, banking is of benefit, as in using statistical process control (SPC) in trading machines. To cope globally, service industries need efficiency with operational processes. Statistical quality control (SQC) control approaches provide tools, for example, control charts for monitoring processes. SQC was introduced by Deming and Juran who convinced managers in Japan that continuously controlling and improving quality would lead to improved productivity, to new world markets and to survival (Evans & Lindsay, 2005). Walter Shewhart who introduced SQC charts maintains that the process expands beyond inspection to focus on identifying and eradicating the problems in the production processes that cause defects (Evans & Lindsay, 2005). SQC approaches provide tools for monitoring and detection of anomalies and assists employees by keeping 'key quality measurements' in a range that is acceptable. Furthermore, a control chart monitors actual and desired quality measurements for operations that are repetitive.

Furthermore, statistical process control (SPC), a method of fault detection (Yang, Chang, Niu & Wu, 2008), is a methodology for process monitoring to identify special causes of variation and to signal the need to take corrective action appropriately. It gives a rational basis for applying statistical thinking to controlling processes, thereby enhancing consistency of output (Evans, 2005). Failing to implement and operate SPC effectively can hinder an organization's ability to meet product specifications, reduce the cost of production and improve quality, amongst others (Goetsch & Davis, 1994, cited in Yang et al., 2008). Simply, the SPC statistical technique monitors to reduce production variation. Decades have foreseen the use of SPC to improve quality processes and products in quality management (Bergman & Klefsjo, 2003, cited in Bergquist & Albing, 2006). The SPC quality improvement technique quantifies the performance of a process over a period of time. It tracks the process output to ascertain the variation that exists and to determine whether performance targets are met with the process. Control charts, a segment of SPC, aid in tracking the consistent calculation of statistical information and detects changes that are of significance in a process, and with the detection of special cause action it can eliminate the form of variation (Boe, Riley & Parson, 2009).

A salient point is that apart from the manufacturing industry, statistical methods have been utilized in other forms of problems, for example, to understand the needs and behavior of customers (Green & Srinivasan, 1978, cited in Bergquist & Albing, 2006). Evidently, statistical methods have 'found appli-cations in service' (Mason & Antony, 2000, cited in Bergquist & Albing, 2006) and this use of statistical methods is also "amplified by the broadened focus of Six Sigma" (Hoerl, 2001, cited in Bergquist & Albing, 2006, p. 962). The comprehension, use and applicability of statistical methods are imperative. Customers may request proof of SPC control from organizations, thereby enabling them to display their ability to deliver quality, which is much needed for survival in a highly competitive corporate environment.

Those concepts that are developed within the process control realms have indicated that close loop systems have superior performance with regard to maintaining the service level requirements (SLR) and "rejecting disturbances than the corresponding open loop systems" (Shaikh & Prabhu, 2009, p. 2786). An advantageous approach to increase performance would be to close the loop between planning and execution. Furthermore, software agents are required to add dual capabilities of monitoring and notification (the detection of discrepancies between planning and execution and indicating alerts) and responding (to determine an appropriate correction action) (Shaikh & Prabhu, 2009). Having a consistent and reliable SPC is important and the tools/techniques form an imperative part of the overall quality management strategy.

Moreover, whilst strategic management concentrates on internal requirements TQM focuses on statistical process control to ensure continuous improvement (Vinzant & Vinzant, 1996). The link between TQM and strategic planning is that strategic planning must be customer driven, and must precede TQM initiatives, and results must be the focus to ensure long-term success.

4. Aims of the study

This study aims to assess managerial perceptions of the extent and nature of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) that takes place in the organization in efforts to achieve total quality management. Biographical influences on these managerial perceptions are also assessed.

5. Research design

5.1. Research approach. The research methodology has been designed to assess the importance of monitoring and controlling quality in order to accomplish total quality management (TQM).

5.2. Respondents. The population comprised of middle, senior and top management in a large public sector department in eThekweni (Durban) in South Africa. The population comprised of approximately 400 managers. The sample of 202 subjects was drawn using a stratified random sampling technique to ensure proportionate representation from the strata of the designated groups of interest, that is, managers. According to the population-to-sample size table by Sekaran (2003), the corresponding minimum sample size for a population of 400 is 196, thereby confirming the adequacy of the sample size for this study. In terms of the composition, 12.9% of the sample consisted of top managers, 32.7% were senior managers and 54.4% were middle managers. In addition, 29.7% of the respondents were 50 years and older, 39.1% were between 40-49 years, and 24.8% were between 30-39 years with only 6.4% being below 30 years. Indian respondents made up 39.1% of the respondents, followed by Whites (34.7%), Blacks (19.8%) and Coloureds (6.4%). In terms of tenure, 24.8% of the respondents worked in the organization for 21 years and over, 16.8% served for 16-20 years, 27.2% for 11-15 years, 21.3% served for a term of 6-10 years and only 9.9% were between 0-5 years in the company. The majority of the subjects have a postgraduate degree/s (40.6%), followed by those who hold a first degree (24.3%), those who have a diploma certificate (16.3%), a postgraduate diploma certificate (10.4%) and 8.4% who have between Standard 8-10 (Grade 10-12). The majority of the subjects were males (85.1%) with only 14.9% being females, thereby indicating the disproportionate percentage of females to males in management. The adequacy of the sample was further determined using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.758) and the Bartlett's Test of Spherecity (1429.264, $p = 0.000$) for the sub-dimensions of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) which respectively indicated suitability and significance. The results indicate that the normality and homoscedasticity preconditions are satisfied.

5.3. Measuring instrument. Data was collected using a self-developed questionnaire consisting of Section A (biographical information) and Section B included items relating to the sub-dimensions of monitoring and controlling quality. The biographical data in Section A was collected using a nominal scale with pre-coded option categories and the items in Sections B were measured using a 5-point Likert scale ranging from strongly disagree (1), disagree (2), neither agree/nor disagree (3), agree (4) to strongly agree (5). The questionnaire was formulated on the basis of identifying recurring themes that surfaced during the literature review and the 20 items included in the questionnaire related directly to the constructs being measured (10 items related to competitive benchmarking, 3 items pertained to continuous monitoring of sources of defects and 7 items related to statistical quality control). This ensured face, content and construct validity. Furthermore, in-house pretesting was adopted to assess the suitability of the instrument. Pilot testing was also carried out using 12 subjects, selected using the same procedures and protocols adopted for the larger sample. The feedback from the pilot testing confirmed that the questionnaire was appropriate in terms of relevance and construction.

5.4. Statistical measures of the questionnaire. The validity of the questionnaire was assessed using Factor Analysis. A principal component analysis was used to extract initial factors and an iterated principal factor analysis was performed using SPSS with an Orthogonal Varimax Rotation. Only items with loadings > 0.4 were considered to be significant and when items were significantly loaded on more than one factor only that with the highest value was selected. In terms of the sub-dimensions of monitoring and controlling quality (Section B), three factors with latent roots greater than unity were extracted from the factor loading matrix. Factor 1 related to statistical quality control and accounted for 16.17% of the total variance, Factor 2 related to continuous monitoring of sources of defects and accounted for 15.47% of the total variance and Factor 3 related to competitive benchmarking and accounted for 14.63% of the total variance in monitoring and controlling quality to achieve total quality management. The reliability of Section B of the questionnaire relating to the sub-dimensions of monitoring and controlling quality was determined using Cronbach's Coefficient Alpha (Alpha = 0.854). This alpha coefficient indicates a very high level of internal consistency of the items and hence, a high degree of reliability. The reliabilities for the individual sub-dimensions of monitoring and controlling quality were also assessed. Whilst competitive benchmarking (Alpha = 0.760) and statistical quality control (Alpha = 0.789) reflected strong reliabilities, the inter-item consistency for continuous monitoring of sources of defects (Alpha = 0.483) displayed a moderate level of reliability.

5.5. Administration of the measuring instrument. The questionnaires were administered over a three month period and respondents could either post the questionnaire in the attached self-addressed envelope or send them electronically to the researchers.

5.6. Statistical analysis. Descriptive (means, standard deviations) and inferential (correlation, ANOVA, *t*-test, Post Hoc Scheffe's test) statistics were used to analyze the quantitative data. The data was captured using Excel (Version 5), processed with Symstat and presented using tabular representations.

5.7. Results. Managerial perceptions of efforts in the organization to monitor and control quality in order to enhance total quality management were assessed in terms of assessing the extent to which the organization engages in competitive benchmarking, continuous monitoring of sources of defects and statistical quality control (Table 1).

Table 1. Descriptive statistics – monitoring and controlling quality

Statistic	Monitoring and controlling quality			
	Overall	Competitive benchmarking	Continuous monitoring of sources of defects	Statistical quality control
Mean	3.1729	3.2640	3.2600	3.0157
95% confidence (Lower bound)	3.0887	3.1738	3.1560	2.9058
Interval for mean (Upper bound)	3.2572	3.3542	3.3640	3.1257
Variance	0.354	0.418	0.556	0.622
Std. deviation	0.5951	0.64660	0.74585	0.78857
Minimum	1.40	1.20	1.00	0.57
Maximum	4.45	4.80	5.00	5.00

Overall, managerial perceptions of monitoring and controlling quality to achieve total quality management is fairly positive (Mean = 3.1729). In this organization, the focus on competitive benchmarking (Mean = 3.2640) and continuous monitoring of sources of defects (Mean = 3.2600) are almost equal, followed by statistical quality control (Mean = 3.0157). Against a maximum attainable score of 5, there is room for improvement in each of the sub-dimensions.

Frequency analyses were computed to obtain greater insight into these managerial perceptions. With regards to competitive benchmarking, 65.3% of the managers agreed and a further 5.4% strongly agreed that they find that action plans are developed to ensure improvement. Furthermore, 63.4% of the managers either agreed or strongly agreed that the organization incorporates best practices into its operations in terms of setting targets. However, 12.4% of the managers either disagreed or strongly disagreed that with benchmarking, their organization sets realistic goals. Furthermore, 9.4% of the managers disagreed that their organization incurporates best practices into its operations in terms of developing strategies and another 37.1% were not convinced about this. Also, 9.4% of the managers disagreed that with benchmarking action plans are developed to ensure innovation and another 41.6% were not convinced about this. In addition, 38.7% of the managers were unsure that with benchmarking, action plans are developed to ensure creativity.

With regards to continuous monitoring of sources of defects, 60.4% of the managers agreed and a further 7.4% strongly agreed that by observing, monitoring and controlling sources of defects, the occurrences of defects are eliminated. However, a substantial 64.2% of the managers were not convinced that in the organization, the improvement processes in total quality is continuous so that where applicable the concept of zero defects is maintained.

With regards to statistical quality conrol, whilst 57% of the managers find control charts to be of importance to establish a state of statistical control, 53% did not find control charts to be of importance to monitor a process to identify special causes of variation and to take correction action when needed and 62.4% did not find them to be important in determining process capability. Furthermore, managers were not convinced that the practice in their organization is to control (65.4%) or improve (65.9%) quality by using statistical quality control charts. Also, 57.4% of the managers did not feel that the tools/techniques used in quality control are an integral part of the overall TQM strategy of the organization.

Hypothesis 1: The sub-dimensions of monitoring and controlling quality that contribute to total quality management (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly correlate with each other (Table 2).

Table 2. Intercorrelation – sub-dimensions of monitoring and controlling quality

Sub-dimension	Competitive benchmarking	Continuous monitoring of sources of defects	Statistical quality control
Competitive benchmarking	1		
Continuous monitoring of sources of defects	0.567 0.000*	1	
Statistical quality control	0.542 0.000*	0.388 0.000*	1

Note: * $p < 0.01$.

Table 2 indicates that the sub-dimensions of monitoring and controlling quality that contribute to total quality management (competitive benchmarking, continuous monitoring of sources of defects, statistical quality control) significantly correlate with each other at the 1% level of significance. Hence, hypothesis 1 may be accepted. The implication is that an improvement or change in any one sub-dimension has the potential to impact on the other sub-dimensions thereby, influencing total quality management. The combined improvement of all the sub-dimensions will have a snowballing effect and exponentially contribute to monitoring and controlling quality and hence, the realization of TQM.

Hypothesis 2: There is a significant difference in the perceptions of managers varying in biographical data (position, age, race, tenure, academic qualification, gender) regarding each of the sub-dimensions of monitoring and controlling quality that have the potential to contribute to total quality management (Tables 3-5).

Table 3. ANOVA and *t*-test – biographical variables and sub-dimensions of monitoring and controlling quality

Monitoring and controlling quality and sub-dimensions	ANOVA										*t*-test		
	Current position		Age		Race		Tenure		Academic qualifications		Gender		
	F	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*F*	*p*	*t*	*df*	*p*
Monitoring and controlling quality	5.552	0.005*	0.627	0.598	1.381	0.250	1.248	0.292	2.503	0.044**	-1.035	196	0.302
Competitive benchmarking	8.072	0.000*	1.998	0.116	1.327	0.267	1.244	0.294	1.434	0.224	-0.312	195	0.756
Continuous monitoring of sources of defects	0.949	0.389	0.286	0.835	2.500	0.061	0.308	0.872	0.957	0.432	0.773	195	0.441
Statistical quality control	2.443	0.089	0.414	0.743	1.199	0.311	1.608	0.174	2.641	0.035**	-0.165	196	0.869

Note: * $p < 0.01$, ** $p < 0.05$.

Table 3 indicates that the perceptions of managers varying in position (top, senior, middle managers) regarding monitoring and controlling quality and competitive benchmarking respectively, differs significantly at the 1% level of significance. Furthermore, academic qualifications of managers also significantly influence their perceptions of monitoring and controlling quality and statistical quality control at the 5% level of significance. No other significant biographical influences were noted in Table 3. Hence, hypothesis 2 may only be partially accepted. In order to assess exactly where these significant differences lie, the Post Hoc Scheffe's test was computed (Tables 4-5).

Table 4. Post Hoc Scheffe's test – current position and dimension and sub-dimensions of monitoring and controlling quality (multiple comparisons)

Dependent variable	(I) Current position	(J) Current position	Mean difference (I-J)	*p*
Monitoring and controlling quality	Top manager	Middle manager	0.412	0.001*
Competitive benchmarking	Top manager	Senior manager Middle manager	0.348 0.533	0.017** 0.000*

Dimension and sub-dimensions of monitoring and controlling quality		Top manager	Senior manager	Middle manager
Monitoring and controlling quality	*N* Mean Std. dev.	26 3.487 0.459	66 3.223 0.573	110 3.075 0.612
Competitive benchmarking	*N* Mean Std. dev.	26 3.669 0.522	66 3.322 0.662	110 3.136 0.621

Notes: * The mean difference is significant at the 0.01 level. ** The mean difference is significant at the 0.05 level.

The mean differences in the Post Hoc Scheffe's test results (Table 4) indicate that top managers (Mean = = 3.487) differ significantly from middle managers (Mean = 3.075) with regards to monitoring and controlling quality. Top managers strongly believe that monitoring and controlling quality occurs in the organization in attempts to ensure total quality management as compared to middle managers. With regards to competitive benchmarking, top managers (Mean = 3.669) differ significantly from senior managers (Mean = 3.322) and to a large extent from middle managers (Mean = 3.136). Top managers' perceptions of competitive benchmarking as a mechanism to bring about total quality management are more positive in comparison to senior managers and middle managers in the organization.

Table 5. Post Hoc Scheffe's test – academic qualifications and dimension and sub-dimensions of monitoring and controlling quality (multiple comparisons)

Dependent variable	(I) Academic qualifications	(J) Academic qualifications	Mean difference (I-J)	p
Monitoring and controlling quality	Post-graduate degree/s	Standard 8-10	0.429	0.012*
		Diploma/Certificate	0.253	0.037*
	Post-graduate diploma/certificate	Standard 8-10	0.427	0.035*
Statistical quality control	Post-graduate degree/s	Standard 8-10	0.558	0.011*
		Diploma/Certificate	0.394	0.014*

Dimension and sub-dimensions of monitoring and controlling quality		Standard 8-10	Diploma/certificate	Undergraduate degree	Post-graduate degree	Post-graduate diploma/certificate
Monitoring and controlling quality	*N*	15	33	49	82	21
	Mean	2.864	3.041	3.146	3.293	3.291
	Std. dev.	0.793	0.748	0.437	0.553	0.525
Statistical quality control	*N*	15	33	49	82	21
	Mean	2.623	2.792	3.009	3.186	3.075
	Std. dev.	1.101	1.071	0.589	0.702	0.627

Notes: * The mean difference is significant at the 0.05 level.

The mean differences in the Post Hoc Scheffe's Test results (Table 5) indicate that managers who have post-graduate degree/s (Mean = 3.293) differ significantly from managers who have Standard 8-10 (Mean = 2.864) and from managers who have a Diploma/Certificate (Mean = 3.041) in terms of monitoring and controlling quality in the organization. The results reflect that managers who have a post-graduate degree/s have more positive perceptions about the role of monitoring and controlling quality in TQM as compared to managers who have a Diploma/Certificate or Standard 8-10. Furthermore, with regards to monitoring and controlling quality, there is a significant difference between managers who have a post-graduate Diploma/Certificate (Mean = 3.291) and managers who have Standard 8-10 (Mean = 2.864). Clearly, managers who have a post-graduate Diploma/Certificate are more certain that monitoring and controlling quality takes place in the organization in efforts to bring about total quality management as compared to managers who have Standard 8-10.

Table 5 also indicates that with regards to statistical quality control, there is a significant difference between managers who have a post-graduate degree/s (Mean = 3.186) and managers who have Standard 8-10 (Mean = 2.623) and those who have a diploma/certificate (Mean = 2.792). Clearly, managers who have a post-graduate degree are more certain that statistical quality control effectively takes place in the organization in efforts to bring about total quality management as compared to managers who have Standard 8-10 or a Diploma/Certificate.

6. Discussion of results

The results (Mean = 3.1729) indicate that monitoring and controlling quality takes place at a moderate pace in the organization with the greatest focus being on competitive benchmarking (Mean = 3.2640), followed by continuous monitoring of sources of defects (Mean = 3.2600) and lastly, on statistical quality control (Mean = 3.0157). Evidently, against a maximum attainable score of 5, there is room for improvement in monitoring and controlling quality in efforts to achieve total quality management with the greatest improvement needed in statistical quality control. Statistical quality control was introduced by Deming and Juran who convinced managers in Japan that continuously controlling and improving quality would lead to improved productivity and to 'new world markets' (Evans & Lindsay, 2005). Evans (2005, p. 298) cautions that since statistical process control needs processes to reflect measurable variation, "it is ineffective for quality levels approaching Six Sigma" but statistical process control is effective for organizations that are in the early phases of quality efforts. Cognizance must be taken of the three applications of control charts:

- the establishment of a state of statistical control;
- process monitoring and signalling when the process goes out of control;
- to determine process capability (Evans & Lindsay, 2005).

The results also reflect that the sub-dimensions of monitoring and controlling quality (competitive benchmarking, continuous monitoring of sources of defects and statistical quality control) significantly relate to each other at the 1% level of significance. Hence, an improvement in any one sub-dimension of monitoring and controlling quality has the potential to have a snowballing effect and enhance all the other sub-dimensions as well as total quality management. A combined improvement in all the sub-dimensions therefore has the potential to enhance total quality management exponentially. For example, an organization can strive to adopt best practices in benchmarking in attempts to enhance total quality management. Best practices in benchmarking refers to approaches that give outstanding results, are innovative regarding the use of 'technology or human resources', and are recognized by 'customers or industry best practices' (Evans, 2005). Statistical quality control also plays a significant role in ensuring performance. Based on the philosophy of W. Edwards Deming, the methods of statistical process control, and basic statistics, a system may be designed for effectively benchmarking a performance index (Maleyeff, 2003). However, a standardized system for performance benchmarking does not exist due to the differences among industries with regard to the nature of the benchmarking process and the complex statistical methods that may be involved (Maleyeff, 2003). Statistical process control is imperative for monitoring the process to identify special causes of variation that signals the need to take corrective action when needed (Evans & Lindsay, 2005). However, Six Sigma does indicate that a few defects are acceptable (Crosby, 2006).

With regards to the impact of biographical data, it was found that there is a significant difference amongst employees varying in current position (top, senior and middle managers) in the organization regarding both monitoring and controlling quality and competitive benchmarking at the 1% level of significance. Furthermore, there is a significant difference amongst employees varying in academic qualifications regarding both monitoring and controlling quality and statistical quality control at the 5% level of significance. A similar finding shows that managers without graduate degrees often take courses to equip themselves with methods, techniques and statistical formulae to enhance efficiency and improve quality (CareerPlanner.com, 2008). However, no significant difference was found amongst employees varying in the other biographical data (tenure, gender, age, race) regarding monitoring and controlling quality. Similarly, with regards to monitoring and controlling quality and gender, it was noted that women have entered into every sphere of activity and are performance-oriented; therefore, companies will work towards retaining them irrespective of gender. Furthermore, the relationship between gender diversity and business outcomes is evidenced in the performance of organizations with a more robust mix of women and men in senior management (Pellegrino, D'Amato & Weisberg, 2011).

Recommendations and conclusion

A strong recommendation to monitor and control quality is to adopt benchmarking in order to set realistic goals in the organization. Furthermore, it is imperative to implement control charts to indicate its importance in determining process capability. Furthermore, when monitoring sources of defects where quality improvement is the focus, engage in constant improvement processes that ensure that products and services are within the specification range, are of quality and have zero defects. With competitive benchmarking, search for industry best practices that result in superior performance and assess performance gaps, set realistic goals and ensure continuous creativity, innovation and improvement. In addition, with statistical quality control (SQC) and statistics process control (SPC), use SQC and SPC charts to identify and eradicate problems in the production process by taking corrective action. Consistent and reliable SPC ensures consistency of output and is an imperative part of the overall TQM strategy.

With regards to the biographical data, monitoring and controlling quality is influenced by managers' current position in the organization. The finding in this study reflects that the higher the managerial level, the more convinced managers are that monitoring and controlling quality is occurring in the organization and influences TQM. In view of this, it is of utmost importance that managers at lower levels be aware and understand that monitoring and controlling quality would lead to improved productivity as this forms an imperative part of the overall TQM strategy.

Furthermore, monitoring and controlling quality is influenced by managers' academic qualifications in the organization. The finding in this study indicates that the higher the academic qualifications of managers, the more convinced they are that monitoring and controlling quality is evident in the organization and influences TQM. In light of this, it is important to ensure that managers with lower qualification are given the opportunity to perhaps further their education or attend training courses to fully understand the impact of monitoring and controlling quality on the organization's overall productivity.

In addition, competitive benchmarking is influenced by managers' current position. In this study it was found that the higher the managerial level, the stronger the perceptions that competitive benchmarking is practiced in the organization. In view of this, managers at lower levels must be communicated to and convinced that benchmarking, which involves searching for industry best practices, results in superior performance.

Furthermore, statistical quality control is influenced by managers' academic qualification. In this study, it was found that the higher the academic qualifications of managers, the more convinced they are that statistical quality control is taking place in the organization and influence TQM. Taking this into consideration, it is important to ensure that managers with lower qualifications are equipped with adequate knowledge and perhaps take further studies to understand statistical quality control within the organization as customers may request proof of statistical quality control from the organization.

The aforementioned recommendations relating to monitoring and controlling quality are graphically represented in Figure 1 and when effectively implemented have the potential to ensure total quality management.

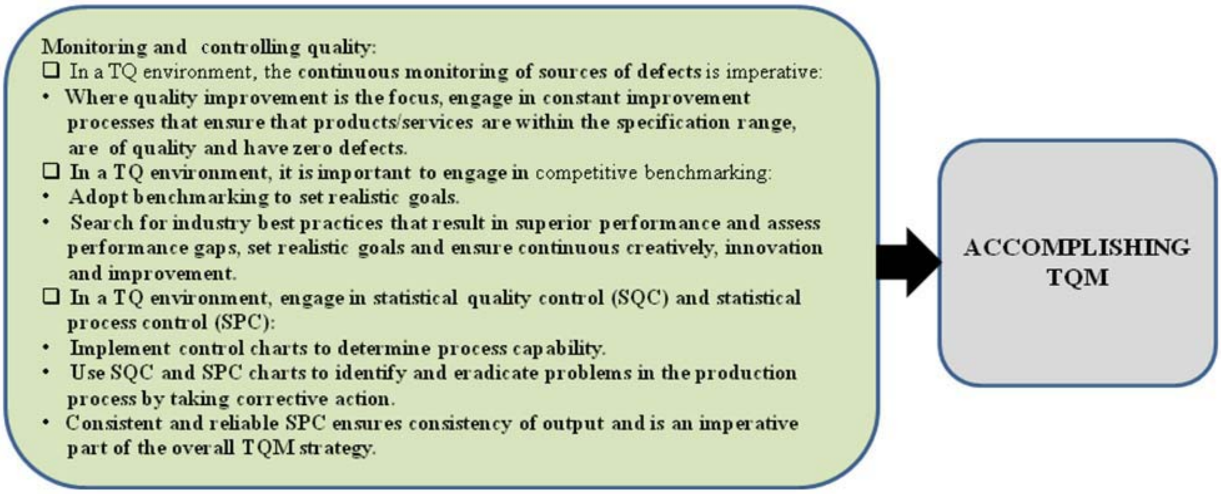

Fig. 1. Recommendations relating to monitoring and controlling quality in efforts to accomplish total quality management

The results of the study open many avenues for a fresh perspective of the various facets of monitoring and controlling quality in attempts to enhance total quality management. In particular, it emphasizes the role of competitive benchmarking, continuous monitoring of sources of defects and statistical quality and process control in the evolution of world class organizations. Organizations need to search for industry best practice and engage in gap analyses in order to timeously identify shortfalls or gaps (be it knowledge, standards, delivery, communication or overall gaps) so that corrective action may be taken. Management needs to continuously assess the gap between the TQM program implemented and the actual practice and results, which ultimately determines the effectiveness of a TQM corporate transformation strategy. Ironically, very often it is management's failure to ardently investigate these gaps through inquiry, analysis and action (that are fundamentally needed in a TQM implementation) that results in the TQM initiative's failure. Performance measurement is also needed to monitor sources of defects. While it is important for the culture of zero defects to permeate the organization, every organization should aim to constantly subscribe to a Six Sigma level of capability and an objective approach to achieving this is to use quality control techniques. These strategies are imperative for organizations seeking to produce more with less and to design customer centric strategies and fuel their growth objectives.

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