The Influence of Integrating Quality Management Systems on Strategic Business Plan of Electricity Industries

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Abstract

The usage of electricity for heating, lighting, transportation, cooling and operating appliances has become the main source of energy for socio-economic development. As a result, the consistent accessibility of electricity supply is crucial in ensuring sustainable global best practice measures in the electricity industries. Moreover, the ease of reliability, affordability, quality, and availability of electricity supply is essential in stimulating sustainable economic activities. Yet, there is an energy crisis especially electricity in many developing countries in Sub-Sahara, which have lead these countries in extreme poverty due to lack energy. In addition, there has been challenges with electricity supply resulting to power shortages. As a result energy resources industries and stakeholders are seeking for best practices on renew and sustainable energy. Equally, this paper intends to determine how the application of Quality Management Systems (QMS) can utilized as a sustainable quality tools in energy industries. In this regard, a case study the South African energy industry particularly the electricity area was selected in accomplishing envisaged objectives. The findings suggest that the implementation of an effective QMS for continual improvement relate to meeting the supply demands still lagging behind. Therefore, strategic planning for developing a sustainable structure for implementing an effective QMS is needed.

Keywords
Electricity industries, Quality management systems, Strategic business plan.

1. Introduction

The adoption of the ISO 9001 has become regulatory or a necessity for the global standard organization to subscribe to the best practice requirements for the effective implementation of QMS. This standard put into effect the compliance of ensuring quality goods and services that are free to errors, harmless to consumer and meeting the need and exceed the expectations costumers. In terms of sustainable QMS requires, a dynamic change in the ethics of corporate sectors (Golder, et.al, 2012). There is a necessity to constantly review organizations QMS. The ISO 9001 certification serves as a marketing tool employed by most corporate sectors in sustaining competitiveness (Poksinska, et.al, 2006) rather than an instrument for the improvement of internal processes and systems. A structure for constant review and maintenance of QMS post certification through a proactive approach driven by a continuous improvement strategy is therefore essential in corporate sectors (Kaziliūnas, 2010). The electricity industries are challenged in mitigating electricity restrictions, ensuring the regular supply of safe and quality electricity. The quality of electricity supplied is facilitated towards stimulating sustainable economic developments. Literature presents certain limitations in the effective adoption of sustainable QMS. These are inclusive of the scarcity of resources, employee engagement, and managerial attitude. Literature establishes corporate sectors consider the implementation of QMS as the obligation of quality departments rather than the entirety of the business units (Chemuturi, 2011). This presents gaps in comprehensively understanding and implementing QMS within business units. Electricity industries in South Africa are continually challenged with electricity restriction issues in form of power outages. These limitations present a need for this paper. The adoption of QMS in relation to a defined business strategic plan of a selected electricity industry based in South Africa is investigated. This paper seeks to enhance the quality and reliability supply of electricity to consumers in South Africa. The effectiveness of QMS is dependent on the efficient implementation of a defined business strategic plan (Kaziliūnas, 2010). A gap analysis

examination between the current QMS status of the selected electricity industry comparable with global best practice standards is investigated.

2. Literature

South Africa has experienced electricity restrictions in recent years, presenting a need for urgent best practice QMS measures (Phaala, 2015). A white paper publication from statistics South Africa establishes the lack of an effective maintenance strategy implemented relative to the power generation and transmission system is a major cause of system downtime resulting in power restrictions. Electricity restrictions refer to shortages in the supply of electricity as compared to demand from consumers. Electricity restrictions describe the temporal shutting down of electricity generation and distribution system in selected discreet zones. This is as a result of ineffective load generation maintenance at the power stations. Electricity practitioners in South Africa attribute population and economic growth as some causes of irregular maintenance. This paper, however, disputes these claims as the major causes for electricity restrictions in South Africa. This paper corroborates this assertion by presenting a structure for investigating the influence of QMS on a defined strategic business plan. A white paper publication from (Mastercontrol, 2006) affirms corporate sectors with fully implemented QMS are stimulated with enhanced operational efficiency and overall compliance. Kaziliūnas establishes the effective integration between QMS implementation based on ISO 9001 benchmarks and performance outcomes in the electricity sector is a best practice measure. An optimally developed QMS stimulates success factors, facilitating QMS implementation from the early phases of planning, designing, and completion (Kaziliūnas, 2010). This paper presents a document affirming the lack of an effective integrated QMS on strategic business plan and operations is a major cause for electricity restrictions (Mastercontrol, 2006). This paper focuses on presenting an exploration of the influence of integrating an effective QMS on an electricity industry strategic business plan. This paper further presents recommendations in relation to developing an effective QMS structure. A framework for defining, implementing and maintaining QMS measures in the post-certification period is enabled. The results present critical measures for enterprise practitioners in the electricity sector, to overcome QMS challenges and enhance operational efficiency.

No definite description of quality exists, as several authors present different definitions of quality (Willar, 2012). The ISO 9001 white paper publication (2015) defined quality as a set of collaborated procedures implemented in achieving regulatory and statutory standards. A QMS is described as a collection of corporate activities focused on reliably satisfying consumers' expectations (Simões, et.al. 2016; ISO 9001:2015; White, 2014). These activities are inclusive of defined strategic procedures and direction in ensuring the effective implementation of QMS policies. Several QMS domains and principles exist (Foster, 2010). The eight (8) QMS principles are detailed in (Hoyle, 2010 and Tricker, 2008). These include "Customer focus", "Leadership management", "People participation", "Process approach", "System's methodology to management", "Continual enhancement", "Factual tactic to decision making" and "Mutually valuable supplier relationship". Three (3) domains of implementing an effective QMS aligning with QMS principles defined exist (Gryna, et.al, 2007). The domains are inclusive of "Quality planning", "Quality control" and "Quality improvements". Literature elaborates on the importance of effectively collaborating these benchmark principles and domains. This facilitates an optimal structure for corporate communication and teamwork (Willar, 2012).

QMS is a major fundamental constituent of Total Quality Management (Thorpe & Sumner, 2004). TQM is a strategic business plan ensuring employees and management team in business units are actively involved in achieving global best practice QMS benchmarks (McGeorge & Palmer, 2002). Literature defines several Key Performance Indicators (KPIs) of TQM in relation to implementing an effective QMS (Davies, 2004). This is presented in Figure 1 and includes "Management responsibility", "Resource management", "Product realization", Measurement analysis" and "Measurement improvements". Effectively developing strategies to integrate defined TQM KPIs with a defined strategic business plan ensures customers satisfaction.

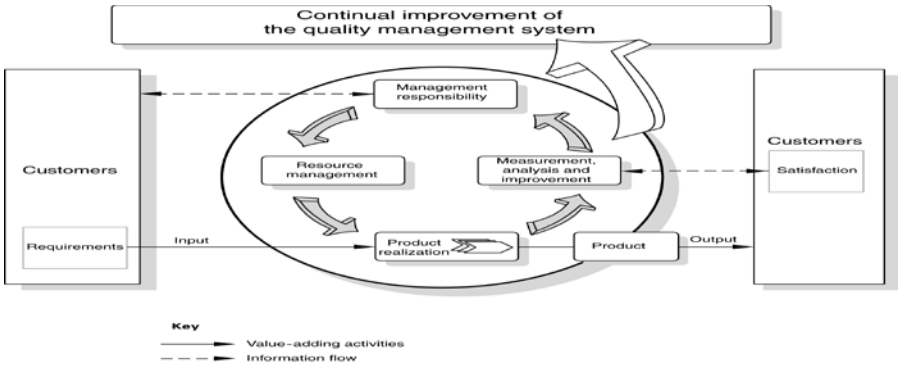

Figure 1. Process flow model of QMS adapted from (Davies, 2004)

Based on the subset electricity industry investigated, the researcher identified certain limitations in QMS implementation. This is as compared with ISO 9001: 2015 benchmarks. The electricity industry investigated generates approximately 95% of the electricity consumption in South Africa and 45% in Africa. This is generated from diverse sources inclusive of wind, solar, and nuclear sources. The nominal generating capacity after the year 2014 is 252578 GWH compared to 252938 GWH in 2007 (Staff writer, 2015 and Phaala, 2015). This shows a decreasing trend and is considerably low compared to South Africa increasingly demand energy. As a result of a decrease in electricity production, imported electricity to meet consumers' needs has increased significantly, while exported electricity decreased (Phaala, 2015). Table 1 presents the volume of electricity generated in relation to percentage change between the years 2009 to 2014 (StatsSA (2014).

Table 1. Electricity change and percentage change adapted from StatsSA (2014)

Index of electricity generated and percentage change (Base: 2010 = 100)		
Year	**Volume generated**	**Percentage change (%)**
2009	96.1	
2010	100.0	4.0
2011	101.1	1.1
2012	99.3	-1.8
2013	98.6	-0.7
2014	97.3	-1.4

Ineffective planning and lack of vision relative to the South Africa energy requirements is attributed as a major reason for low generating capacity, resulting in power restrictions (Staff writer, 2015). Poor financial motivations are attributed as a major reason for ineffective planning (Phaala, 2015). Other limitations identified include "Management crisis", insufficient skilled Labour", "Insufficient capacity structure", "Enormous maintenance backlogs", "Unbilled consumption" and "Infrastructure theft". Developing an effective QMS in relation to a strategic defined business plan addresses these limitations. Figure 2 presents a diminishing trend in electricity distribution as compared with consumers' demands (Visagie, 2010). The graphical trend shows energy demand in South Africa will continually increase.

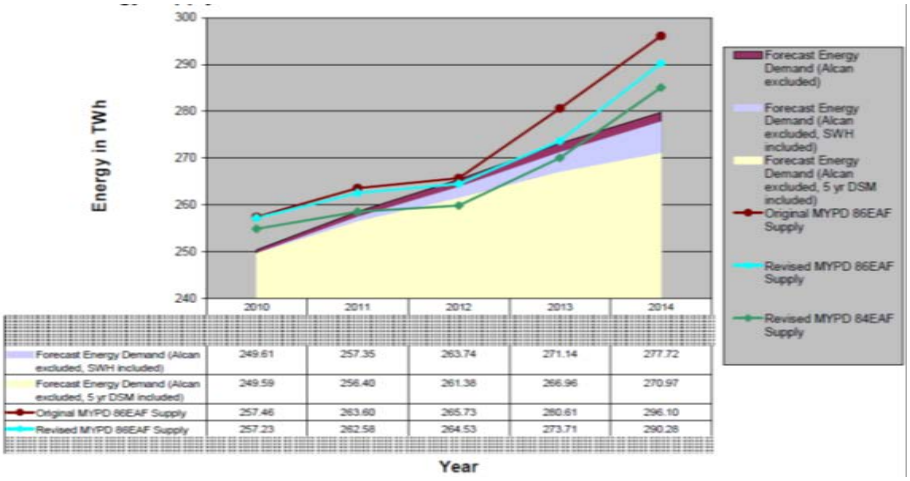

Figure 2. Energy supply and demand balance

3. Methodology

A pragmatic mixed methodology based on a detailed search of literature, survey questionnaires, interview sessions and observations is employed in executing defined objectives in this paper. The research method employed facilitates an effective structure for "Conducting", "Analysing", "Drawing conclusions" and "Presenting recommendations" in this research. A search of literature as a research approach explores documents defining best practice QMS benchmarks in electricity industries, in relation to a strategic defined business plan. This is considered as a point of reference and guide to initiate this research. Observations as a research approach involve a detailed review of available documents illustrating processes in the subset electrical industry in consideration. The processes include quality policies, organization organogram, corporate objectives and training programs. Interview as a research approach aims at establishing the understanding of the respondents in relation to the questionnaire constructs. This is executed via emails and telephone communications. Observations and interviews facilitate a framework for the qualitative analysis of the data collected. The survey questionnaires designed as Likert scales closed-ended options seeks to collect data on the questionnaire constructs. The results present a framework for quantitative analysis of the responses gathered. The collected data are analyzed employing statistical descriptive techniques. This presents a framework for identifying and addressing current limitations and recommending measures towards developing an effective integrated QMS. The reliability of the data collected is tested based on Cronbach alpha principles, while triangulation approach is employed to test for the research's validity. These are best practice reliability and validity testing approaches (Brynard et.al. 2014).

This paper employs the probability sampling and non-probability sampling techniques for collecting both the qualitative and quantitative data. Sampling is the process of selecting a portion of a larger population, which is sufficient for gathering information required. Both techniques are considered in employing the pragmatic mixed methodology defined. In non-probability sampling, samples are selected based on the subjective decision of the researcher rather than random selection, while probability sampling is based on some form of random selection. The questionnaire construct is designed based on defined question categories explored in various subthemes presented in the next section.

4. Results

Based on the research methodology facilitating the questionnaire construct employed, the data collected under each question category is presented in this section. The research results affirm QMS as an essential tool in streamlining the business operations of a business unit. Specifically enhancing the strategic the business plans or defined goals of electricity industries. A major limitation of this research is the challenges in getting respondents to participate in the questionnaire survey and interviews. The researcher confirms the reliability and validity of the data collected, testing for the consistency and appropriateness of the research inferences. Research validity refers to an integrated judgment of the degree to which an empirical evidence and theoretical rationales support the appropriateness of the research inferences, propositions, or conclusions (Gomez & Elliot, 2013). The reliability of a measurement is a type of validity describing the extent to which a measurement consistently results to the same result on different defined scenarios (Neuendorf, 2002). Cronbach's alpha is calculated employing the Statistical Package for Social Sciences (SPSS) software to check for the reliability of the data collected. The generally accepted lower limit for Cronbach

alpha is 0.7, which can decrease to approximately 0.6 in exploratory research (Hair, et al. 2010). The researcher ensured the reliability of the data collected in this paper aligns with the acceptable limit. The validity of the research is tested based on five defined categories employing the Kaiser-Meyer-Olkin (KMO)/Bartlett's test. The validity outputs present the total variance and correlation matrix values for each category. The five categories tested and statistical output obtained is presented in Table 2. The five categories aligned with associated KPIs are selected based on a comprehensive literature search (Simões, et.al. 2016; Kigotho, 2012; Willar, 2012; Al-Najjar & Jawad, 2011).

Table 2. Cronbach alpha result of the factor analysis

S/N	Category	Statistical output	Key performance indicators
1	Behaviour relating to QMSs	0.779	9
2	Quality management principles	0.910	8
3	Barriers to implementation	0.733	5
4	Benefits of using QMSs	0.855	6
5	Performance of the department	0.930	7

All five categories tested resulted in a high alpha value above the recommended 0.7, which is an acceptable value in social science research (Hair, et al, 2010). The introductory section of the questionnaire constructs explored for data relative to the gender, age, ethnicity, education level and training of the respondents. The researcher also seeks for information in relation to defined corporate objectives and improvement strategies of the subset electrical industry selected. These data are a prerequisite to providing information on the five categories detailed in Table 2. Gender is an essential variable in research, as the roles assigned to different genders may influence respondents' perceptions and responses to specific issues (Robin, 1996). The sample respondents employed for analysis in this paper comprises of 50.8% males and 49.2% females. This indicates an approximate equality in gender hence fulfills the assertion of gender as a vital variable in research.

Ethnicity is an essential variable in this research as different ethical and cultural beliefs of the respondents might have a significant influence on the effective implementation of QMS. Diverse ethnic groups are represented in the questionnaires employed for analysis. The ethnic groups consist 58.1% of blacks, 24.2% of whites, 8.1% of colored and 9.7% of Indians/Asians.

Age is an essential variable which influences the implementation of an effective QMS (Kigotho, 2012). The researcher ensured the questionnaire employed for analysis are not discriminatory in relation to age groups. Literature asserts older people are wiser as a result of amassed knowledge or experiences, and more efficient in dealing with diverse situations. The respondents employed in this paper fall into the mature age bracket of (30 -38). The researcher assumes this age bracket is ideal for collecting data relative to integrating QMSs on a strategic defined business plan.

Level of education is an essential variable influencing the implementation of QMS (Razak, et.al. 2010). Education is a willingness to learn or be trained and definitely influences the integration of QMS principles on a strategic defined business plan. In this paper, 22 (37.3%) respondents hold a bachelor degree, 16 (27.1%) a Post-graduate degree, 11 (18.6%) a national certificate, 6 (10.2%) matric and 4 (6.8%) have an in-job training.

Respondent's level of training is an essential indicator in relation to effective QMS implementation. In this paper, 55 respondents have undergone the ISO 9001 training, which amounts to 88.7% of total sample investigated, while 11.3% of the respondents are not trained in ISO 9001 benchmarks.

The defined objectives relative to an effective implementation of QMS of the selected subset electrical industry is a priority in this paper. Based on the total sample explored, 56 (90.3%) respondents agreed availability of defined objectives, 6 (9.7%) respondents say no defined objective, while one respondent remained neutral. The respondents who agreed to the availability of defined objectives have received different categories of training relative to designated roles assigned in the organization.

The availability of continuous improvement structure relative to an effective implementation of QMS of the selected subset electrical industry is a priority in this paper. Based on the total sample explored, 59 (96.7%) respondents agreed availability of continuous improvement structure, 2 (3.3%) respondents say no defined continuous improvement structure, while 2 respondents remained neutral. Most of the respondents indicated the availability of a continuous improvement structure relative to an effective implementation of QMS.

The Spearman's Rank order correlation (rho-value) indicates the strength and direction (negative or positive) of the correlation. The correlation coefficient (p-value) specifies the probability of a given rho-value. In each of the five categories investigated, a correlation test is performed to obtain the p-value and rho-value of

relationships between the categories. The results of each category investigated in the questionnaire construct is presented in subthemes below.

Category 1: Behavior relating to QMSs

This subtheme investigates nine key KPIs based on behaviour in relation to implementing effective QMS. The KPIs explored are inclusive of availability of resources and information essential for quality procedures, personnel training, suitable work environment and process equipment. The data collected is subjected to Principal Component Analysis (PCA) investigation. The following outputs are obtained: P-value = 0.3 and KMO value = 0.571. The results indicate all KPIs < 1, presenting a clear break of the screen plot with a 69.982% total variance. This establishes a strong correlation between behaviour as a strategic business benchmark and effective QMS implementation.

Category 2: Quality management principles

This subtheme investigates eight key KPIs based on implementing effective quality management principles. The KPIs explored are inclusive of customer requirements, management obligations, and QMS policies. The data collected is subjected to PCA investigation. The following outputs are obtained: P-value = 0.371, rho-value = 0.408 and KMO = 0.854. The results indicate one KPI with an eigenvalue greater than 1, presenting a total variance of 56.337%. The paper observes the dissimilar KPI focuses on customer requirements. The outputs establish a strong correlation between quality as a strategic business benchmark and effective QMS implementation.

Category 3: Barriers to the implementation of QMS

This subtheme investigates five KPIs based on barriers in relation to implementing an effective QMS. The data collected are subjected to PCA investigation. The following outputs are obtained: P-value = 0.3, rho-value = -0.481 and KMO = 0.719. The results indicate one dissimilar KPI with an eigenvalue greater than 1, presenting a clear break of the screen plot with a total variance of 38.035%. The outputs establish a negative correlation between barriers as a strategic business benchmark and effective QMS implementation.

Category 4: Benefits of using QMS

This subtheme investigates six KPIs based on benefits in relation to implementing an effective QMS. The data collected are subjected to PCA investigation. The following outputs are obtained: P-value = 0.3, rho-value = 0.330 and KMO = 0.806. The results indicate one dissimilar KPI with an eigenvalue greater than 1, presenting a clear break of the screen plot with a total variance of 52.424%. The outputs establish a positive correlation between benefits as a strategic business benchmark and effective QMS implementation.

Category 5: Performance of the department

This subtheme investigates seven KPIs based on performance in relation to implementing an effective QMS. The KPIs explored are inclusive of strategies towards achieving a defined business goal. The data collected are subjected to PCA investigation. The following outputs are obtained: P-value = 0.3, rho-value = 0.267 and KMO = 0.866. The results indicate one dissimilar KPI with an eigenvalue greater than 1, presenting a clear break of the screen plot with a total variance of 65.641%. The outputs establish a positive correlation between performance as a strategic business benchmark and effective QMS implementation.

A further regression analysis test is performed to further establish a relationship between the selected categories. Performance (category 5) is selected as a dependent variable, while “Benefits (category 4)”, “Barriers (Category 3)”, “Quality (Category 2)”, “Behaviour (Category 1)” as the independent variables. The research seeks to determine the relationship between the dependent variable and the independent variables. The results present an r-value = 0.577, R^2 value = 0.333 and standard error = 0.594. The ANOVA analysis presents an F value = 5.397 set at 0.000 significance level. This research infers from the results, both negative and positive relationships exist between the dependent and independent variables. The beta coefficient between performance and behaviour is -0.24, which indicates the relationship is skewed negatively. There is a strong positive relationship between performance and quality, with a beta value of 0.275. Performance and barriers resulted in a beta value of -0.325, indicating a negative relationship between both categories. The relationship between performance and benefits resulted in a beta value of 0.209, indicating a positive relationship between both categories.

Recommendations

The results affirm the five categories aligned with associated KPIs investigated, are benchmark constituents of a defined business strategic plan in relation to the effective implementation of QMS. The correlation and regression tests affirm the integration of QMS on a defined business strategic plan will result in an enhanced electricity distribution in South Africa. Based on the research results collected and data analyzed, this research confirms the following arguments. Recommendations towards developing an effective QMS in relation to a defined business strategic plan in electricity industries are also presented.

- Results establish the need to develop QMS benchmarks based on a collaborative structure of business strategic indicators investigated. This paper recommends implementing a unified framework of "Behaviour", "Quality", "Barriers", "Benefits", and "Performance" categories in relation to an effective implementation of QMS. A collaborative structure enhances the efficiency and execution of day-to-day operations.
- Results affirm on the importance of developing a structure which supports QMS developments resulting in a framework for continuous transparency, monitoring, visibility, and assessments. This is in relation to implementing effective QMS policies and sustainable practices, facilitating a base for identifying and addressing concerns timeously. This ensures risks and opportunities are catered for when it arises. A structure for continuously driving QMS policies both internally and externally is extremely recommended in this paper.
- Results encourage for frequent re-certification of the company's processes based on ISO quality management benchmarks. This ensures employees, customers, and stakeholders are aware of improvements in service mandate based on the integration of quality management principles. Educating on the importance of obtaining an updated certified document from ISO on QMS benchmarks is highly recommended in this paper.
- Results affirm continually developing an effective maintenance strategy based on ISO quality management policies is essential. This paper encourages and recommends a cultural shift from the pre-ISO certification period to the post-ISO certification phase.
- Results established the need for frequent training of employees and management team in relation to quality management benchmarks. This enhances the efficiency of the management team and employees in relation to implementing an effective ISO QMS benchmarks.

The results indicate implementing a unified framework of strategic business indicators explored (Behaviour, Quality, Barriers, Benefits, and Performance) serves as an effective tool for implementing an effective QMS. These tools enhance electricity generation, distribution, reliability, and sustainability. Increasing generating capacity and mitigating electricity restrictions. These align with TQM (strategic business plan) benchmarks in ensuring employees and management team are actively involved in achieving global best practice QMS benchmarks. A framework for effectively facilitating "Management responsibility", "Resource management", "Product realization", Measurement analysis" and "Measurement improvements" is stimulated.

Conclusion

This paper selects an electricity industry based in South Africa as a subset of electricity industries in accomplishing envisaged objectives. This paper conducted a gap analysis testing in relation to the implementation of an effective QMS. The influence of integrating QMS on a defined strategic business plan of electricity industries is investigated. This is based on ISO 9001:2015 benchmarks. The results present best practice measures as an effective TQM tool relative to developing a sustainable structure for implementing an effective QMS. This paper established for electricity industries to ensure sustainability of a QMS, the business unit must support a paradigm for the redesign and continuous development of QMS benchmarks. This research demonstrated the development, integration, and adoption of an effective QMS on a defined strategic business plan results in an enhanced generation and distribution of electricity. Future research can be directed to a broader investigation of the research objectives. A case study comparison between Africa as an underdeveloped continent and the developed countries globally can be explored. This is in relation to the adoption of QMS benchmarks on a defined strategic business plan.

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