Proceedings of the 8th European Conference on Industrial Engineering and Operations Management
Paris, France, July 2-4, 2025

Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/EU08.20250371
Published: July 2, 2025

Driving Factors for the Application of Quality Management (QM) on Product and Service Delivery in South African Manufacturing Industry

Festus Uche Uwadia, Emmanuel Innocents Edoun and Anup Pradhan
Faculty of Engineering and Built Environment
Department of Quality & Operation Management
University of Johannesburg, South Africa, 55 Beit St, Doornfontein, Johannesburg
South Africa
festus_u@yahoo.com, edounsen@hotmail.com, anupp@uj.ac.za

Abstract

Quality Management (QM) is a critical pillar for enhancing productivity, reducing waste, and ensuring customer satisfaction in manufacturing environments. In South Africa's manufacturing industry, which is often challenged by outdated machinery, limited skilled labour, and inconsistent infrastructure, the strategic implementation of Quality Management Systems (QMS) becomes even more vital. This study investigates the driving factors influencing the application of QM in the delivery of products and services in the South African manufacturing sector. Adopting a quantitative cross-sectional survey design, data were collected from 400 quality-related professionals using structured questionnaires. Descriptive statistical techniques, including Mean Item Score (MIS), and Exploratory Factor Analysis (EFA) were used to analyse the data. Findings revealed that key drivers for QM implementation include employee involvement, focus on customer satisfaction, continuous improvement, training, teamwork, and knowledge sharing. The top-ranked factor was active involvement in QM application, followed closely by client satisfaction and continuous improvement. EFA identified five principal components—customer focus, team engagement and learning, team cohesion, knowledge sharing, and quality orientation—which explained over 66% of the total variance in driving QM practices. These results underscore the human-centric nature of quality management and suggest that technical standards must be complemented by inclusive and participatory organisational cultures. The study concludes that successful QM application is anchored on leadership commitment, active employee participation, and a sustained focus on meeting customer expectations. It recommends that manufacturing firms invest in staff training, foster teamwork, and institutionalise continuous improvement strategies. These efforts will not only enhance product and service quality but also promote long-term competitiveness in South Africa's evolving manufacturing landscape.

Keywords
Quality Management (QM), Manufacturing Industry, South Africa, Exploratory Factor Analysis, Customer Satisfaction

1. Introduction
In the opinion of *Maney and Patail (2015),* quality management has to do with the preservation of value over time, and this encompasses steps which includes quality control, planning, and assurance. Adopting all the three components provides the foundation for maintaining and improving quality of products and services in the manufacturing industry. Quality planning is the stage where a company's standards are clearly defined within a systematic framework that includes labour, materials, products, and expected outcomes, aligning with the company's mission and vision statements. Quality control involves determining the quality standards of an operation, product, or service through result analysis of both the expected and actual input and output within the supply chain. It also measures the degree

of quality in products and services and provides solutions when standards are not met. The final step, quality assurance, focuses on maintaining quality standards through consistent and continuous overall project assessment.

All Quality Management Systems (QMSs) share similar goals, with a focus at attaining effective and efficient management within the organisations where they are applied through continual improvement *(Casadesus, Marimon and Alonso, 2010)* however, these systems operationalise the components differently. For instance,
Uwadia et al. (2022) opined that to achieve the highest quality performance, there must be an enhancement in sustainable development capacity through continuous improvement. According to the author, the Total quality management (TQM) model offers this benefit by eliminating unproductive segments in the production process, preventing breakage of goods before they reach the storage room, and avoiding other negative impacts on customer satisfaction. *Douglas and Connor (2003)* also highlighted the need to fully assess quality performance directed toward customers, as this requires a balance between customers' and the company's quality management processes in terms of understanding, perception, and the effects on both parties.

TQM model generally focuses on how to continually improve product and services quality for the sake of customers through changes in organisational culture *(Bon and Mustafa, 2013).* Six Sigma is another model in Quality management, and in contrast to TQM, this model uses data-driven method to reduce defects and fluctuations in process, thereby achieving better quality and increasing customer satisfaction with reduced cost *(Dehwari, 2013).* On the other hand, *Lasida, Isola, and Sarasola (2016)* and *Nicoletti (2008)* mentioned that ISO:9001 standards and the excellence model from the European Foundation for Quality Management (EFQM) are two of the QMS most frequently used and appreciated in organisations generally. However, the EFQM model emphasises the pursuit of excellence, whereas ISO 9001 is centred on quality assurance, concentrating on elements that influence the quality of the products or services provided by the implementing organisation. Compared to the ISO:9001 standards, the EFQM model's scope is more comprehensive in this respect *(Rodríguez-Mantilla, Martínez-Zarzuelo, and Fernández-Cruz, 2020).* In developing countries where manufacturing firms often face infrastructural, financial, and human capital challenges, rigid quality systems may be difficult to sustain without adequate support. In the words of *Carvalho, Carvalho and Silva (2019)* and *Goshime, Kitaw and Jilcha (2019),* many manufacturing industries present in developing countries use outdated machinery, which negatively impacts production quality and distribution. *Zahraee (2016) and Kinyondo, Wangwe, Mmari and Aikael (2014)* supported this observation, adding that these sectors also suffer from the non-availability of skilled workers together with the inadequacy of basic resources which include water, electricity and also raw materials. This has led to production losses, underproduction, and customer dissatisfaction. The manufacturing sector in South Africa has seen notable contributions from various divisions, including petroleum, chemical products, rubber and plastic products (which contributed 9.6%, -2.1 percentage points), food and beverages (which contributed 2.9%, -0.9 percentage points), basic iron and steel, non-ferrous metal products, metal products, and machinery (which contributed 3.9%, -0.7 percentage points), despite this, there was a 3.5% decrease in the sector in November 2020 compared to the previous fiscal year *(South African Market Insight, 2022).* In order to overcome these obstacles and produce high-quality goods and services, a quality management system (QMS) must be implemented. The QMS's guiding principles include process approach, people engagement, leadership, evidence-based decision-making, customer focus, and relationship management *(Uwadia et al., 2022; Techiequality, 2023*). Based on this, this study is aimed at evaluating the driving factors for the application of quality management (QM) in product and service delivery in South African manufacturing industry

2. Principles of Quality Management System

A Quality Management System (QMS) serves as a framework for orchestrating operations to optimise customer satisfaction and facilitate ongoing enhancement *(Uwadia et al., 2022).* The authors emphasised the importance of a number of QMS principles, including customer-centricity, leadership, employee engagement, process orientation, relationship management, quality enhancement, and decision making grounded in evidence. Customer focus entails aligning business objectives with customer expectations. Leadership necessitates active involvement and strategic planning to ensure the availability of top-notch materials. Engaging people involves empowering and relying on capable and motivated employees. The process approach entails cultivating a seamlessly integrated organisation capable of delivering anticipated outcomes. Relationship management entails identifying opportunities for sustainable development and taking corrective action for any deviations.

Enhancing quality demands an ongoing dedication to adapting to shifts in both external and internal circumstances. This involves prioritising the identification of root causes and the adoption of preventive and corrective actions to foster novel opportunities. Employing empirical decision-making, grounded in analytical and factual evidence, confers substantial advantages to the company in terms of impartiality, efficiency, and the capacity to evaluate the outcomes of continuous improvement efforts. This concept is depicted in Figure 1.

Figure 1: ***Quality management principles (Uwadia et al., 2022)***

2.1 The Quality Management Principles/Factors

Eight quality management principles form the basis of the ISO 9001:2008 and 2015 standard. These principles are fundamental for any quality-oriented work organisation and can be articulated as follows:

2.2 The focus on customer

The total quality management (TQM) is a comprehensive, organisation-wide approach to enhance the quality of products and services *(Lazenby, 2018*). It begins with customer focus, which means that work organisation rely on their customers and need to know what they want now and, in the future, and to fulfil their requirements and go beyond their expectations. Customers serve as the vital essence of any organisation *(Lazenby, 2018).* It is imperative for organisations to prioritise investment in their customers over their profit-making processes. In essence, directing attention outward is more crucial than focusing inward. The ISO 9001 standard reflects and strengthens the customer-centric principle through the following requirements: effective communication with customers; protection of customer property; understanding of customer requirements and expectations; designation of a management or operations representative; and commitment from senior management.

2.3 The leadership

The second quality component has to do with leadership. Leaders are tasked with establishing a shared purpose and vision for the organisation, inspiring employees to attain business goals. Leaders can emerge across all levels and departments within an organisation and are accountable for fostering a conducive work atmosphere. Rather than demoralising employees, leaders should inspire and uplift them. This principle is embodied in the standard through the establishment of organisational objectives, strategic planning, internal communication, and the cultivation of an efficient work environment *(Kok, Lebusa and Joubert, 2014)).*

2.4 The involvement of people

This principle concentrates on the involvement of individuals in the process. According to *Hennersdorf and Krallmann (2016),* the success of implementation hinges on the level of awareness and engagement among employees. Kok *et al.,* (2014) *f*urther contend that it necessitates employers to employ participative approaches in managing their workforce and investing in their development. People's engagement involves acknowledging the significance of each individual's contribution, and their active participation improves organisational performance and yields advantages. Fundamental to this principle is the shift from individual labour to collective endeavours. The principle in question is apparent in the standard assessment of designs, establishment of objectives across various organisational levels, cultivation of a motivating work environment, facilitation of effective internal communication channels, and identification of skill deficiencies.

2.5 The process approach

This principle revolves around employing a process-oriented approach to oversee the organisation's production and business activities, regardless of their complexity. It aids in assessing the organisation's effectiveness and efficiency in attaining its objectives. The process-oriented approach suggests a shift from a procedural approach to a process-based one. The procedural approach tends to generate more waste and lower efficiency and productivity compared to the process-oriented approach. However, not all processes are equally effective and efficient, hence the need for careful design, monitoring, maintenance, and regular updates *(Hennersdorf and Krallmann, 2016).* Updating is also mandated by the standard, as outlined in clause 8, which calls for continuous improvement. The standard clearly demonstrates this quality principle by specifying processes, defining their inputs and outputs, and allocating the necessary infrastructure, information, and resources to support their operation.

2.6 The system approach to management

According to this principle, every procedure within the organisation is interlinked and collaborated to accomplish its objectives. To be efficient, it's crucial to comprehend how these processes intertwine and operate collectively. This principle advocates transitioning from a functional perspective to a systemic approach, as demonstrated in the standard through the creation, execution, and upkeep of the management system, the integration of processes, and the establishment of measurement mechanisms *(Nogalski, Niewiadomski and Spitzter, 2019).*

2.7 The continual improvement

An essential quality principle advocates ongoing improvement. The standard deliberately employs the term 'continual' rather than 'continuous'. 'Continuous' denotes a state without interruptions, whereas 'Continual' implies regular and recurrent progress. This underscores the expectation that ISO 9001 users should develop, implement, and employ a process capable of adapting to changes in the Quality Management System (QMS) or, at the very least, maintaining customer satisfaction. Embracing this principle entails transitioning from mere error rectification to proactive course adjustment. The primary skill requiring continual enhancement is the ability to discern customer preferences, as noted by *Nogalski et al. (2019).* The standard underscores the principle of continual improvement through processes dedicated to enhancement, exploration of improvement avenues, and regular scrutiny of documents and processes for opportunities to enhance quality.

2.8 The factual approach to decision making

One essential quality principle is that decision-making must be grounded in empirical evidence. Organisations are obligated to adhere to this principle by basing their decisions on data analysis as opposed to emotions or personal opinions. Therefore, organisations should establish a process for measuring inputs and outputs and verifying processes as necessary. The standard addresses this verification and testing procedures in clause 7.0, considering them as processes requiring documentation *(Nogalski et al., 2019).* Documentation entails the planning, establishment, utilisation, and maintenance of processes. The standard illustrates this principle through several means, including management reviews, tools for obtaining factual information, measuring device calibration, data analysis to extract facts, maintenance of records to demonstrate factual evidence, and approval based on factual findings.

2.9 Supplier Relationship

The ultimate quality concept places a high emphasis on developing a rapport with suppliers. This principle emphasises that external influences, in addition to internal processes within the organisation, also have an impact on the quality of the product that is given to the client. For instance, certain companies outsource parts of their manufacturing processes and procure raw materials from various suppliers. Hence, it is imperative for the organisation to ensure the delivery of high-quality products to their customers by enhancing their relationships with suppliers. The organisation gains advantages as ISO standards enable it to provide customers with more affordable, quicker, and superior services, consequently fostering growth, partnerships, increased revenue, and sustained relevance in the long term *(Bedgood, 2018).* Embracing this principle necessitates a shift within the organisation from a culture of conflict to one of cooperation. The standard encompasses this principle by addressing supplier control, supplier evaluation, and the analysis of supplier data.

Quality Management Systems (QMS), such as ISO 9001, TQM, and Six Sigma, serve as frameworks for improving product and service delivery, especially through principles that guide how quality is defined, measured, and improved. While ISO 9001 (2008; 2015) codifies eight core principles, scholars have interpreted and applied these principles in various ways, highlighting both consensus and divergence. A dominant view in the literature prioritizes customer satisfaction as the core of quality. *Lazenby (2018*) emphasises that a customer-focused approach drives long-term success, pushing organizations to align their processes and values with external expectations. *Hennersdorf and Krallmann (2016)* on the other hand, advocated for careful design, monitoring, maintenance, and regular updates. The author emphasises allocating the necessary infrastructure, information, and resources to ensure process optimisation. Several of the studies including *Kok et al. (2014)* and Hennersdorf & *Krallmann (2016)* agree on the importance and vitality of leadership in setting direction, building culture, and supporting a quality-oriented environment, however, is this always the case, especially in developing countries, where there is non-availability of skilled workers, issue of outdated machinery, inadequacy of basic resources such as water, electricity and also raw materials *(Zahraee, 2016; Kinyondo et al., 2014*). For instance, while Six Sigma's data-driven rigor may enhance precision, its complexity may hinder adoption in resource-constrained firms lacking the technical expertise to sustain its methodologies.

Despite the extensive advocacy for worldwide Quality Management System models like ISO 9001 and Six Sigma, the implementation of these systems in developing nations presents significant obstacles. Resistance to change constitutes a significant obstacle to the adoption of Quality Management Systems (QMS). Senior management efforts to implement QMS may be thwarted by opposition to change and rejection of new standards *(Getahun et al., 2019)*. Implementing and maintaining quality efforts is further hampered by a lack of qualified staff and inadequate training opportunities. The adoption of the QMS may be hampered by a shortage of human resources and employee turnover *(Gachuki et al., 2016).* The QMS implementation strategy is a crucial resource that influences the efficacy of the system's execution. An unsuitable implementation strategy hinders QMS adoption. Moreover, technological constraints, including antiquated equipment and insufficient digital infrastructure, impede efficient monitoring, data acquisition, and ongoing enhancement processes *(Carvalho et al. 2019; Tanasiichuk, Karaman, and Natrus, 2023).*

While scholars like *Lazenby (2018) and Kok et al. (2014) emphasise* intrinsic quality drivers such as customer satisfaction and leadership engagement, others like *Zahraee (2016)* and *Kinyondo et al. (2014*) draw attention to structural limitations that challenge these ideals, such as lack of infrastructure and outdated machinery. This suggests that although global quality frameworks provide ideal standards, their implementation in resource-limited settings may necessitate modification. Moreover, some authors like *Hennersdorf and Krallmann (2016)* advocate for a process- and data-driven approach. Integrating all of these perspectives demonstrates that quality management is not simply a collection of rules, but a delicate balance between strategic objectives and operational feasibility. In this work, the conceptual model is based on these theoretical differences.

In summary, the literature on quality management presents a broad spectrum of principles. However, these principles may not be universally applicable, particularly in developing countries where infrastructure, skills, and systems are lacking. Although there is general agreement that QMS frameworks enhance product and service delivery, the driving factors behind their successful implementation remain underexplored in the South African manufacturing context. There is a need to examine which factors are most influential in enabling effective QM practices. This study therefore seeks to address this critical gap.

3. Research Methodology

This study employed a quantitative cross-sectional survey design to investigate the driving factors for the application of Quality Management Systems (QMS) in South Africa's manufacturing sector. The research utilised structured questionnaires to collect primary data, supplemented by secondary sources such as journals, industry reports, and archived materials. The study was geographically centred in Johannesburg due to its prominence in manufacturing activities and accessibility to relevant professionals. The target population included approximately 400 individuals such as managers, operators, and labourers directly involved in quality management. A census sampling method was adopted, and data collection was conducted in two stages while observing COVID-19 regulations. A pilot study, as recommended by *Majid et al. (2017),* was carried out to refine the questionnaire, identify ambiguities, and improve question clarity. The questionnaire, divided into five sections, focused on driving factors, impacts, barriers, and benefits of QMS in the delivery of products and services. Data collection occurred between June and November 2023 using online surveys for safety and reach. For analysis, a five-point Likert scale was employed, and the mean item score (MIS) was calculated using a specific equation to rank responses. Exploratory Factor Analysis (EFA) was applied to distil patterns among variables and understand correlations *(Pallant, 2011; Yong and Pearce, 2013*). Key EFA techniques included the Kaiser-Meyer-Olkin test, Bartlett's test, pattern matrices, and scree plots. To ensure the integrity of findings, emphasis was placed on reliability and validity, with employee involvement being highlighted as essential to the success of QMS *implementation (Birolini and Birolini, 2017; Moodliyar, 2008).*

4. Findings

The demographic analysis of respondents reveals varied educational backgrounds, age groups, and professional affiliations within the manufacturing industry. The majority of respondents hold a bachelor's degree (20.5%), closely followed by those with honours (20%) and master's degrees (19.5%). A smaller proportion possess either a doctorate or a post-matric certificate (13.3% each), while 11.9% have a professional degree and only 1.4% hold a national vocational certificate. Regarding age distribution, the largest group falls within the 35–49 years range (33.8%), followed closely by those aged 50–70 years (32.9%). Younger participants aged 25–34 and 18–24 account for 19.5% and 12.4% respectively, with a minimal number aged 76 (1%) and 82 (0.5%) years. In terms of job affiliation, the respondents held various positions in the manufacturing sector, with operators making up the largest group at 15.2%, followed by quality management directors (14.3%), supervisors (12.9%), and processing workers (12.4%). General labourers and managers each comprised 11.9%, material handlers 11.4%, and assemblers 10%. The work experience of respondents also varied, with 26.7% having 6–10 years of experience, and 19.5% having 1–5 years. Additionally, 16.7% had 11–15 years, 14.3% had over 20 years, 13.8% had 16–20 years, while only 9% had less than one year of experience in the manufacturing industry.

4.1 Descriptive analysis for driving factors for the application of QM

The descriptive analysis provided the mean item score (MIS), standard deviation (SD), and ranking of the variables, which are displayed in Table 1. On a five-point Likert scale, the participants ranked the driving factors as follows: 1 (Strongly disagree), 2 (Disagree), 3 (Neutral), 4 (Agree), and 5 (Strongly agree). The respondents' viewpoints are manifested in the order of the variables' rankings. The results show that involvement in the QM application process was ranked first with MIS of 4.90 and SD of 0.322, focus on client's satisfaction was ranked second with MIS of 4.73 and SD of 0.454, continuous improvement of QM was ranked third with MIS of 4.71 and SD of 0.455, focus on customers' needs was ranked fourth with MIS of 4.69 and SD of 0.463, encourage and motivate other employees was ranked fifth with MIS of 4.63 and SD of 0.483, attend training sessions was ranked sixth with MIS of 4.61 and SD of 0.517, contribute to improvements was ranked seventh with MIS of 4.58 and SD of 0.495, produce quality work the first time was ranked eight with MIS of 4.57 and SD of 0.496, accept change of cultures and systems was ranked ninth with MIS of 4.55 and SD of 0.499, accept new ideas from colleagues was ranked tenth with MIS of 4.54 and SD of 0.499, motivate colleagues in sharing ideas, and encourage mutual respect and teamwork were both ranked eleventh with MIS of 4.51 and SD of 0.501 respectively. "Take into account the shared ideas" was ranked lowest with a MIS of 4.46 and SD of 0.509. In contrast, "Share knowledge and skills" was ranked thirteenth with a MIS of 4.47 and SD of 0.510.

Table 1: Driving Factors for the Application of QM

Codes	Driving Factors for the Application of QM	Mean	Std. Deviation	Rank
DFQ1	Involvement in the QM application process	4.90	0.322	1
DFQ2	Focus on client's satisfaction	4.73	0.454	2
DFQ3	Continuously improvement of QM	4.71	0.455	3
DFQ4	Focus on customer needs	4.69	0.463	4
DFQ5	Encourage and motivate other employees	4.63	0.483	5
DFQ6	Attend training sessions	4.61	0.517	6
DFQ7	Contribute to improvements	4.58	0.495	7
DFQ8	Produce quality work the first time	4.57	0.496	8
DFQ9	Accept change of cultures and systems	4.55	0.499	9
DFQ10	Accept new ideas from colleagues	4.54	0.499	10
DFQ11	Motivate colleagues in sharing ideas	4.51	0.501	11
DFQ12	Encourage mutual respect and teamwork	4.51	0.501	11
DFQ13	Share knowledge and skills	4.47	0.510	13
DFQ14	Take into consideration the shared ideas	4.46	0.509	14

4.2 Exploratory factor analysis for driving factors for the application of QM

All the identified driving factors for QM application were subjected to Exploratory Factor Analysis (EFA) to reveal underlying relationship among the variables. The data suitability for exploratory factor analysis was determined the correlation matrix as illustrated in Table 2. A preliminary inspection of the correlation matrix revealed that while some variable pairs exhibit moderate correlations (e.g., DFQ8 and DFQ9 = 0.516), others showed weak (e.g., DFQ3 and DFQ1 = 0.047) or even negative correlations (e.g., DFQ6 and DFQ3 = -0.188). While EFA does not require all variables to be strongly correlated, it assumes that there are sufficient interrelationships to justify factor extraction. Therefore, individual weak correlations are acceptable as long as the overall matrix demonstrates factorability *(Field, 2013).*

Table 2: Correlation Matrix for Driving Factors for the Application of QM

	DFQ1	**DFQ2**	**DFQ3**	**DFQ4**	**DFQ5**	**DFQ6**	**DFQ7**	**DFQ8**	**DFQ9**	**DFQ10**	**DFQ11**	**DFQ12**	**DFQ13**	**DFQ14**
DFQ1	**1.000**													
DFQ2	0.248	**1.000**												
DFQ3	0.047	0.273	**1.000**											
DFQ4	-0.112	-0.019	0.344	**1.000**										
DFQ5	0.050	0.088	-0.022	0.315	**1.000**									
DFQ6	0.091	0.009	-0.188	-0.050	0.305	**1.000**								
DFQ7	0.117	0.087	0.094	-0.155	-0.168	0.280	**1.000**							
DFQ8	0.070	0.162	0.128	-0.080	-0.032	-0.029	0.337	**1.000**						
DFQ9	0.135	0.179	0.127	0.032	0.048	-0.049	0.114	0.516	**1.000**					
DFQ10	0.098	0.008	0.140	0.133	-0.004	0.074	0.007	0.009	0.206	**1.000**				
DFQ11	0.008	0.051	0.189	0.132	0.067	-0.013	-0.041	-0.176	-0.080	0.236	**1.000**			
DFQ12	-0.054	-0.079	0.049	0.067	0.173	0.243	0.082	-0.202	-0.293	-0.054	0.345	**1.000**		
DFQ13	-0.094	-0.008	0.080	0.044	0.047	0.003	0.115	0.068	0.032	-0.107	0.057	0.206	**1.000**	
DFQ14	0.015	0.030	0.248	0.097	-0.062	0.025	0.129	0.059	0.029	0.234	0.105	0.189	0.236	**1.000**

In order to determine the overall suitability of the data for exploratory factor analysis, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) sampling adequacy measure were estimated. *Field (2013)* states that factor analysis is generally deemed appropriate to continue with when the KMO value is 0.6 or greater. Furthermore, for Bartlett's test of sphericity, significance is defined as $P \leq 0.05$ *(Williams, 2011).* Based on the results displayed in Table 3, which include a significant Bartlett's test of sphericity (value of $\chi^2 = 455.67$, $p < 0.001$), and a KMO (value = 0.742), the survey responses are deemed valid and suitable for exploratory factor analysis indicating that the correlation matrix is not an identity matrix and that underlying relationships exist among the variables. Together, these results justify proceeding with factor analysis, despite the presence of some weak pairwise correlations.

Table 3: KMO and Bartlett's Test for Driving Factors for the Application of QM

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.742
Bartlett's Test of Sphericity	Approx. Chi-Square	455.677
	Df	91
	Sig.	0.000

Presented in Table 4 is the communalities of the driving factors for QM application, with extraction values of not less than 0.3. A look at the extraction values shows no figure less than 0.3 which indicates that the variables fit well with other variables in their components with no variance. With the variables having high extraction values as shown in the Table, the factor grouping can be relied upon.

Table 4: Communalities for Driving Factors for the Application of QM

Driving Factors	**Initial**	**Extraction**
Involvement in the QM application process	1.000	0.575
Continuously improvement of QM	1.000	0.696
Produce quality work the first time	1.000	0.674
Encourage mutual respect and teamwork	1.000	0.680
Contribute to improvements	1.000	0.813
Accept change of cultures and systems	1.000	0.767
Accept new ideas from colleagues	1.000	0.638
Focus on customer needs	1.000	0.697
Focus on client’s satisfaction	1.000	0.685
Motivate colleagues in sharing ideas	1.000	0.813
Share knowledge and skills	1.000	0.527
Take into consideration the shared ideas	1.000	0.678
Encourage and motivate other employees	1.000	0.575
Attend training sessions	1.000	0.533
Extraction Method: Principal Component Analysis.		

Once the suitability of the data set had been determined, exploratory factor analysis was performed. The eigenvalues of the QM application driving factors with values greater than one were extracted. This aligns with Kaiser's criterion, which specifies the retention of factors whose eigenvalues are greater than 1.0. Table 4.6 demonstrates that six factors satisfied this criterion. 1.110, 2.081, 1.965, 1.564, 1.399, 1.234, and 1.385 are the eigenvalues of the six factors, which account for 14.865%, 14.035%, 11.170%, 9.992%, 8.814%, and 7.931% of the variance, respectively. The six extractions collectively explain 66.807% of the total variance. Stern (2010) proposes a 50% threshold, which is exceeded by this value.

Table 5: Total Variance Explained for Driving Factors for the Application of QM

Factors	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.081	14.865	14.865	2.081	14.865	14.865	1.870	13.358	13.358
2	1.965	14.035	28.900	1.965	14.035	28.900	1.595	11.392	24.750
3	1.564	11.170	40.070	1.564	11.170	40.070	1.532	10.942	35.692
4	1.399	9.992	50.062	1.399	9.992	50.062	1.497	10.692	46.384
5	1.234	8.814	58.876	1.234	8.814	58.876	1.448	10.341	56.725
6	1.110	7.931	66.807	1.110	7.931	66.807	1.411	10.082	66.807
7	0.855	6.108	72.915						
8	0.839	5.996	78.911						
9	0.688	4.913	83.824						
10	0.610	4.360	88.184						
11	0.454	3.242	91.426						
12	0.422	3.017	94.442						
13	0.418	2.989	97.431						
14	0.360	2.569	100.000						
Extraction Method: Principal Component Analysis.									

In a comparable manner, the scree plot, as illustrated in Figure 2, examines the component number along with the eigenvalue. As indicated by the graph, the line becomes more diagonal towards the bottom of the horizontal axis (component number) as the number of components increases. Because each succeeding factor contributes a decreasing amount to the overall variance, this is the case. The graph illustrates that the retention of only six factors is worthwhile, given that the sixth factor reveals a change in the elbow.

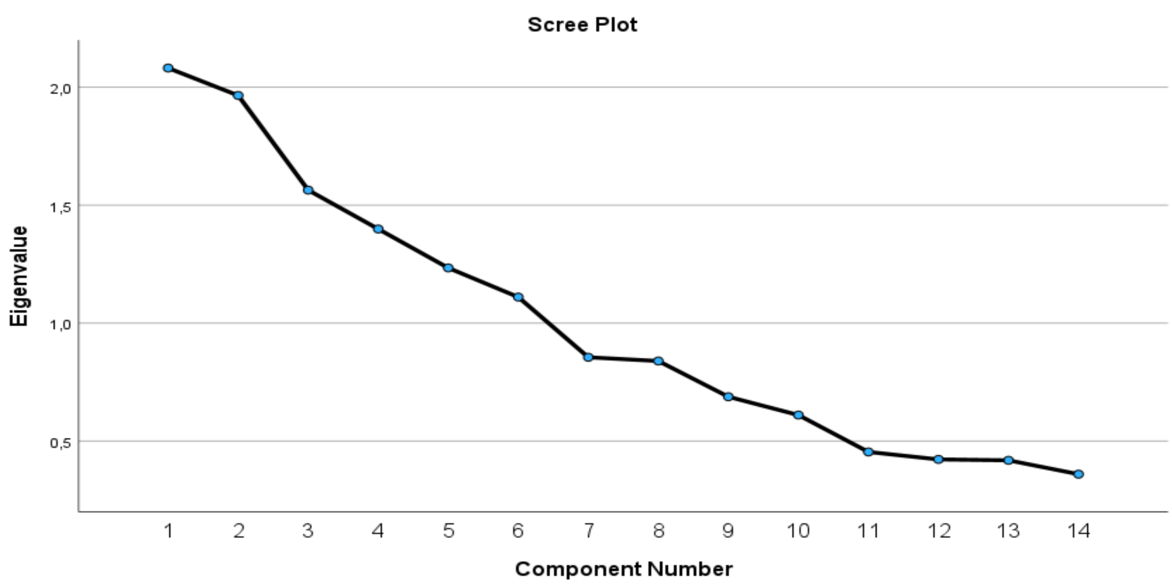

Figure 2: Scree Plot for Driving Factors for the Application of QM

Table 6 displays the extracted pattern matrix, which provides an overview of the loading variables and the corresponding loading values of factors. A total of six (6) components were achieved through varimax rotation. However, *Kline (2014),* stated that a component is named when two or more variables are clustered on it. Hence the component was removed, and the total components were reduced to five (5) as shown in Table 6. Factor retention adhered to the Kaiser criterion (Eigenvalues > 1). A preliminary loading criterion of 0.5 was employed to ascertain substantial item-factor associations. Nonetheless, in accordance with recommendations made by *Hair et al. (2010)* and *Field (2013),* certain items that had somewhat lower loadings (between 0.45 and 0.5) were retained since they showed a strong conceptual relationship and thematic coherence with other items. In contrast, variables exhibiting low loadings and insufficient theoretical alignment were omitted to enhance internal consistency

Table 6: Extracted Pattern Matrix for Driving Factors for the Application of QM

Factors Driving QMS Application	**Components**				
	1	2	3	4	5
Customer Fous					
Focus on customer needs	0.787				
Focus on client's satisfaction	0.785				
Team Engagement and Learning					
Encourage and motivate other employees		0.721			
Attend training sessions		0.551			
Take into consideration the shared ideas		0.498			
Team Cohesion					
Encourage mutual respect and teamwork			0.776		
Contribute to improvements			0.738		
Knowledge Sharing					
Motivate colleagues Fin sharing ideas				0.872	
Share knowledge and skills				0.480	
Quality Orientation					
Continuous improvement of QM					0.809
Involvement in the QM application process					0.667
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.a					
a. Rotation converged in 9 iterations.					

As shown in the Table 6 above. five extracted components were named guided by thematic coherence and existing QM literature

1.The first extracted principal factor with eigenvalue of 2.081 and accounting for 14.865% of the total variance, contains two variables which includes 'Focus on customer needs' (78.7%), and 'Focus on client's satisfaction' (78.5%). This factor reflects a strong orientation toward meeting and exceeding client expectations and was subsequently named Customer Focus.

2. Loaded in factor 2 are three variables which are 'Encourage and motivate other employees' (72.1%), 'Attend training sessions' (55.1%), and 'Take into consideration the shared ideas' (49.8%), This component highlights employee involvement in motivational and developmental activities, and despite the low loading of one of its variables, it was retained due to its conceptual alignment with continuous improvement. This factor was thus named Team Engagement and Learning

3. The third factor explains 11.170% of the total variance and has two variables which includes 'Encourage mutual respect and teamwork' (77.6%) and 'Contribute to improvements' (73.8%). This factor was named Team Cohesion

4. Loaded in factor four are two variables which explains 8.814% of the variance. These variables are 'Motivate colleagues in sharing ideas' (87.2%), and 'Share knowledge and skills' (48%). This factor captures communication

and shared expertise in QM practices. One variable had a loading slightly below 0.5 but was retained due to alignment with literature. They were subsequently named Knowledge sharing.

5. Loaded in factor five are two variables which includes 'Continuous improvement of QM' (80.9%), and 'Involvement in the QM application process' (66.7%). This component reflects adherence to quality principles and employee involvement. This was labelled as Quality orientation
The component correlation matrix, which illustrates the relationship among the five extracted principal factors, is displayed in Table 7. A solid relationship is denoted by positive values, whereas a weak relationship is indicated by negative values among the factors.

Table 7: Component Transformation Matrix for Factors driving QMS

Component	1	2	3	4	5	6
1	0.845	0.12	-0.148	-0.109	0.187	0.45
2	-0.239	0.586	0.486	0.097	0.54	0.251
3	-0.021	0.358	-0.44	0.801	-0.178	0.068
4	0.359	0.371	0.534	0.04	-0.568	-0.352
5	0.308	-0.152	0.017	0.27	0.564	-0.701
Extraction Method: Principal Component Analysis.						
Rotation Method: Varimax with Kaiser Normalisation.						

From the findings above, it can be seen that, involvement in the QM application process, focus on client's satisfaction, and focus on customer needs, are the top ranked driving factors. Similarly, the factor analysis carried out coherent with the descriptive findings, as focus on client and customer needs is the most important component (component 1). Achieving clients and customers' needs is only possible if all top managements and employees are involved in the QM application process. These findings corroborate the view of *Mangi et al. (2015)* that involvement of all employees through teamwork is essential and crucial for the successful implementation of the QM, as it promotes effective communication and strengthens organisational integration by ensuring everyone is involved. In the same line, the factor analysis further revealed 'team encouragement and motivation', and relationship among team members' as the second and third factors that contribute more to the QM application, with respective total variance of 14.035% and 11.170%. This invariably means that teamwork encouragement and teamwork are critical factor for successful QM implementation. Literature further revealed the importance of employees' encouragement in sharing their thoughts and insights based on experience and expertise to support the company's continuous quality development, as a critical factor *(Juran, 2009)*. This is crucial because teamwork is better than individual work. Soliciting feedback and suggestions from each employee regarding quality and performance enhancements will additionally contribute to the organisation's productivity and goal attainment. Furthermore, there is evidence from literature that focus on client and customer needs, changes in culture and system are major factors to be considered in QMS application *(Knowles, 2011; Lazenby, 2018; Schraeder, 2009)*. Furthermore, *Gonzalea and Guillen (2002)* concurred that leadership and management commitment are among the most critical elements for the effective execution of TQM.

5. Conclusion and Recommendation

This study explored the driving factors influencing the application of Quality Management (QM) in the delivery of products and services within South Africa's manufacturing industry. Through a comprehensive analysis combining descriptive statistics and exploratory factor analysis, the research identified several critical elements that significantly motivate the implementation of QM systems in manufacturing processes. Key among these factors are involvement of employees in QM processes, a strong focus on client and customer satisfaction, continuous quality improvement, encouragement of teamwork, and knowledge sharing among staff members. These findings affirm that successful quality management hinges not only on technical standards and procedures but also on human and relational aspects within organisations. The results demonstrated that the most highly ranked driving factor was the involvement of employees in QM applications, which highlights the importance of inclusive participation in quality initiatives. This was closely followed by a focus on client satisfaction and customer needs—underscoring the external orientation necessary for competitive performance in today's customer-driven manufacturing landscape. The factor analysis reinforced these findings, with "Customer Focus" emerging as the most dominant component. Other essential components such as "Team Engagement and Learning," "Team Cohesion," "Knowledge Sharing," and "Quality Orientation" further revealed the centrality of people-related variables in driving quality performance

It is also evident that a holistic approach to QM, one that aligns leadership, employee engagement, systematic process orientation, and customer-centric thinking, is critical for ensuring sustainable improvements in quality outcomes. The study supports the view that quality management cannot be achieved in isolation but must be embedded into the organisational culture and reinforced through continuous learning and adaptation. The use of tools such as training, open communication, and mutual respect were shown to be crucial mechanisms through which organisations can empower staff and foster collective responsibility for quality. Based on these insights, it is recommended that manufacturing firms in South Africa should prioritise the creation of a participatory quality culture, where all employees, regardless of rank, are engaged in the quality management process. Companies should establish regular training programs to build employee competence and confidence in QM practices. Furthermore, leadership should actively promote a vision of quality excellence, not merely as a compliance requirement, but as a strategic asset that enhances customer satisfaction and business competitiveness. Organisations are also encouraged to invest in systems that facilitate effective communication, continuous feedback, and knowledge sharing. By creating an environment where ideas are openly exchanged, and contributions are valued, firms can unlock innovative solutions and foster a sense of ownership among employees. Importantly, there must be a sustained effort to monitor and evaluate QM initiatives using evidence-based approaches, ensuring that decision-making processes are guided by data rather than intuition.

References

Bon, A.T., and Mustafa, E.M., Impact of total quality management on innovation in service organizations: Literature review and new conceptual framework, Procedia Engineering, vol. 53, pp. 516–529, 2013.

Carvalho, C., Carvalho, D., and Silva, M., Value stream mapping as a lean manufacturing tool: A new account approach for cost saving in a textile company, International Journal of Production Management and Engineering, vol. 7, no. (1), pp. 1–12, 2019.

Casadesus, M., Marimon, F., and Alonso, M., The future of standardised quality management in tourism: Evidence from the Spanish tourist sector, The Service Industries Journal, vol. 30, no. (14), pp. 2457–2474, 2010.

Dehwari, M., Designing a comprehensive system model for Iran's light industries, Master's thesis, Zahedan, Nikbakht University, 2013.

Douglas, L., and Connor, R., Attitudes to service quality – The expectation gap, Nutrition and Food Science, vol. 33, no. (4), pp. 165–172, 2003.

Field, A., Discovering statistics using IBM SPSS statistics, 4th ed., Thousand Oaks, CA: Sage, 2013.

Gachuki, T., Sewe, R., Umuro, M., Mwangi, J., Turgeon, D., Luman, E.T., and Garcia, M., Attaining ISO 15189 accreditation through SLMTA: A journey by Kenya's National HIV Reference Laboratory: Lessons from the field, African Journal of Laboratory Medicine, vol. 5, no. (2), pp. 1–9, 2016.

Getahun, M.S., Yemanebrhane, N., Desalegn, D.M., Kitila, K.T., Dinku, T.T., Wondimagegnehu, D.D., Wolde, E.A., Bika, A.T., Mersha, T.B., Asferie, K.D., and Rorissa, A.W., Medical laboratory accreditation in a resource-limited district health centre laboratory, Addis Ababa, Ethiopia, African Journal of Laboratory Medicine, vol. 8, no. (1), pp. 1–5, 2019.

Gonzalez, T.F., and Guillen, M., Leadership ethical dimension: A requirement in TQM implementation, The TQM Magazine, vol. 14, no. (3), pp. 150–164, 2002.

Goshime, Y., Kitaw, D., and Jilcha, K., Lean manufacturing as a vehicle for improving productivity and customer satisfaction, International Journal of Lean Six Sigma, vol. 10, no. (2), pp. 273–285, 2019.

Hair Jr, J.F., Black, W.C., Babin, B.J., and Anderson, R.E., Multivariate data analysis, Multivariate Data Analysis, 7th ed., pp. 785–785, 2010.

Hennersdorf, S.S., and Krallmann, S.H., Enhanced method for quality-fit (ISO 9001) operations within the automotive industry, Proceedings of the 26th DAAAM International Symposium, pp. 614–619, 2016.

Kinyondo, A.A., Wangwe, S., Mmari, D., and Aikael, J., The performance of the manufacturing sector in Tanzania: Challenges and the way forward, Available at: https://scholar.google.com, [Accessed 24 April 24,. 2024],

Kline, P., An easy guide to factor analysis, London: Routledge, 2014.

Knowles, G., Quality management, Illinois: Bookboon Press, 2011.
Kok, L., Lebusa, J.M., and Joubert, P.A., Employee involvement in decision-making: A case at one university of technology in South Africa, Mediterranean Journal of Social Sciences, vol. 5, no. (23), pp. 55–69, 2014.
Lasida, J., Isola, R., and Sarasola, M., Estudio de impacto de instrumentos de evaluación y mejora de centros educativos: Impact study of evaluation and improvement tools of schools, Páginas de Educación, vol. 9, no. (1), pp. 20–50, 2016.
Lazenby, J.A., General management, 5th impression, Pretoria: Van Schaik, 2018.
Majid, M.A., Othman, M., Mohamad, S.F., Lim, S.A.H., and Yusof, A., Piloting for interviews in qualitative research: Operationalization and lessons learnt, International Journal of Academic Research in Business and Social Sciences, vol. 7, no. (4), 2017.
Maney, P.P., and Patail, J.R., Quality management system at construction projects, Proceedings of the Civil Engineering PG Conference, 24–25 April, Pune: MAEER's MIT, 2015.
Mangi, A.A., Kanasro, H.A., Burdi, M.B., and Rehman, F.N., Teamwork: A key to organizational success, The Government – Annual Research Journal of Political Science, vol. 3, no. (3), pp. 335–348, 2015.
Moodliyar, L., The sustainable implementation of ISO 9001:2000 at an automotive service centre, BEng., University of Pretoria, 2008.
Nicoletti, J.A., Adaptation and application of ISO 9000:2000 quality standards in the educational field, Educational Horizons, vol. 13, no. (2), pp. 75–86, 2008.
Pallant, J., SPSS survival manual: A step-by-step guide to data analysis using SPSS, 4th ed., 2011.
Rodríguez-Mantilla, J.M., Martínez-Zarzuelo, A., and Fernández-Cruz, F.J., Do ISO: 9001 standards and EFQM model differ in their impact on the external relations and communication system at schools??, Evaluation and Program Planning, vol. 80, p. 101816, 2020.
Stern, L., A visual approach to SPSS for Windows: A guide to SPSS 17.0, 2nd ed., Boston: Allyn and Bacon, 2010.
Tanasiichuk, I., Karaman, O., and Natrus, L., Key success factors for the implementation of quality management systems in developing countries, African Journal of Laboratory Medicine, vol. 12, no. (1), p. 2058, 2023.
Techiequality, 7 principles of Quality Management Principles (QMS), Available at: https://www.techiequality.com, [Accessed on March 27,. 2022].
Uwadia, F.U., Edoun, E.I., Pradhan, A., and Mbohwa, C., The roles of employee and management in the application of Quality Management System (QMS) in South African manufacturing industry, Proceedings of the First Australian International Conference on Industrial Engineering and Operations Management, 20–21 December, Sydney, Australia, 2022.
Williams, C., Research methods, Journal of Business and Economics Research (JBER), vol. 5, no. 3, 2011.
Yong, A.G., and Pearce, S., A beginner's guide to factor analysis: Focusing on exploratory factor analysis, Tutorials in Quantitative Methods for Psychology, vol. 9, no. 2, pp. 79–94, 2013.

Biographies

Uwadia Uche Festus is a passionate Engineer and a Researcher by profession. He earns a Doctorate Degree (PhD) in Quality Engineering within the Faculty of Engineering and Built Environment, University of Johannesburg. He holds a master's degree in Operation Management from University of Johannesburg, South Africa and a bachelor's degree of Engineering (B.Eng.) in Computer Science and Engineering from Enugu State University of Science and Technology, Enugu State, Nigeria. He has several working experiences in the field of Computer Engineering with specific experience in networking, fibre installation, robotics and software designs. His research specializations include operations management, quality engineering, sustainable management engineering, innovation management and supply chain management with general research interests in the field of operations management, quality engineering, innovation management, engineering sustainability, supply chain management. renewable sustainable engineering issues, cyber security management, artificial intelligence, sustainable development in industrial management, continuous improvement and sustainability in industrial management and life cycle assessments. He has published several conference papers. He has applied to be a member of Engineering Council of South Africa (ECSA) and awaiting approval.

Edoun E.I is an academic, he holds a PhD from the University of Witwatersrand in Johannesburg South Africa. He has travelled widely between different countries in Africa while interacting with academic institutions, policy makers, policy implementers and community members. He is industrious and has good conceptual and organizational skills, He has consulted and spearheaded projects at the African Union, NEPAD, the Pan African Parliament ; AFRODAD.I have been involved as an academic at various University is South Africa and abroad. He has supervised more than 20 PhD Students, 30 full masters and 100 MBAs students. He has attended many conferences, locally and abroad, and has published many articles in the International accredited Journals.

Anup Pradhan is an Associate Professor in the Department of Quality and Operations Management at the University of Johannesburg, South Africa. He received BSc in Agricultural Engineering from Bangladesh Agricultural University, Bangladesh, ME in Agricultural Engineering and Systems from Asian Institute of Technology, Thailand, and PhD in Biological and Agricultural Engineering from University of Idaho, USA. His research interests include life cycle assessment, renewable energy, farm mechanization, smart factory, smart grid management, applied research and optimization, organizational productivity, knowledge management. He has published several journal and conference papers. He is a NRF rated researcher in South Africa and a registered engineer with Nepal Engineering Council (NEC). He is a member of American Society of Agricultural and Biological Engineers (ASABE), Engineering Council of South Africa (ECSA), Nepal Engineer’s Association (NEA), Gamma Sigma Delta, Golden Key International Honour Society.