



International Journal of Business Excellence

ISSN online: 1756-0055 - ISSN print: 1756-0047

<https://www.inderscience.com/ijbex>

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DOI: [10.1504/IJBEX.2020.10032315](https://doi.org/10.1504/IJBEX.2020.10032315)

Article History:

Received:	06 January 2020
Accepted:	04 June 2020
Published online:	16 January 2023

A Fourth Industrial Revolution approach to total quality management on innovation performance: evidence from South Africa

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Abstract: Although many studies on the relationship of TQM practices and innovation performance within manufacturing have been conducted, extant literature from a research perspective is very much lacking. Currently, the Fourth Industrial Revolution (FIR) will continue to drive the strategic research, development and business focus towards strategic investment, geared in the direction of the building of innovation capacities and organisation performance, whilst utilising effective quality management practices. The aim is to examine the impact of total quality management (TQM) practices on innovation performance in a research organisation from a South African context. A multi-collinearity test was used to assess the data collected. The results indicate that TQM practices; namely: leadership, customer focus, people management, and strategy display a significant and positive relationship with innovation performance. A distinct benefit is a renewed customer-centric approach which will enable the development, sustainability and enhance organisational strategy for the commercialisation of products and processes.

Keywords: total quality management; TQM; research organisation; leadership; innovation; performance; strategy; multi-collinearity; South Africa.

Reference to this paper should be made as follows: Naidoo, S. and Govender, V. (2023) 'A Fourth Industrial Revolution approach to total quality management on innovation performance: evidence from South Africa', *Int. J. Business Excellence*, Vol. 29, No. 1, pp.61–79.

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1 Introduction

Globally research and development is growing at a rapid pace, altering the direction of innovation focus, research strategy and investment (Department of Science and Technology, 2018; OECD, 2018). Currently, with a dynamic intention to build on its scientific, engineering, technological and enhance infrastructure to ensure sustainability of its national business imperatives, resources and research institutions, developing countries such as South Africa are now pursuing the development of centres of research excellence in the fields of biotechnology, medical, mining, artificial intelligence, robotics, machine learning and data analytics.

Thereby ensuring a sense of readiness and preparedness in terms of innovation capacity, skilled researchers, quality products, processes, infrastructure and effective management of its technology based institutions towards Fourth Industrial Revolution (FIR) capabilities. As a result, it is imperative, that research and development investment be treated a national priority, increased and sustained long term to enhance the connection between both innovation and business within South African research organisations. Partnerships in the scientific, technological, and innovation sphere need to be aligned to the strategic focus areas of Government and the private sector to ensure a sustainable society to enable targeted resources to build the research infrastructure required by a global economy. Improvements in quality management, productivity, a knowledge based economies and the sustainability of society can all be achieved through the better utilisation and management of science, technology and innovation based research and development organisations (Department of Science and Technology, 2018).

Extant literature over recent years has shown positive correlations between total quality management (TQM) practises and innovation performance, with both aspects globally recognised for improving both performance of the organisation and competitive advantages (Bigliardi and Galati, 2014; Long et al., 2015; Fallahnejad and Lori, 2015; Maistry et al., 2017). However, although much research on the relationship of TQM practices and innovation performance within a manufacturing organisation had been conducted, extant literature from a research organisation is very much lacking or absent. This paper will therefore attempt to add to the limited body of knowledge regarding the impact of TQM dimensions on innovation performance within the South African research sector. The primary objective of the study therefore is to identify the relationship between TQM practices and innovation performance in a research organisation. The research focus will seek to examine four selected TQM practices namely: customer focus, leadership, and strategy and people management. Additionally, this research paper will attempt to establish which TQM construct foster or hinder the performance of innovation in a research organisation.

2 Literature review

2.1 TQM philosophy

TQM first introduced by quality guru Deming, Feigenbaum, Juran, and Crosby (Foster, 2017), can be defined as a management philosophy that seeks to direct organisations towards continual improvement of both its processes and quality management systems. Thereby ensuring not only continuous improvement in products and processes but customer satisfaction, organisational performance and sustainability (Bigliardi and Galati, 2014; Sadikoglu and Olcay, 2014). Empirical studies (Kafetzopoulos et al., 2015; Aquilani et al., 2017; Patyal and Koilakuntla, 2017; Singh et al., 2018) have shown that the successful implementation of TQM practises and principles has a significant and positive influence on an organisation's performance. Although TQM is widely suitable as a process improvement practise in terms of improving organisational performance, organisations are still motivated to achieve continuous improvement in order to become sustainable in a highly competitive and ever changing business environment (Mehmood et al., 2014).

Despite its contribution to the continuous improvement of processes, products, services and quality, the TQM concept today still faces many barriers to implementation. Barriers related to increased costs due to poor associations between cultural limits and organisational performance standards (Yousif et al., 2017). Moreover, Sadikoglu and Olcay (2014) state that the positive correlation between TQM and organisational performance highlights the importance of TQM practises with respect to organisational sustainability and implementation of TQM within an organisation. This may guide managers in their motivation of employees towards improving business performance.

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The above literature review shows that there is no single definition of TQM, but rather that many holistic definitions may be interpreted in the context of an organisation and its requirements. The successful adoption of TQM in an organisation may thus depend on what dimensions or constructs of TQM are practised (Bigliardi and Galati, 2014).

2.2 Leadership

From a TQM perspective, leadership plays a critical role in the effective and successful implementation of TQM in an organisation (Manders et al., 2016). Management support fosters employees engagement, productivity, practice and behaviour, leading to the better allocation of resources, improvements in quality, performance, and attainment of objectives (Yeng et al., 2018). The active involvement and participation of both employees and executive management are critical to the success of TQM (Ooi, 2014). For this to succeed, leadership in a TQM context requires continuous improvement and changes in organisational culture, with guidance and motivation being directed from management to employees (Panuwatwanich and Nguyen, 2017). Similarly, Manders et al. (2016) regarded the role of leadership to establish quality objectives and drive the provision of necessary resources and training. Training and development of employees

should be effective and in alignment with the objectives of the organisation, while striving for continuous improvement. Patyal and Koilakuntla (2017) state that management should strive to maintain and develop an organisation's quality management system with sufficient resources, which are needed to achieve the highest business performance.

2.3 Strategy

Strategic planning within a TQM context seeks to involve all employees within an organisation to be effectively implemented. Employees should be well versed in quality policy and systems and be competent and capable in order to ascertain the correct quality plan to implement and manage a sustainable and effective quality management system (Al-Damen, 2017). Anil and Satish (2016) stated that a lack of strategic planning may inhibit the successful implementation of TQM in an organisation. Within the TQM context, strategic planning is necessary to ensure that long-term organisational sustainability within a competitive environment is addressed. Pisano (2015) state that a good organisational strategy helps to promote the alignment between groups within an organisation, clarify corporate objectives and priorities, and direct the focus of all employees in achieving these objectives. Sadikoglu and Olcay (2014) assert that with effective strategic planning initiatives, employees will be more involved, together with management, in the development of the organisational vision, mission and business strategy and strategic objectives. This type of employee involvement may foster better acceptance and support for the strategic planning initiatives and will aid the improvement of corporate social responsibility, as environmental and social concerns will also be taken into account (Sadikoglu and Olcay, 2014).

2.4 Customer focus

Extant literature identified customer focus as a key construct of TQM practises (Yeng et al., 2018; Sadikoglu and Olcay, 2014; Anil and Satish, 2016). Abuzaid (2015) stated that a customer centric organisation tends to lead to a more sustainable and better competitive quality products and processes. To have a competitive advantage your sector, many organisations need to toughen the management in upstream and downstream of the whole supply chain so that members should have increasingly closer cooperation (Shukla et al., 2018). Kafetzopoulos et al. (2015) posited that customer satisfaction and centricity should be the goal of successful TQM implementation and that the strategy and implementation of an effective quality program should be oriented toward the customer. Mehmood et al. (2014) concluded that a customer centric approach is not necessarily associated with organisational performance. Additionally, a key hurdle to the successful execution and practise of TQM is a lack of customer focus (Anil and Satish, 2016). Also, establishing long term relationship with suppliers can facilitate the exchange of information that are essential for continuous improvement and monitoring process through reducing the variation in the input materials that thereby shift the focus from external variables to the process variation (Saleh et al., 2018). A greater understanding of customers' needs is critical to improve quality management initiatives (Foster, 2017; Al-Damen, 2017). Customer satisfaction is vital to organisational performance (Foster, 2017). Topalovic (2015) concluded that by improving product quality and service

offerings, satisfaction of customers can be maximised, thus leading to the achievement of increased profit and client retention.

2.5 People management

Critical to the successful implementation of TQM practises is the engagement of employees within an organisation. The engagement and integration of people management practices fosters the enhancement of an effective quality management system within the organisation, thereby improving researcher performance and engagement towards achieving the research strategic objectives, quality and business goals. Yeng et al. (2018) describe employee management as the degree to which employees in an organisation participate in training and development programs. Kafetzopoulos et al. (2015) state that effective employee management can promote an understanding of the importance of product quality in employees, thereby ensuring committed employees who are invested in quality improvement (Brajer-Marczak, 2014). Mehmood et al. (2014) assert that a key dimension for the successful implementation of TQM is teamwork and a supportive employee management system to foster efficiencies and enhanced capabilities of employees that accrue into organisational performance over time. Ngambi and Nkemkiafu (2015) recommend that employees within an organisation should be provided with continuous training and development of quality concepts, practises, policies, principles, team dynamic skills, root cause analysis training, and quality strategies. According to Al Kaabi and Sandhu (2018), the skill development process enables individual learning within a working environment that is rooted within an organisational collective context.

2.6 Innovation

According to the Organisation for Economic Cooperation and Development (OECD), OECD (2018), innovation can be defined as the enhancement of products and processes through the application of a new, innovative technique or idea within an organisation. In its entity, innovation can be described as an organisational compromise together with the research and development of new products, processes, and services, thus enabling the commercialisation of products, patents and processes. Thus leading to the sustainability of the organisation enabling the research and development new or enhanced products and services gaining complete advantages over competitors and improving an organisation market share in the economy (Pisano, 2015; Kogabayev and Maziliauskas, 2017; OECD, 2018; Antunes et al., 2017; Kahn, 2018; Gault, 2018). Innovation enables businesses to develop and introduce new or improved products to the market before their competitors and thus increase their market share (Chatzoglou and Chatzoudes, 2018; Edwards-Schachter, 2018; OECD, 2015). In many OECD countries, organisations currently finance the knowledge and intellectual capital that drive innovation R&D, resources and the capabilities of skilled employees and organisational capital, to the same extent as they do in human resources, manufacturing, safety and other sectors of the organisation. According to Pisano (2015), one of the biggest challenges with efforts to enhance innovation are a lack of an effective strategy for innovation. A good innovation strategy will aid the promotion and alignment of the strategic direction of the organisation (Pisano, 2015).

2.7 *TQM in research environments*

Research is a significant component for attaining a competitive advantage in terms of transformation and technology orientated organisations (Bigliardi and Galati, 2014; Pisano, 2015). Pisano (2015) states that most research organisations fail to improve performance due to misunderstandings of performance drivers within research organisations. Research performance stems from a variety of different components, such as the interaction of different decisions, the size and location of the organisation, groups working in silos, type of technologies, resources and capabilities, and well processed management and design (Pisano, 2015). According to Kumar et al. (2014) and Pisano (2015) quality improvement and performance in research organisations can be related to an organisation's competitive strategy; however, it is challenging to implement and practise successfully within research organisations. Every research organisation is different. The quality systems and the implementation of such practises may not be the same as in other sectors of industry, such as the manufacturing industry, where extant literature has shown TQM to be successfully implemented (Bigliardi and Galati, 2014). In recent years there has been a growing interest within research organisations to modify their strategies in line with TQM and research (Kumar et al., 2014). A review of the literature shows that TQM principles can be effective for enhancing capabilities within a research organisation (Honarpour et al., 2017) and that there is a significant association between the execution of TQM practices and research performance.

2.8 *The relationship between TQM and innovation*

Extant literature (Bigliardi and Galati, 2014; Maistry et al., 2017; Panuwatwanich and Nguyen, 2017) have shown that a significant correlation between the successful adoption of TQM practices and innovation, as well as the implementation of such practices, on organisational performance. Although quality management and innovation are two separate areas of study, they share many meaningful connections, including technological, human, organisational, and managerial and standardisation aspects. Practically, the association between management quality and innovation are not well documented or utilised (Anttila and Jussila, 2019). As a result, this study will aim to gather knowledge in terms of TQM practices namely: leadership, strategy, and customer focus and people management and its influence on innovation performance.

2.9 *Leadership and innovation*

Jia et al. (2018) assert the significant role of executive leadership styles in organisational innovation. In addition, the empowerment and mentorship of employees by leadership can help to enable the conception and application of innovation, and thereby improve innovation performance in an organisation. Hughes et al. (2018) argue that leadership is a significant variable that can either foster or hinder workplace creativity and innovation. Therefore, within a research organisation, leadership within a TQM and innovation context needs to be researched in more depth to ascertain whether leadership hinders or inhibit innovation performance. Leaders, according to Slimane (2015), motivate and inspire employees through their deeds and behaviours. Similarly, Jia et al. (2018) and Bouhali et al. (2015) assert that leadership plays an important role in promoting organisational innovation.

2.10 Strategy and innovation

Hajar (2015) conclude that an organisation's business strategy has a positive impact on innovation. Karabulut (2015) concluded that having an innovation strategy has the potential to improve the financial, customer, process, internal business processes and learning and growth performance of an organisation within the manufacturing sector. Antunes et al. (2017) posited that having an effective innovation strategy in an organisation may have a positive influence on business performance. However, an organisation will not benefit from the rewards of innovation if there is no support in place for this strategy (Antunes et al., 2017). Within an innovation context, organisations need to have an innovation strategy or strategic planning in place to effectively build on its existing and future innovation capacities to successfully innovate products and services for its customers. According to Hajar (2015), successful business strategies characteristically aim to build original, strong or unique competencies and capabilities in more than one area which is critical to the strategic success of the organisation. This forms the basis for gaining a competitive advantage over competitors.

2.11 Customer focus and innovation

Customer expectations and requirements are often better achieved when an organisation produces innovative, high-quality and efficient products (Sara, 2016). Long et al. (2015) assert that an organisation that is focused on customers motivates employees to enhance the innovativeness of the organisation's product, in order to meet both customer demand and satisfaction. Sadikoglu and Olcay (2014) state that successfully gaining knowledge into customer specific needs, wants, complaints, and suggestions for improvements encourages employees and organisations to research, develop and produce high quality reliable products and services. Therefore, a customer focus leads to improvements in efficiencies and production and as results in improved customer satisfaction, organisational performance and increased market shares.

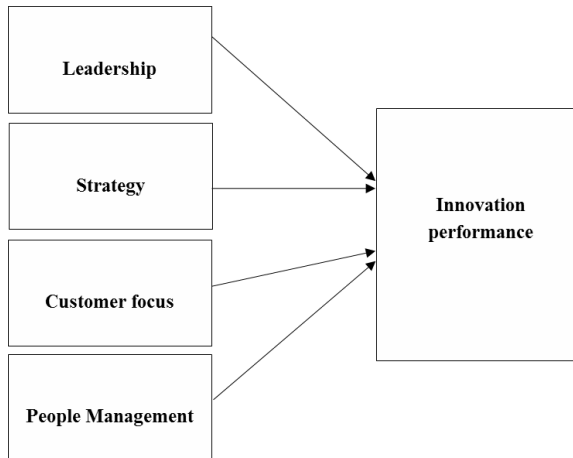
2.12 People management and innovation

Over the last decade, value co-creation emerged as a strategy for attaining sustained competitive advantage (Bharti et al., 2018). According to Long et al. (2015) the strategic management of human resource management is fundamental to the successful implementation of TQM practises as it fosters innovation output amongst employees. In addition, employees should seek to become partners with management in the development of an effective innovation strategy and policies in order to grow innovation performance in an organisation (Long et al., 2015). Similarly, Maier et al. (2014) state that employees of an organisation are a critical drivers for innovation and that a supportive and nurturing environment by management fosters a successful innovation culture. According to Rajapathirana and Hu (2018), an organisation with an innovation culture that is nurtured and supported by both employees and management provides a creative environment for innovation of ideas and the conversion of these into tangible and profitable products and services.

3 Conceptual framework

The literature review aimed to identify and define the dimensions of TQM with a specific focus on leadership, strategy, and customer focus and people management. Empirically and conceptually, the impact of TQM dimensions on innovation performance in a research context is examined. The conceptual framework for this article is presented in Figure 1.

Figure 1 Conceptual framework to assess innovation performance in a research organisation



Source: Researchers

4 Experimental method

The results of this research study were generalised for a South African research organisation, specialising in mining technology and encompassing of approximately 600 employees. This study attempted to focus on the employees in a research organisation and their perception of TQM practise in relation to innovation performance within their organisation. This research study attempted to derive diverse perceptions of TQM and innovation performance. Additionally, this study also aimed to determine whether TQM practices foster innovation performance based on the perception of each respondent. Respondents comprised of management, consultants, technical specialists, scientists and engineers. A non-probability, purposive sampling technique was employed for this study. The limitation of a non-probability purposive sampling technique is that the researcher was not able to predict or ensure whether sample representatively was acquired (Leedy and Ormrod, 2015). This type of sampling allowed for judgmental selection by the researcher in participant selection and represented diverse perspectives of respondents (Leedy and Ormrod, 2015).

A total of 110 questionnaires, designed by the researchers and consisting of 38 questions were distributed to potential respondents at the selected research organisation. The questions related to four specific constructs of TQM, innovation performance, products and processes. The data was collected utilising a self-administered

research instrument in the form of a questionnaire. The questionnaire was completed by respondents themselves. Each questionnaire was sent to each respondent via email.

4.1 Validity

The Pearson correlation coefficient was employed to quantify both the convergent and divergent validity of the measure (Schober et al., 2018). To measure the validity of the data collection tool, a benchmark target Pearson correlation coefficient of 0.3–0.4 was used (Schober et al., 2018). Content validity was examined by the researcher to assess the clarity and completeness of the research instrument.

4.2 Reliability

Cronbach's alpha coefficient was selected to accurately quantify the robustness and reliability of the questionnaire that was utilised in this study and generated using the statistical software. Utilising the statistical software, Cronbach's coefficient alpha was quantified and expressed as a number between 0 and 1. Should the Cronbach's coefficient alpha be 0.7 or greater, the results will be internally consistent and reliable (Fernandes et al., 2014).

5 Results

Of the total 110 targeted respondents, 94 (85%) responded positively, giving a response rate of 85%, which is suitable. Thus affirming that response rate was acceptable, reliable and valid. The results can therefore be generalised over the target population in the selected research organisation.

5.1 Reliability data

In terms of reliability data, overall, the Cronbach's alpha coefficient estimates presented in Table 1 were above 0.7 for leadership, strategy, people management and innovation performance indicating good data reliability and internal consistency. With exception to customer focus with a low Cronbach's alpha of 0.423, inferring poor internal consistency and reliability.

Table 1 Reliability data

<i>Variable</i>	<i>Cronbach's alpha</i>	<i>No. of items</i>
Customer focus	0.423	5
Leadership	0.802	4
People management	0.622	5
Strategy	0.823	2
Innovation performance	0.887	13

5.2 Composite indices

Composite indices were obtained by the addition of the sum of all scores of a construct, divided by the number of items analysed.

Overall, the respondents agreed with customer focus, leadership, and people management, but were neutral about product and process (p-value = 0.138 > .05), strategy (p-value = 0.497 > .05) and innovation performance (p-value = 0.114 > .05) (Table 2).

Table 2 T-test results for composite indices

Variable	Hypothesis testing ($H_0: \mu = 3$)						
	Mean	<i>t</i>	<i>df</i>	<i>p</i> -value	Mean difference	Lower boundary	Upper boundary
Customer focus	2.635	-7.072	96	0.000	-0.36495	-0.4674	-0.2625
Leadership	2.557	-5.688	96	0.000	-0.44330	-0.5980	-0.2886
People management	2.804	-3.031	96	0.003	-0.19588	-0.3241	-0.0676
Strategy	3.063	0.682	95	0.497	0.06250	-0.1195	0.2445
Products and processes	3.106	1.496	96	0.138	0.10567	-0.0346	0.2459
Innovation performance	3.101	1.596	96	0.114	0.10071	-0.0245	0.2260

5.3 Normality

Since innovation performance was the only dependent variable, a normality test was done for this aspect only. Employing the skewness and kurtosis of the frequency distributions of the independent variable, the evaluation of the normal distribution of the data was assessed (Leedy and Ormrod, 2015). The skewness was -0.059 (close to zero) and kurtosis was -0.328, indicating a normal distribution (Table 3 and Figure 2). The majority of the measured data plots occur on a 45 degree straight line (Figure 3). The Kolmogorov Smirnov and Shapiro-Wilk tests (Sarstedt and Mooi, 2014), indicate a normal distribution for innovation performance because of the null hypothesis, indicating that the violation was normal and therefore not omitted (p-value = 0.200 > 0.05 for Kolmogorov Smirnov and p-value = 0.665 > 0.05 for Shapiro-Wilk test).

Table 3 Normality test

Kolmogorov Smirnov			Shapiro-Wilk		
Statistic	<i>df</i>	<i>p</i> -value	Statistic	<i>df</i>	<i>p</i> -value
0.058	96	0.200*	0.990	96	0.665

Figure 2 Showing the histogram of frequency and innovation performance (see online version for colours)

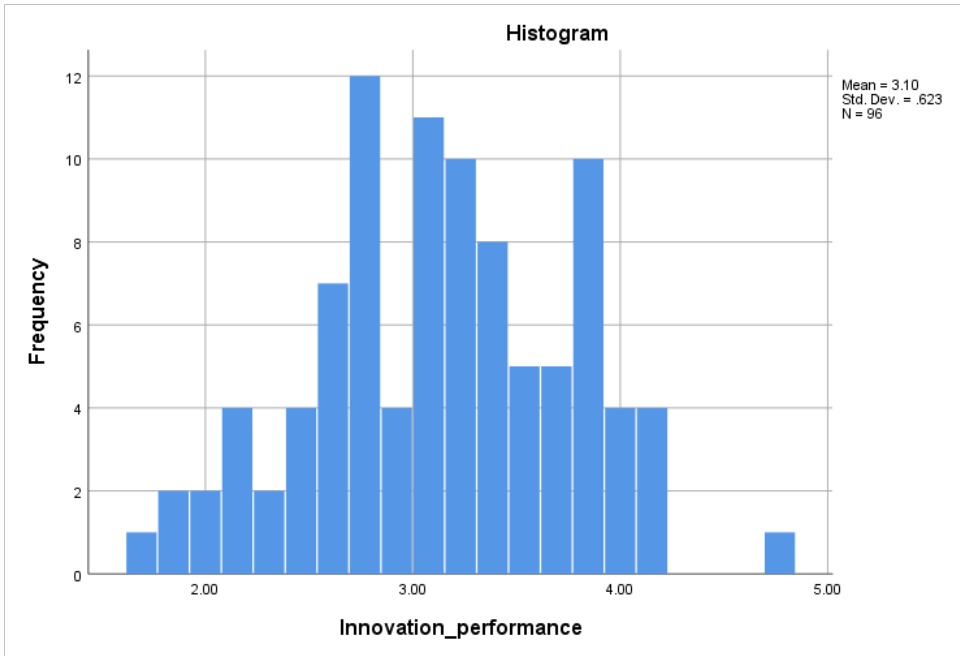
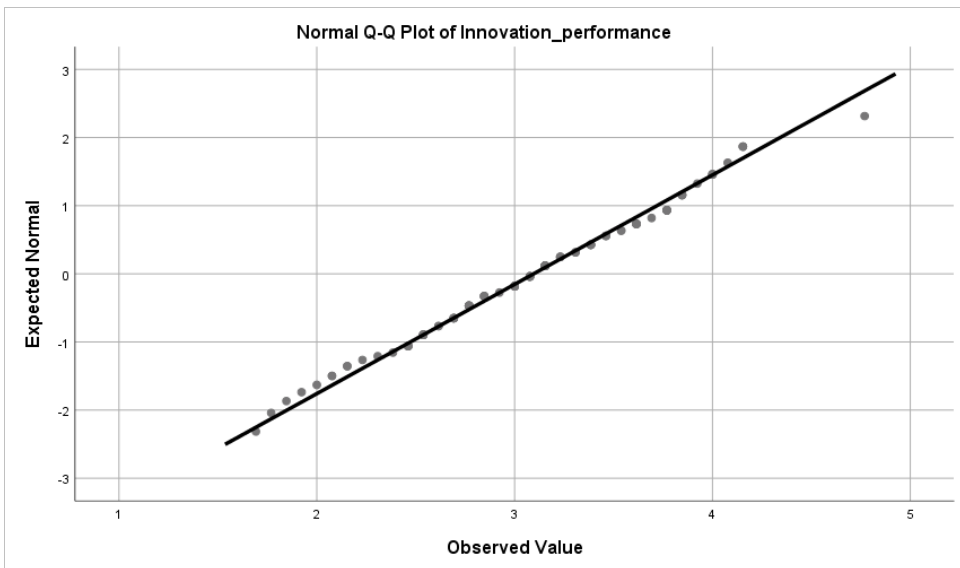


Figure 3 Showing normal Q-Q plot of innovation performance



5.4 Correlational and regression analysis of the independent variables

Table 4 given below presents the results of the correlation analysis showing the relationship between TQM practices namely: leadership, customer focus, strategy, people management and innovation performance. The correlation matrix indicates that all the TQM practices are highly correlated at the 1% level.

Table 4 Correlation analysis

<i>Variables</i>	<i>Customer focus</i>	<i>Leadership</i>	<i>People management</i>	<i>Strategy</i>
Customer focus	1			
Leadership	0.441	1		
People management	0.419	0.590	1	
Strategy	0.418	0.531	0.518	1

Table 4 presents the regression analysis data that was applied to the questionnaire data to determine the relationship between TQM practices and innovation performance.

For the regression analysis phase of this study, the following null hypothesis was tested:

H⁰ TQM practices: customer focus, leadership, people management and strategy influence innovation performance.

Table 4 Coefficient regression analysis

<i>Variables</i>	<i>Beta</i>	<i>Std. error</i>	<i>Standardised coefficient beta</i>	<i>T</i>	<i>p-value</i>	<i>Collinearity tolerance</i>	<i>VIF</i>	<i>R-square</i>	<i>Adjusted R-square</i>
(Constant)	0.676	0.206		3.281	0.001			0.735	0.720
Customer focus	0.022	0.077	0.018	0.288	0.774	0.736	1.358		
Leadership	0.193	0.060	0.238	3.199	0.002	0.534	1.872		
People management	0.211	0.075	0.216	2.802	0.006	0.494	2.024		
Strategy	0.293	0.054	0.422	5.442	0.000	0.490	2.042		

A multi-collinearity test was conducted to assess the tolerance values and variation inflation factors (VIF). A multi-collinearity problem is present when the tolerance values are <0.20 or 0.10 and the VIF are 5, 10 or greater (Sarstedt and Mooi, 2014). However, based on the current tolerance values and VIF levels presented in Table 4, a multi-collinearity problem is not present in the dataset. The adjusted R-square of 0.720 implies that 72% of the variability in the dataset was explained by the regression model and gives a good indication of the model fit in terms of innovation performance prediction. The highest beta values of the standardised coefficient indicates that strategy contributes significantly to that of innovation performance (B = 0.293, p-value <0.05). Beta values for TQM practises for both leadership (B = 0.193, p-value <0.005) and people management (B = 0.211, p-value >0.005) indicate that these constructs play a pivotal role in contributing to innovation performance. Implying that all TQM practices, with the exception of customer focus (B = 0.022, p-value = 0.774 > .05) explain the levels of innovation performance, and are therefore factors of innovation performance.

6 Findings

6.1 Objective 1

The null hypothesis that TQM constructs namely: customer focus, leadership, strategy and people management does have a positive relationship with innovation performance has been accepted. Therefore, the effect of TQM management practises such as leadership, people management and strategy on innovation performance is to enhance it. Customer focus displays a low to non-significant correlation to innovation performance, exhibiting a Cronbach's alpha of 0.432, below the acceptable internal reliability threshold, implying poor internal consistency and reliability.

6.2 Objective 2

In terms of establishing whether TQM practices foster or hinder innovation performance, from this study, it can be concluded that TQM practices can be used to drive innovation performance in a research organisation. Moreover the data shows that 73.5% (R-square value) of the variations in innovation performance can be explained by the fluctuations of TQM practices in a research organisation. This study determines that TQM dimensions such as leadership, strategy, customer focus and people management in relation to innovation performance in a research organisation is critical for enhancing an R&D organisation's innovation capacity and performance.

7 Discussion of the results

The correlation between TQM practises and innovation performance is critical to South African research organisations who aim to be international research leaders in the fields of science and engineering distinction and gaining competitive advantages over global competitors. The results of this study are derived from statistical data. The quantitative results show that leadership, people management and strategy have a significant association with innovation performance. The results are consistent and supported by the work of Bigliardi and Galati (2014), Long et al. (2015); Fallahnejad and Lori (2015); Raja and Wei (2014), who also identified a positive correlation between TQM practices and innovation performance. The study shows that the implementation of TQM and adoption of such dimensions; namely, leadership, strategy and people management, can galvanise innovation performance in a research organisation.

In determining the adoption level to which the adoption and application of TQM constructs are practiced in a research organisation, the calculated mean score results show that the construct strategy is strongly implemented and adopted at this organisation (mean score = 3.063), followed by people management (means score = 2.804), customer focus (mean score = 2.635) and lastly leadership with a much weaker adoption with a mean score of 2.557, as compared to the other constructs of TQM. This tends to indicate that TQM is weakly to moderately implemented in this research organisation.

In terms of establishing whether TQM practices foster innovation performance, for this study, a R-square value of 0.735 was obtained for the regression analysis, indicating that TQM practices such as customer focus, leadership, strategy, and people management

may enable the prediction and nurturing of innovation performance in a research organisation.

Customer focus displays a low to non-significant correlation to innovation performance, exhibiting a Cronbach's alpha of 0.432, below the acceptable internal reliability threshold, implying poor internal consistency and reliability. Additionally, this construct exhibits the lowest correlation coefficient ($r = 0.018$, $p > 0.01$) as compared to the other constructs. Results are consistent with the research conducted by Sarar, (2016, p.287) who concluded that customer focus has a lower correlation and impact coefficient with innovation performance as compared to the other TQM constructs; namely, leadership, strategy and people management. Further analysis of this construct in relation to innovation performance, indicates that findings are inconsistent with studies conducted by Fernandes et al. (2014), Manders et al. (2016), Topalovic (2015), Sadikoglu and Olcay (2014) and Long et al. (2015) who determined that a customer centric organisation fosters the innovation of products.

In terms of leadership, this construct is significantly related to innovation performance ($r = 0.238$, $p > 0.01$) in a research organisation. The findings of this empirical research are in alignment with the conclusions drawn by previous research conducted by scholars (Long et al., 2015; Jia et al., 2018; Bouhali et al. (2015) who determined that leadership is significantly related to innovation performance. This finding in this study is further supported by Foster (2017) and Manders et al. (2016), who asserted that effective leadership support is vital to successful TQM implementation in an organisation.

A significant relationship is identified between people management ($r = 0.216$, $p > 0.01$) and innovation performance within a research organisation. The results of this empirical study confirm the results of previous research conducted by Kahn (2018), Rajapathirana and Hu (2018) and Maier et al. (2014) who concluded that a people centric approach to management is a significant driver for innovation performance.

Strategy displays a prominent correlation and association to innovation performance ($r = 0.422$, $p < 0.01$), exhibiting the strongest correlation coefficient as compared to the other TQM constructs. Responses derived from participants tend to infer that having an effective innovation strategy in place is essential to a research organisation improving its innovation performance. The results are consistent with studies conducted by Hajar (2015) and Pisano (2015), who asserted that the implementation of an effective strategy is pivotal to building and sustaining innovation capacity. Additionally, Kalay and Lynn (2015) posited that innovation performance is positively impacted by an effective strategy.

For this study, product and process was considered a dimension of innovation performance. In determining the adoption level to which products and process innovation is implemented in this research organisation, the calculated mean score results show that this dimension is strongly adopted with a mean score of 3.106. The overall findings of this study have shown that there are a number of significant factors that are crucial to improving innovation and building capacity in a research orientated organisations. Moreover, these research results demonstrate that the implementation of TQM practices in a research orientated organisation is positive and can lead to enhancements and progression in innovation performance.

8 Managerial implications

The results of this study further emphasise the importance of leadership support and engagement, customer focus, strategy, and people management in a research organisation to promote innovation and enhance performance. If leadership engagement is active, and employees are included in the strategy development and implementation process, employees will feel engaged, invested and empowered, thereby improving the overall innovation culture and performance of the research organisation. Furthermore an effective innovation strategy may result in the appropriate allocation of research funding, budgets, and commercialisation of products, technologies, and intellectual property. Additionally, an effective innovation strategy will allow for the alignment of key research objectives to the business strategic goals, better overall management, and will foster the creation of centres of global research excellence and innovation.

9 Limitations and future research directions

Limitations to the research include the following: owing to constraints in terms of funding and research time to complete this study, only four constructs of TQM were analysed. This study was conducted at one research organisation and thus generalised inferences were made and are not entirely representative of the entire R&D sector within South Africa. Although a high response rate was acquired for the survey, the participation of a greater number of respondents would have provided a more in-depth assessment of research institutions.

Although, the current study demonstrates a positive correlation between TQM practices such as leadership, strategy, people management and innovation performance in a research organisation, and has contributed immensely to the understanding of this correlation, further research into TQM practices and innovation is recommended. Such future research may be able to demonstrate the holistic understanding of TQM and innovation amongst different types of research organisations within South African, as well as other TQM constructs such as continuous improvement, quality and process management. This would enable organisations to empirically assess the innovation performance in other research organisations by providing different views and results. Secondly, a further evaluation of the impact of TQM practices on the quality and organisational performance in research organisations is recommended to catapult South African organisations further into the forefront of research, development and innovation. This is especially important with the country's research and innovation strategic objectives now focused on readiness for the FIR and the research and development of globally sustainable and environmentally friendly products and processes innovation.

10 Conclusions

Firstly, to be successful and build on the capacity to innovate, research organisations require a highly qualified, capable and skilled workforce. This is essential to creating globally competitive research institutions. It is recommended that research organisations improve and modify their current retention and recruitment strategies to ensure an adequate pipeline of critical skills and capabilities. Secondly, the fostering and supporting

of employees by leadership is of paramount importance in a research organisation. A motivated, supported, engaged, inspired, and passionate workforce stimulates creativity in employees to research and develop innovative products, technologies and processes. Thirdly, an effective innovation strategy be developed and implemented, enabling a better working environment and organisational culture. It is vital that leadership supports the successful performance of innovation in a research organisation. Lastly, divisional silos among research divisions are broken down. Doing so will amalgamate key skills and innovative ideas and reduce administrative processes and procedures, or 'red tape' through the development of more streamlined computer aided administrative processes and procedures; thus enabling a more productive and efficient and research organisation.

References

- Abuzaid, A.N. (2015) 'Examination the impact of total quality management practices in achieving strategic agility: applied study on the Jordanian private hospitals', *European Journal of Business and Management*, Vol. 7, No. 27, pp.87–96.
- Al Kaabi, K. and Sandhu, M. (2018) 'The role of workforce skills development for entrepreneurship: an Emiratisation perspective', *International Journal of Business Excellence*, Vol. 14, No. 1, pp.101–120.
- Al-Damen, R.A. (2017) 'The impact of total quality management on organisational performance Case of Jordan Oil Petroleum Company', *International Journal of Business and Social Science*, Vol. 8, No. 1, pp.192–202.
- Anil, A.P. and Satish, K.P. (2016) 'Investigating the relationship between TQM practices and firm's performance: a conceptual framework for Indian organisations', *Procedia Technology*, Vol. 24, No. 555, pp.554–561.
- Anttila, J. and Jussila, K. (2019) 'Striving for benefits of sustainability from the interactivity of quality and innovation', *Journal of Cleaner Production*, Vol. 212, No. 1, pp.409–419.
- Antunes, M.G., Quirós, J.T. and Do Rosário Fernandes Justino, M. (2017) 'The relationship between innovation and total quality management and the innovation effects on organisational performance', *International Journal of Quality and Reliability DST Management*, Vol. 34, No. 9, pp.1474–1492.
- Aquilani, B., Silvestri, C., Ruggieri, A. and Gatti, C. (2017) 'A systematic literature review on total quality management critical success factors and the identification of new avenues of research', *TQM Journal*, Vol. 29, No. 1, pp.184–213.
- Bharti, K., Agrawal, R. and Sharma, V. (2018) 'Embrace, before it is too late! Prediction of future studies on value co-creation', *International Journal of Business Excellence*, Vol. 14, No. 1, pp.121–151.
- Bigliardi, B. and Galati, F. (2014) 'The implementation of TQM in R & D environments', *Journal of Technology Management and Innovation*, Vol. 9, No. 2, pp.157–171.
- Bouhali, R., Mekdad, Y., Lebsir, H. and Ferkha, L. (2015) 'Leader roles for innovation: strategic thinking and planning', *Procedia – Social and Behavioral Sciences*, Vol. 181, No. 11, pp.72–78.
- Brajer-Marczak, R. (2014) 'Employee engagement in continuous improvement of processes', *Management*, Vol. 18, No. 2, pp.88–104.
- Chatzoglou, P. and Chatzoudes, D. (2018) 'The role of innovation in building competitive advantages: an empirical investigation', *European Journal of Innovation Management*, Vol. 21, No. 1, pp.44–69.
- Department of Science and Technology (2018) *DRAFT White Paper on Science, Technology and Innovation in South Africa*, Government Printer, Pretoria.

- Edwards-Schachter, M. (2018) 'The nature and variety of innovation', *International Journal of Innovation Studies*, Vol. 2, No. 2, pp.65–79.
- Fallahnejad, M. and Lori, E.S. (2015) 'A Framework for connection between total quality management and innovation processes', *Science Journal*, Vol. 36, No. 3, pp.1515–1524.
- Fernandes, A.A.C.M., Lourenço, L.A.N. and Silva, M.J.A.M. (2014) 'Influence of quality management on the innovative performance', *Review of Business Management*, Vol. 16, No. 53, pp.575–593.
- Foster, S.T. (2017) *Managing Quality, Integrating the Supply Chain*, Pearson, London.
- Gault, F. (2018) 'Defining and measuring innovation in all sectors of the economy', *Research Policy*, Vol. 47, No. 3, pp.617–622.
- Hajar, I. (2015) 'The effect of business strategy on innovation and firm performance in the small industrial sector', *The International Journal of Engineering and Science*, Vol. 4, No. 2, pp.1–9.
- Honarpour, A., Jusoh, A. and Nor, K.L. (2017) 'Total quality management, knowledge management, and innovation: an empirical study in R&D units', *Total Quality Management & Business Excellence*, Vol. 29, Nos. 7–8, pp.1–19.
- Hughes, D.J., Lee, A., Wei, A., Newman, A., Legood, A. and Kneller, G. (2018) 'Leadership, creativity, and innovation: a critical review and practical recommendations', *The Leadership Quarterly*, Vol. 29, No. 5, pp.549–569.
- Jia, X., Chen, J., Mei, L. and Wu, Q. (2018) 'How leadership matters in organisational innovation: a perspective of openness', *Management Decision*, Vol. 56, No. 1, pp.6–25.
- Kafetzopoulos, D., Gotzamani, K. and Gkana, V. (2015) 'Relationship between quality management, innovation and competitiveness. Evidence from Greek companies', *Journal of Manufacturing Technology Management*, Vol. 26, No. 8, pp.1177–1200.
- Kahn, K.B. (2018) 'Understanding innovation', *Business Horizons*, Vol. 61, No. 3, pp.453–460.
- Kalay, F. and Lynn, G.S. (2015) 'The impact of strategic innovation management practices on firm innovation performance', *Research Journal of Business and Management*, Vol. 2, No. 3, pp.412–429.
- Karabulut, A.T. (2015) 'Effects of innovation strategy on firm performance: a study conducted on manufacturing firms in Turkey', *Journal of Innovation & Knowledge*, Vol. 195, No. 3, pp.1338–1347.
- Kogabayev, T. and Maziliauskas, A. (2017) 'The definition and classification of innovation', *HOLISTICA*, Vol. 8, No. 1, pp.59–72.
- Kumar, P., Kansal, J. and Singhal, S. (2014) 'Impact of quality management systems on firm performance', *International Journal of Quality and Reliability Management*, Vol. 35, No. 5, pp.1034–1059.
- Leedy, P.D. and Ormrod, J.E. (2015) *Practical Research: Planning and Design*, Pearson, Boston.
- Long, C.S., Abdul Aziz, M.H., Kowang, T.O. and Ismail, W.K.W. (2015) 'Impact of TQM practices on innovation performance among manufacturing companies in Malaysia', *The South African Journal of Industrial Engineering*, Vol. 26, No. 1, pp.75–85.
- Maier, A., Brad, S., Nicoar, D. and Maier, D. (2014) 'Innovation by developing human resources, ensuring the competitiveness and success of the organisation', *Procedia – Social and Behavioral Sciences*, Vol. 109, No. 2, pp.645–648.
- Maistry, K., Hurreeram, D.K. and Ramessur, V. (2017) 'Total quality management and innovation: relationships and effects on performance of agricultural R&D organisations', *International Journal of Quality and Reliability Management*, Vol. 34, No. 3, pp.418–437.
- Manders, B., de Vries, H.J. and Blind, K. (2016) 'ISO 9001 and product innovation: a literature review and research framework', *Technovation*, February–March, Vols. 48–49, No. 1, pp.41–55.

- Mehmood, S., Qadeer, F. and Ahmad, A. (2014) 'Relationship between TQM Dimensions and organisational performance', *Pakistan Journal of Commerce and Social Sciences*, Vol. 8, No. 3, pp.662–679.
- Ngambi, M.T. and Nkemkiafu, A.G. (2015) 'The impact of total quality management on organisational performance', *American Journal of Management*, Vol. 15, No. 4, pp.69–85.
- OECD (2015) 'OECD innovation strategy 2015 – an agenda for policy action, OECD', *Reviews of Innovation Policy*, pp.395–423, OECD, Paris.
- OECD (2018) *Effective Operation of Competitive Research Funding Systems*, OECD Publishing, Science, Technology and Industry Policy Papers, No. 57, pp.1–70, OECD, Paris.
- OECD/Eurostat (2018) *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th ed., The Measurement of Scientific, Technological and Innovation Activities. OECD Publishing, pp.1–258, OECD, Paris/Eurostat.
- Ooi, K. (2014) 'Expert Systems with applications TQM: a facilitator to enhance knowledge management? A structural analysis', *Expert Systems with Applications*, Vol. 41, No. 11, pp.5167–5179.
- Panuwatwanich, K. and Nguyen, T.T. (2017) 'Influence of total quality management on performance of Vietnamese construction firms', *Procedia Engineering*, Vol. 182, No. 7, pp.548–555.
- Patyal, V.S. and Koilakuntla, M. (2017) 'The impact of quality management practices on performance: an empirical study', *Benchmarking: An International Journal*, Vol. 24, No. 2, pp.511–535.
- Pisano, G.P. (2015) 'You need an innovation strategy', *Harvard Business Review*, Vol. 93, No. 6, pp.44–54.
- Raja, M.W. and Wei, S. (2014) 'TQM practices and innovation performance: a review of current literature', *British Journal of Economics, Management & Trade*, Vol. 4, No. 7, pp.1018–1032.
- Rajapathirana, R.P.J. and Hu, Y. (2018) 'Relationship between innovation capability, innovation type, and firm performance', *Journal of Innovation & Knowledge*, Vol. 3, No. 1, pp.44–55.
- Sadikoglu, E. and Olcay, H. (2014) 'The effects of total quality management practises and the reasons of and barriers to TQM practises in Turkey', *Advances in Decision Science*, No. 3, pp.1–18.
- Saleh, R.A., Sweis, R.J., Mahmoud Saleh, F.I., Sarea, A.M., Sharaf Eldin, I.M. and Obeid, D.N. (2018) 'Linking soft and hard total quality management practices: evidence from Jordan', *Int. J. Business Excellence*, Vol. 14, No. 1, pp.49–86.
- Sarar, H. (2016) 'Total quality management and innovation performance: an empirical evaluation of quality and innovation in Dubai Islamic Bank Pakistan', *Advances in Social Sciences Research Journal*, Vol. 3, No. 13, pp.275–295.
- Sarstedt, M. and Mooi, E. (2014) *A Concise Guide to Market Research*, Springer Texts in Business and Economics, Berlin Heidelberg, Springer-Verlag.
- Schober, P., Boer, C. and Schwarte, L.A. (2018) 'Correlation coefficients: appropriate use and interpretation', *Anesthesia and Analgesia*, Vol. 126, No. 5, pp.1763–1768.
- Shukla, R.K., Garg, D. and Agarwal, A. (2018) 'Modelling supply chain coordination for performance improvement using analytical network process-based approach', *International Journal of Business Excellence*, Vol. 14, No. 1, pp.18–48.
- Singh, V., Kumar, A. and Singh, T. (2018) 'Impact of TQM on organisational performance: the case of Indian manufacturing and service industry', *Operations Research Perspectives*, Vol. 5, No. 1, pp.199–217.
- Slimane, M. (2015) 'Relationship between innovation and leadership', *Procedia – Social and Behavioral Sciences*, Vol. 181, No. 3, pp.218–227.
- Topalovic, S. (2015) 'The implementation of total quality management in order to improve production performance and enhancing the level of customer satisfaction', *Procedia Technology*, Vol. 19, No. 8, pp.1016–1022.

- Yeng, S.K., Jusoh, M.H. and Ishak, N.A. (2018) 'The impact of total quality management (TQM) on competitive advantage: a conceptual mixed method study in the Malaysia', *Academy of Strategic Management Journal*, Vol. 17, No. 2, pp.1–9.
- Yousif, A.S.H., Najm, N.A. and Al-Ensour, J.A. (2017) 'Total quality management (TQM), organisational characteristics and competitive advantage', *Journal of Economic & Financial Studies*, Vol. 5, No. 4, pp.12–23.