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THE MODERATING EFFECT OF IMPORTANT INNOVATIONS ON THE RELATIONSHIP BETWEEN QUALITY RESULTS AND PRODUCTIVITY

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A B S T R A C T

There are several empirical studies that have found that quality has a positive and significant impact on productivity. However, very few have considered the inclusion of contingency variables to provide more insight into the nature of this relationship. Therefore, this study attempted to further investigate the impact of quality results on productivity by including important innovations as a moderating variable to provide more insight into the nature of this relationship by collecting sample data from managers of the Tanzania Zambia Railway Authority. The model fit, validity and reliability were tested using principal component analysis, factor analysis and regression analysis using Jamovi software. The results of the study show a significant positive relationship between quality results and productivity. The results also show that important innovations moderate the relationship between quality results and productivity. This study makes a theoretical contribution to the literature by being the first study to empirically test the relationship between quality results and productivity with important innovations as a moderating variable. The study recommends that decision makers in organizations should always make sure that they encourage important innovations in their organizations while paying attention to quality results. It is also hoped that this study will be replicated in other industries and that future studies will include other contingency variables as either moderating or mediating variables to provide further insight into this relationship.

1. INTRODUCTION

In this 21st century era, every organization is making meticulous efforts to survive in this dynamic competitive market environment (Yadav, 2022) as it is evident that the key to sustaining and achieving higher customer satisfaction levels is to provide quality services and products. This is supported by Juran (1993) who predicted that the 21st century would be centered on quality unlike the 20th century which was centered on productivity.

This focus on quality by every organization has been accompanied by the need to improve productivity across all operations in organizations. In the last twenty years, there has been an increase in the use of practices that promote productivity in the operations of organizations. Such practices include TQM practices, which have been proven to be key to improving productivity and quality (Chauhan &Nema, 2017; Putrì et al., 2017; Yangailo & Kaunda, 2021).

1.1 Purpose of Study

Although some studies have shown that quality has a significant positive impact on productivity (see Nanda et al., 2022; Yangailo, 2022a; Lee et al., 2007; McCracken & Kaynak, 1996; Luo et al., 2022; Qiu et al.,2022; Abolghasem & Mancilla-Cubides, 2022), very few have considered including contingency variables to

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provide more insight into the nature of this relationship. Therefore, this study attempted to further investigate the impact of quality results on productivity by including important innovations as a moderating variable to bring more insights on the nature of this relationship.

On the other hand, the sector on which this study was conducted has received little attention from researchers. Despite its significant contribution to the global economy, the railway sector has received little attention in research (Yangailo & Mpundu, 2023; Yangailo, 2023a;Yangailo, 2023b; Talib & Rahman, 2010; Yangailo, 2022b; Janelle &Beuthe, 1997; Yangailo et al., 2023). This gap also necessitated the need to conduct this study in the context of the railway sector.

The main objective of this study was to explore the nature of the relationship between quality results, productivity and important innovations. This was the first empirical study to investigate this relationship.

2. LITERATURE REVIEW

2.1 Important Innovations

This is an important critical success factor of TQM and the main driver of quality improvement (Ang et al., 2000), which ensures that the ever-changing desires and tastes of customers are met promptly (Yangailo & Mkandawire, 2023).

Important innovations help to improve productivity, reduce costs, and increase profitability (Yangailo, 2023b). "Innovation is a driver of prosperity, and it is deeply dependent on management and not just a technological innovation" (Rizhamadze &Ābeltiņa, 2021, p.1).

2.2 Quality Results

The element of quality results ensures that the cost of production and production measures are emphasized along with the evaluation of employee success (Ang et al., 2000). Conformity to requirements is called quality.

"Quality results include higher levels of customer satisfaction, reduced costs, increased profitability, and increased customer loyalty and retention" (Yangailo, 2022a, p.328). Raynor (1992) predicted that in the future (today's 21st century), companies that do not focus on quality will fail to retain customers (p.3).

2.3 Productivity

Productivity is the relationship between the amount of output provided and the amount of input required to produce it (Yangailo, 2022a). Productivity is defined as a measure of efficiency in the production of services and goods. "Productivity is a multidimensional term whose meaning can vary depending on the context in which it is used" (Prasad et al., 2015, p.274). Productivity is a measure of the quantity and quality of work performance by taking into account the resources used (Innocent & Levi, 2017). Productivity can also be expressed as success in the dimensions of effectiveness, efficiency and performance.

2.4 Quality Results and Productivity

As quality improves, so does productivity. This is mainly due to the fact that resources are usually optimally utilized and waste and rework are reduced. The improvement in productivity allows the organization to reduce the price and gain competitiveness in terms of price and quality. This enables the customers to get value for their money and get satisfied in the process.

Lee et al (2007) conducted a study in the manufacturing industry to determine the relationship between quality and productivity. The results of the study supported the belief that quality and productivity are related.

Nanda et al. (2022) conducted a study to understand the co-associations of the variables and how product quality improves productivity of DRI in rotary kiln. The results show that quality improves productivity.

McCracken and Kaynak (1996) studied the relationship between quality and productivity. The results showed that quality and productivity are directly related and as defects, scrap and rework decrease, productivity also increases.

Other recent studies have also shown that there is a positive relationship between quality and productivity (see Luo et al., 2022; Qiu et al., 2022; Abolghasem & Mancilla-Cubides, 2022), so this study adopted the following hypothesis:

Hypothesis 1: Quality results has a positive significant effect on productivity.

2.5 Innovation and Productivity

In South Africa, Kahn et al. (2022) assessed the impact of technological innovation on productivity in the manufacturing firms. The results revealed that innovation has a positive impact on productivity of the manufacturing firms.

Nguyen et al. (2021) investigated the association between innovation and productivity in the tourism's SMEs. The results present thattechnological and marketing innovations increase productivity in tourism.

Hall (2011) examined the impact of innovation on productivity in the firms. The study presented a positive significant relationship between product innovation and revenue productivity.

2.6 Innovation and Quality

Innovation and quality are very important and relevant business factors in any organization, although they are separate areas of knowledge. Usually, quality professionals are not aware of innovation phenomena and innovation experts are not familiar with quality principles and procedures (Anttila & Jussila, 2016).

Quality improves the innovation process, while innovation provides different ways to achieve customer satisfaction and meet the organization's quality goals.

Schniederjans and Schniederjans (2015) investigated the relationship between quality management and innovation. The study revealed a positive and significant relationship between the two.

Other studies have also found that there is a positive relationship between quality and innovation (see Jasmani et al., 2021; Zeng et al., 2017; Prajogo& Sohal, 2004; Zeng et al., 2015).

3. CONCEPTUAL FRAMEWORK

Based on the relationship of the variables in this study as well as the literature review, a conceptual framework was formulated as shown in Figure 1.

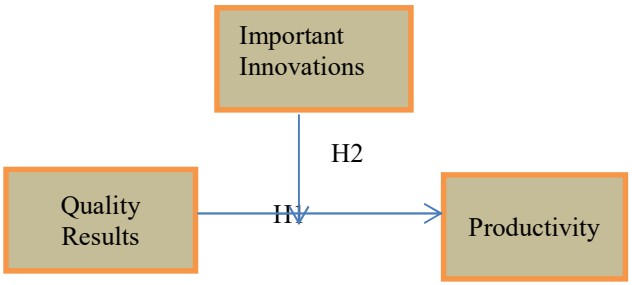

Figure 1 Hypothesized Model *Source: Author (2023)*

To answer the objective of this research study based on the literature and the hypothesized model, the following hypothesis was adopted:

Hypothesis 2: Important Innovations has a moderating effect on the relationship between Quality Results and productivity.

3.1 Research Hypotheses

The following hypotheses are based on the objective of this research study, the findings from the literature review, and a hypothesized model.

Hypothesis 1: Quality results has a positive significant effect on productivity.

Hypothesis 2: Important innovations has a moderating effect on the relationship between Quality Results and productivity.

4. METHODOLOGY

The Tanzania Zambia Railway Authority (TAZARA) was the organization on which this study was conducted. TAZARA is owned by two states, namely Zambia and Tanzania, on a 50/50 basis and has been in operation since its construction in the 1970s.

Table 1. Determining Sample Size of a given Population by using Krejcie and Morgan (1970) formula

N	*S*	*N*	*S*	*N*	*S*
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note: N is the population size.
S is size of the sample.
Krejcie and Morgan (1970)

A structured questionnaire was distributed to 215 managers out of a target population of 240. One hundred and sixty five (165) respondents completed and returned the questionnaire, representing a response rate of 76.74%. The collected data were analyzed using quantitative research approach with the help of Jamovi software. The adequacy of the sample was checked using Krejcie and Morgan's (1970) formula and it was found that the sample was adequate, see Table 1 below.

4.1 Measures

Five-point Likert scales was used to measure the constructs with one (1) representing strongly disagree and five (5) representing strongly agree. The measures of quality results, important innovations and productivity were adopted from quiet a number of previous studies (see Ang et al., 2000; Claver et al., 2003; Coşkun, 2011; Prajogo& Sohal, 2006; Aquilani et al., 2017; Terziovski, 2006; Grayson et al., 2016).

5. DATA PRESENTATION AND ANALYSIS

The study results have been presented in terms of descriptive statistics, figure, tables, and hypothesis tests.

5.1 Response Rate

Out of the 215 questionnaires against the target of 240, hundred and sixty-five (165) questionnaires were completed and returned representing 76.74% response rate performance.

5.2 Respondent's Demographic Characteristics

The demographic profile of 165 respondents who participated in this research study based on their gender and experience are presented in Table 2.

Table 2.Demographic Profile

Description	Frequency	Percentage (%)
Gender		
Female	28	17.0
Male	137	83.0
Total	**165**	**100**
Years-Experience		
< 10	48	29.0
10-20	61	37.0
> 20	56	34.0
Total	**165**	**100**

Out of 165 respondents, 83% were male and 17% were female. Regarding the profile of experience with the organization, out of the total 165 respondents, 29% had less than 10 years of work experience, 37% had 10 to 20 years of experience, and 34% had more than 20 years of work experience.

5.3 Descriptive Statistics

The mean, standard deviation, kurtosis, and skewness for the constructs used in this study are presented in Table 3.

Table 3. Mean, Standard Deviation, Kurtosis & Skewness of Constructs (N = 165)

	QR	II	P
N	165	165	165
Mean	3.14	2.95	2.89
Median	3.20	3.00	2.89
Standard deviation	0.730	0.782	0.718
Skewness	-0.354	-0.0143	0.0503
Std. error skewness	0.189	0.189	0.189
Kurtosis	0.600	0.376	0.362
Std. error kurtosis	0.376	0.376	0.376

Source: Jamovi computation

The mean values for all three constructs indicate favorable respondent responses. Kurtosis and skewness are within the recommended threshold range of -2 to +2, indicating no serious deviation from normality for each construct.

5.4 Reliability and Validity

The sample data were tested for validity and reliability using factor analysis. In order to conduct principal component analysis, the collected data must meet four (4) assumptions in order to provide valid results. These assumptions include linear relationship between variables, no significant outliers, multiple variables measured at either continuous or ordinal levels, and sampling adequacy (Laundau&Everitt, 2003). The sample data collected in this study met all four assumptions after verification. A minimum of one hundred and fifty (150) cases is required to conduct principal component analysis (Fan et al., 2008), so the sample size of 165 was adequate to conduct principal component analysis.

In order to obtain reliable measures for good internal fit and consistency of the measures, a reliability test was conducted. The Cronbach alpha for each construct was calculated by conducting a reliability analysis with the recommended minimum threshold of seven points (0.7) (Nunnally, 1978; Hair et al., 2006).

5.4.1 Results of Reliability and Validity Tests

Factorability of nineteen (19) items in the instrument was measured and it was observed that all the 19 items correlated at least point three (0.3) with another item, indicating a good reasonable factorability. Kaiser Meyer Olkin (KMO) measure of sampling adequacy was 0.903 over 0.6 value. The proportion of variance in the variables that could be caused by the underlying factors is represented by the KMO measure of sampling adequacy. The Bartlett's sphericity test was statistically significant ($\chi 2$ (171) = 1264, $p < .001$). Based on the

results described above, principal components analysis was considered highly appropriate for the 19 items shown in Table 4.

Table 4. Kaiser-Meyer-Olkin and Barlett's Test result

Kaiser-Meyer-Olkin and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.903
Bartlett's Test of Sphericity	Approx. Chi-Square	1264
	Degrees of freedom	171
	Significance	.000

Source: Jamovi computation

The results of the analysis showed that the Cronbach's alpha for the instrument was above the recommended minimum threshold of seven points (0.7) (Nunnally, 1978; Hair et al., 2006). The alpha coefficients for the instrument ranged from 0.769 to 0.849. The alpha coefficient for the quality outcome scales was 0.769, the alpha coefficient for the major innovation scales was 0.793, and the alpha coefficient for the productivity scales was 0.849. The three Cronbach alpha coefficients were all within the recommended acceptable threshold of above 0.7, as shown in Table 5.

Table 5. Test Results of Cronbach Alpha

Items	Cronbach's Alpha	McDonald's Mega	Number of Items	Comment
Overall	.910	.911	19	Accepted
Important Innovations	.793	.797	5	Accepted
Quality Results	.769	.776	5	Accepted
Productivity	.849	.850	9	Accepted

Source: Jamovi computation

5.4.2 Linearity

The relationship between the variables was linear. This assumption was verified by calculating Pearson and Spearman correlation coefficients, as shown in Table 6.

Table 6. Correlation Matrix

		QR	P	II
QR	Pearson's r	—		
	p-value	—		
	Spearman's rho	—		
	p-value	—		
	N	—		
P	Pearson's r	0.617 ***	—	
	p-value	< .001	—	
	Spearman's rho	0.593 ***	—	
	p-value	< .001	—	
	N	165	—	
II	Pearson's r	0.713 ***	0.634 ***	—
	p-value	< .001	< .001	—
	Spearman's rho	0.610 ***	0.572 ***	—
	p-value	< .001	< .001	—
	N	165	165	—

Note. * p < .05, ** p < .01, *** p < .001

Source: Jamovi computation

The results show positive significant correlations among quality results, important innovations and productivity. Quality results and important innovations have positive significant Pearson and Spearman correlation coefficients of 0.713 and 0.610, quality results and productivity have positive significant Pearson and Spearman correlation coefficients of 0.617 and 0.593, important innovations and productivity have positive significant Pearson and Spearman correlation coefficients of 0.634 and 0.572.

5.5 Fitness of Model

Regression model test was run before estimating the proposed model.

5.5.1 Overall Regression Model Test

Regression models were tested with the following hypotheses.

H0 : $\beta 1=\beta 2= \beta 3$ ……. Bi = 0

Ha :Atleast one regression coefficients isn't equal to zero.

Table 7 shows that there were strong significant relations between the constructs based on the regression analyses carried out. First model that presented the proposed effect of quality results on productivity showed a good fit and a significant values of R(0.617), R^2(0.381) and significant F-Value of 100. This signifies that quality results explain 38.1% of variation in productivity. The second model that suggested the impact of important innovations on productivity, indicates a good fit and values that are statistically significant of R(0.634), R^2(0.402) and significant F-Value of 110. This is signifying that important innovations elaborate 40.2% of variation in productivity. Last model that suggested the effect of important innovations on quality results indicates a good fit and significant values of R(0.713), R^2(0.508) and significant F-Value of 168. This shows that important innovations elaborate 50.8% of variation in productivity.

Table 7. Regression Model Fit Measure Summary

					Overall Model Test	
Model		**R**	**R²**	**Adjusted R²**	**F**	**P**
1	QR predicting P	0.617	0.381	0.377	100	< .001
2	II predicting P	0.634	0.402	0.398	110	<. .001
3	II predicting QR	0.713	0.508	0.505	168	< .001

QR = Quality Results

P= Productivity

II= Important Innovation

Source: Jamovi computation

5.6 HypothesesTesting

This research study undertook two hypotheses with respect to the direct relationship, and moderating effect. Tables 8, 9 and 10 present results of the hypotheses tested.

Table 8. Impact of Quality Results on Productivity

Model Fit Measures

							Overall Model Test		
Model	**R**	**R²**	**Adjusted R²**	**AIC**	**BIC**	**RMSE**	**F**	**df1**	**df2**	**p**
1	0.617	0.381	0.377	285	294	0.563	100	1	163	< .001

Model Coefficients – Productivity

Predictor	Estimate	SE	t	p
Intercept	0.987	0.1955	5.05	< .001
QR	0.607	0.0606	10.02	< .001

Source: Jamovi computation

Table 9. Moderation effect of Important Innovations on Quality Results and Productivity

Moderation Estimates

	Estimate	SE	Z	p
QR	0.366	0.0573	6.39	< .001
II	0.356	0.0519	6.86	< .001
QR ✻ II	0.107	0.0489	2.20	0.028

Simple Slope Estimates

	Estimate	SE	Z	p
Average	0.366	0.0577	6.34	< .001
Low (-1SD)	0.282	0.0612	4.60	< .001
High (+1SD)	0.450	0.0765	5.88	< .001

Note. shows the effect of the predictor (QR) on the dependent variable (P) at different levels of the moderator (II)

Source: Jamovi computation

Table 10. Summary of the Hypotheses

No	Hypothesis	Results
1.	Hypothesis 1: Quality results has a positive significant effect on productivity.	Supported
2.	Hypothesis 2: Important Innovations has a moderating effect on the relationship between Quality Results and productivity.	Supported

Source: Author (2023)

The model path coefficients of this study and the results are presented in Tables 8 and 9. The relationship and the moderation effect hypothesized in this study are both supported.

The results of the hypothesis one H1, on the effect of quality results on productivity shows a positive significant ($\gamma = 0.607$, $p<0.001$), so, H1 is supported.

5.6.1 The Moderation Effect Analysis

The moderating effect of important innovations on quality results and productivity is positive and statistically significant ($\gamma = 0.107$, $p<0.05$). This indicates that important innovations positively moderate the relationship between quality results and productivity. Thus, hypothesis 2 is supported. Table 9 shows that important innovations has an impact on the relationship between quality results and productivity at all levels (low, average, high), with the low impact on the low level moderation and the high impact on the high level moderation.

6. DISCUSSION

Overall, the results have provided strong support for the theoretical model of the relationship between quality results, important innovations, and productivity.

The results of the study have shown that most of the management employees in TAZARA are male. The results also showed that the majority of management employees are those with 10 to 20 years of work experience, followed by those with more than 20 years of work experience, and then those with less than 10 years of work experience.

The study also addressed the first research objective by demonstrating that quality results have a positive significant effect on productivity. This is consistent with the findings of some previous studies that have presented that quality has a significant impact on productivity (see Nanda et al., 2022; Yangailo, 2022a; Lee et al., 2007; McCracken & Kaynak, 1996; Luo et al., 2022; Qiu et al.,2022; Abolghasem & Mancilla-Cubides, 2022).

The study has also addressed the second objective of this study by empirically testing for the first time the moderating effect of important innovations on quality results and productivity. The results of the study have presented that important innovations have a moderating effect on the relationship between quality results and productivity. The results have shown that important innovations at all levels (low, average or high) moderates the relationship between quality results and productivity.

Quality results from quality education and training improve the skills and knowledge of employees who become efficient and effective, reducing errors, lowering costs and increasing job satisfaction. All of this is made possible through innovation. Innovation affects quality outcomes because it leads to improvements in efficiency, quality control, and product features.

This study makes an important theoretical contribution to the literature by being the first to empirically test this relationship with key innovations as a moderating variable.

7. CONCLUSIONS

This research is the first to explore the association among quality results, important innovations and productivity. The study found that quality results has a positive significant effect on productivity, and that important innovations moderates this relationship.

This study provides empirical evidence on the nature of the relationship between quality results and productivity. The study contributes to a better understanding of the association between quality results and productivity by including a moderating variable of important innovations. Thus, incorporating the practice of important innovations is a good investment that improves productivity.

The study recommends that decision makers in organizations should always ensure that they promote important innovations in their organizations while paying attention to quality results.

7.1 Limitation and Future Research

The study focused on one railway company, which limits the generalizability of the study's findings to other industries. It is also hoped that this study will be replicated in other industries and that future studies will include other contingency variables as either moderating or mediating variables to provide further insight into the nature of this relationship.

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