:: IJEBD ::
(International Journal of Entrepreneurship and Business Development)
Volume 7 Number 1 January 2024

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

The Impact of Education and Training on Product–Service Design: The Moderation of Competitive Advantage

Tryson Yangailo
University of Zambia,
Lusaka, Zambia
Corresponding Author: ytryson@yahoo.com

ABSTRACT

Purpose: This study attempted to investigate the impact of education and training on product-service design by including competitive advantage as a moderating variable to provide more insight into the nature of this relationship.

Design/methodology/approach: A quantitative research approach was employed and primary data was collected from TAZARA management employees. Model fit, reliability, and validity were tested using regression analysis, factor analysis, and principal component analysis using Jamovi software.

Findings: The results of the study present a significant positive relationship between education training and product-service design. The results also show that competitive advantage negatively moderates the relationship between education training and product-service design.

Practical implications: The study provides more insights by providing empirical evidence on the nature of the relationship between education and training and product-service design. Organizations need to foster a culture of continuous learning and innovation. Managers should communicate the importance of adapting to changes in the marketplace, even when a competitive advantage exists. Balancing the preservation of what makes the organization successful with an openness to new ideas is critical to long-term sustainability and continued success in product-service design.

Paper type: Research paper

Keywords: product-service design, education, training, competitive advantage, moderation

I. INTRODUCTION

The design of goods and services is strongly influenced by education and training in a wide range of industries. The effects are complex, ranging from the enhancement of personal skills to the expansion of organizational capacity. One of the most popular methods of merging product and service offerings in a consumer market is called Product-Service Design, or PSD. Industries and design firms alike are constantly looking for new and improved ways to meet the ever-changing needs and preferences of their customers (Zakaria & Lim, 2016). Education and training have a significant impact on the design of products and services, affecting everything from organizational strategies to individual skills. To foster innovation, meet user needs, and produce goods and services that benefit both society and the economy, the design workforce must be educated and experienced. Conversely, to stay ahead of the competition and survive in today's volatile, dynamic environment, companies need to differentiate themselves from other competitors (Yangailo, 2024). Businesses everywhere are trying to find new and creative ways to attract more customers and increase profits by improving the skills of their employees. Over the past two decades, there has been a surge in the implementation of competitive strategies within organizations. These strategies include TQM techniques that are essential for achieving competitive advantage (Yangailo, 2024; Yangailo, 2023a,2023b; Yangailo & Mkandawire, 2023; Yangailo & Kaunda, 2021; Chauhan & Nema, 2017). These techniques also include product-service design and education and training.

While some studies (Damali et al., 2016; Mourtzis et al., 20-23; Torkkeli & Lallimo, 2019) have shown a relationship between education and training and product-service design, very few have thought to include contingency variables to shed more light on the nature of this relationship. To shed more light on the nature of

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

this relationship, this study included competitive advantage as a moderating variable to further explore the influence of education and training on product-service design.

Conversely, not much research has been done in the area of this study. Research on the railway industry has been scarce despite the industry's significant contribution to the global economy (Yangailo & Mpundu, 2023; Yangailo, 2023b; Talib & Rahman, 2010; Yangailo, 2022; Janelle & Beuthe, 1997; Yangailo et al., 2023). This gap also made it necessary to conduct this study in the context of the railway industry.

The main objective of this study was to explore the nature of the relationship between education and training, competitive advantage, and product and service design. This was the first empirical study to examine this relationship.

To address the gap identified in the literature, this study developed the following objectives:

1. To relate education and training with product-service design.
2. To determine if competitive advantage moderates the relationship between education and training, and product-service design.

II. LITERATURE REVIEW

1. Education and Training

In addition to ensuring behavioral change and commitment to quality improvement, education and training support managers in creating a common quality language within an organization (Mosadeghrad, 2014). Increased employee knowledge and skills through education and training reduce operational errors and increase the competitiveness of the organization (Hamburg, 2014). Porter (2008) states that the ability of an organization to differentiate itself from its competitors is largely influenced by the training, experience and skills of its employees. The training process should be continuous to maintain competitiveness (Singh et al., 2019).

2. Competitive Advantage

According to Kotler (2000), an organization's ability to conduct its business differently from its competitors gives it a competitive advantage. Competitive advantage allows a firm to consistently outperform its competitors and earn significant profits from a large portion of its market (Yangailo, 2023a). Quality and cost/price are the competitive advantage capabilities that differentiate a firm from its competitors (Tracey et al., 1999).

3. Product Service Design

Furrer (1997) defines the product-service concept as proposing a mix of tangible products and intangible services that are designed and combined to optimize product use and performance. The design process involves forecasting, organizational skills, ideas for improvement, and motivation. Development, innovation, and research are essential steps in the production process. Given the potential influence that product and service design can have on an organization, it is recommended that the design process be integrated into the business plan. Peruzzini et al. (2014) describe product-service design as a novel strategy for conscientious industrial innovation. The integration of a tangible product and an intangible service is known as product-service design or PSD. It involves a lot of design data to create a better package design that meets customer needs. Organizing and making easily accessible all the data and information during the design analysis, such as product-service cost, configuration, and quality, is the main challenge faced by designers (Zakaria & Lim, 2017).

4. Education and Training and Product-Service Design

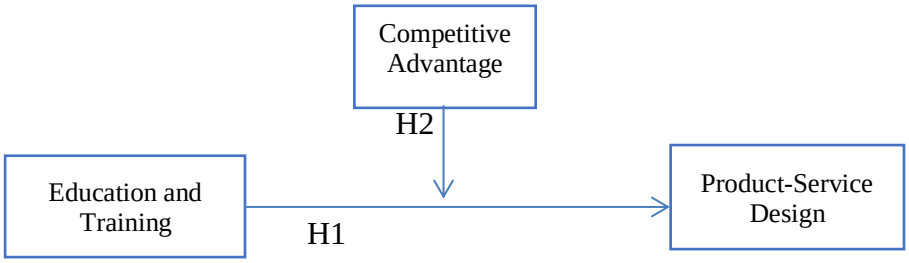
Education and training have a significant impact on the design of products and services, affecting everything from organizational strategies to individual skills. To foster innovation, meet user needs, and produce goods and services that benefit both society and the economy, the design workforce must be educated and experienced. This study adopted the following hypothesis, as research has shown a positive relationship between product-service design and education and training (see Damali et al., 2016; Mourtzis et al., 20-23; Torkkeli & Lallimo, 2019).

Hypothesis 1: Education and training have a positive significant effect on product-service design.

5. Conceptual Framework

An understanding of the relationships between the variables in this study and the literature review led to the development of the conceptual framework shown in Figure 1.

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)



Source: Author (2024)

Figure 1 Hypothesized Model

Based on the literature and the proposed model, the following hypothesis was adopted to address the objective of the research study:
Hypothesis 2: Competitive advantage has a moderating effect on the relationship between education and training and product-service design.

6. Research Hypotheses

The following hypotheses are based on the objective of this study, the results of the literature review, and a hypothesized model.
Hypothesis 1: Education and training has a positive significant effect on product-service design.
Hypothesis 2: Competitive advantage has a moderating effect on the relationship between education and training and product-service design.

III. METHODOLOGY

This study was conducted on the Tanzania Zambia Railway Authority. Since its construction in the 1970s, TAZARA has been operated by Tanzania and Zambia under a 50/50 ownership arrangement.

Of the 240 managers in the target population, 200 received a structured questionnaire. One hundred and fifty-six (156) respondents, or 78% of the sample, completed and returned the questionnaire. A quantitative research methodology was used to analyze the data collected using Jamovi software. When the adequacy of the sample was assessed using Krejcie and Morgan's (1970) formula, it was found to be sufficient (see Table 1 below).

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

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

N	S	N	S	N	S
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)

Five-point Likert scales were used to measure the constructs, with one (1) being strongly disagree and five (5) being strongly agree. The measures of education and training, competitive advantage, and product-service design were adopted from a quiet number of previous studies (see Porter & Parker, 1993; Ang et al., 2000; Rao et al., 1999; Wai et al., 2011; Bayraktar et al., 2008; Coşkun, 2011; Prajogo & Sohal, 2006; Claver et al., 2003; Terziovski, 2006; Berhanu, 2019; Hilmy, 2016).

IV. RESULT AND DISCUSSION

The results of the study are presented in the form of descriptive statistics, figures, tables, and hypothesis tests.

1. Response Rate

Out of the 200 questionnaires against the target of 240, hundred and fifty-six (156) questionnaires were completed and returned representing 78% response rate performance.

2. Descriptive Statistics

The mean, standard deviation, kurtosis, and skewness for the constructs used in this study are presented in Table 2.

Table 2 Mean, Standard Deviation, Kurtosis & Skewness of Constructs (N = 156)

	CA	ET	PSD
N	156	156	156
Mean	2.90	2.80	3.18
Standard deviation	0.760	0.916	0.850
Skewness	-0.0578	-0.0795	-0.322
Std. error skewness	0.194	0.194	0.194
Kurtosis	-0.0336	-0.484	-0.0890
Std. error kurtosis	0.386	0.386	0.386

Source: Jamovi computation

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

3. Reliability and Validity

Factor analysis was used to test the validity and reliability of the sample data. Four (4) assumptions must be met by the collected data for principal component analysis to be performed and provide reliable results. According to Landau and Everitt (2003), these assumptions include a linear relationship between the variables, the absence of significant outliers, the measurement of multiple variables at the continuous or ordinal levels,

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

and adequate sampling. Upon review, the sample data used in this study met each of the four assumptions. According to Fan et al. (2008), principal component analysis requires a minimum of 150 cases; therefore, the sample size of 156 cases was sufficient for this type of analysis.

A reliability test was conducted to obtain reliable measures of the good internal fit and consistency of the measures. Using a reliability analysis and the suggested minimum threshold of seven points (0.7) for each construct, the Cronbach alpha was determined (Nunnally, 1978; Hair et al., 2006).

4. Results of Reliability and Validity Tests

The factorability of twelve (12) items in the instrument was measured and it was observed that all the 12 items correlated at least point four (0.4) with another item, indicating a good reasonable factorability. Kaiser Meyer Olkin (KMO) measure of sampling adequacy was 0.847 above the 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 ($\chi 2$ (66) = 662, $p < .001$). Based on the results described above, principal components analysis was considered highly appropriate for the 12 items shown in Table 3.

Table 3 Kaiser-Meyer-Olkin and Barlett's Test result

Kaiser-Meyer-Olkin and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	Approx. Chi Square	662
	Degrees of freedom	66
	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 0.767 to 0.812. The alpha coefficient for the competitive advantage scales was 0.790, the alpha coefficient for the product-service design scales was 0.767, and the alpha coefficient for the education and training scales was 0.812. The three Cronbach alpha coefficients were all within the recommended acceptable threshold of greater than 0.7, as shown in Table 4.

Table 4 Test Results of Cronbach Alpha

Items	Cronbach's Alpha	McDonald's Mega	Number of Items	Comment
Overall	.849	.852	12	Accepted
Competitive Advantage	.790	.792	5	Accepted
Education and Training	.812	.814	4	Accepted
Product-Service Design	.767	.770	3	Accepted

Source: Jamovi computation

5. Linearity

The relationship between the variables was linear. This assumption was verified by calculating Pearson and Spearman correlation coefficients, as shown in Table 5.

Table 5 Correlation Matrix

		CA		PSD		ET
CA	Pearson's r	—				
	Spearman's rho	—				
	N	—				
PSD	Pearson's r	0.506	***	—		
	Spearman's rho	0.449	***	—		
	N	156		—		
ET	Pearson's r	0.292	***	0.514	***	—
	Spearman's rho	0.253	**	0.489	***	—

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Table 5 Correlation Matrix

	CA	PSD	ET
N	156	156	—

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

Source: Jamovi computation

The results show positive significant correlations among competitive advantage, education and training, and product-service design. Competitive advantage and product-service design have positive significant Pearson and Spearman correlation coefficients of 0.506 and 0.449, and competitive advantage and education and training have positive significant Pearson and Spearman correlation coefficients of 0.292 and 0.253. Product-service design and education and training have positive significant Pearson and Spearman correlation coefficients of 0.514 and 0.489.

6. Fitness of Model

A regression model test was run before estimating the proposed model.

Overall Regression Model Test

Regression models were tested with the following hypotheses.

H0 : $\beta1=\beta2=\beta3$ ……. Bi = 0

Ha : At least one regression coefficient isn't equal to zero

Table 6 shows that there were strong significant relationships between the constructs based on the regression analyses performed. The first model that presented the proposed effect of education and training on product service design showed a good fit and significant values of R(0.514), R^2(0.264), and a significant F-value of 55.3. This means that education and training explain 26% of the variation in product-service design. The second model that proposed the impact of education and training on competitive advantage shows a good fit and statistically significant values of R(0.292), R^2(0.0851), and a significant F-value of 14.3. This means that education and training explain 8% of the variation in competitive advantage. The last model that proposed the effect of product-service design on competitive advantage shows a good fit and significant values of R(0.506), R^2(0.257), and a significant F-value of 53.1. This indicates that product-service design explains 25% of the variation in competitive advantage.

Table 6 Regression Model Fit Measure Summary

					Overall Model Test	
Model		R	R^2	Adjusted R^2	F	P
1	ET predicting PSD	0.514	0.264	0.259	55.3	< .001
2	ET predicting CA	0.292	0.0851	0.0792	14.3	<. .001
3	PSD predicting CA	0.506	0.257	0.252	53.1	< .001
ET = Education and Training						
PSD= Product-Service Design						
CA= Competitive Advantage						

Source: Jamovi computation

7. Hypotheses Testing

This research study undertook two hypotheses concerning the direct relationship and moderating effect. Tables 7, 8, and 9 present the results of the hypotheses tested.

Table 7 Impact of Education and Training on Product-Service Design

Model Fit Measures

							Overall Model Test			
Model	R	R^2	Adjusted R^2	AIC	BIC	RMSE	F	df1	df2	p
1	0.514	0.264	0.259	349	358	0.727	55.3	1	154	< .001

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Model Fit Measures

						Overall Model Test			
Model	R	R^2	Adjusted R^2	AIC	BIC	RMSE	F	df1	df2	p

Model Coefficients - PSD

Predictor	Estimate	SE	t	p
Intercept	1.841	0.1888	9.75	< .001
ET	0.477	0.0642	7.43	< .001

Source: Jamovi computation

Table 8 Moderation Effect of Competitive Advantage on Education and Training and Product-Service Design

Moderation Estimates

			95% Confidence Interval			
	Estimate	**SE**	**Lower**	**Upper**	**Z**	**p**
ET	0.380	0.0569	0.268	0.491	6.68	< .001
CA	0.433	0.0683	0.299	0.567	6.33	< .001
ET ✻ CA	-0.128	0.0655	-0.257	3.94e-5	-1.96	0.050

Simple Slope Estimates

			95% Confidence Interval			
	Estimate	**SE**	**Lower**	**Upper**	**Z**	**p**
Average	0.380	0.0574	0.267	0.492	6.62	< .001
Low (-1SD)	0.477	0.0785	0.323	0.631	6.07	< .001
High (+1SD)	0.283	0.0735	0.138	0.427	3.84	< .001

Note. shows the effect of the predictor (ET) on the dependent variable (PSD) at different levels of the moderator (CA)

Table 9 Summary of the Hypotheses

No	Hypothesis	Results
1.	Hypothesis 1: Education and training have a positive significant effect on product-service design.	Supported
2.	Hypothesis 2: Competitive advantage has a moderating effect on the relationship between education and training and product-service design.	Supported

The model path coefficients of this study and the results are presented in Tables 7 and 8. The relationship and the moderation effect hypothesized in this study are both supported.

The results of hypothesis one H1, on the effect of education and training on a product-service design, show a positive significant ($\gamma = 0.477$, $p<0.001$), so, H1 is supported.

8. The Moderation Effect Analysis

The moderating effect of competitive advantage on education and training and product-service design is negative and statistically significant ($\gamma = -0.128$, $p=0.05$). This indicates that competitive advantage negatively moderates the relationship between education and training on product-service design. Thus, hypothesis 2 is supported. Table 8 shows that competitive advantage hurts the relationship between education and training on product-service design at all levels (low, average, high), with a low impact on high-level moderation and a low impact on the high-level moderation.

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

9. Discussion

Overall, the results have provided strong support for the theoretical model of the relationship between education and training, and product-service design.

The study also showed that education and training have a positive and significant impact on the design of products and services, which addressed the first research objective. This is consistent with the findings of some previous studies (see Damali et al., 2016; Mourtzis et al., 20-23; Torkkeli & Lallimo, 2019), which demonstrated the positive relationships between education and training and product and service design.

The second objective of the study was also met, as the moderating effect of competitive advantage on product-service design and education and training was empirically tested for the first time. The results of the study indicate that the relationship between product-service design and education and training is negatively moderated by competitive advantage. This implies that the impact of education and training on product service design may be limited or hindered by a competitive advantage. This suggests that the organization where the study was conducted has become stale and has placed too much emphasis on its current procedures. Because of this, the organization has been reluctant to accept new information and skills through education and training because it seems that its current status is adequate. This finding also implies that resistance to change occurs when there is a competitive advantage. Fearful of disrupting the tried-and-true formula for success, employees are reluctant to accept new ideas or methods presented to them through training and education. The findings also show that employees tend to avoid exploring new options offered by training programs, preferring to stick with what has worked in the past. In-house training has no positive impact on product-service design if it is not tailored to increase competitiveness.

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

V. CONCLUSIONS

This research is the first to explore the association among education and training, competitive advantage, and product-service design. The study found that education and training have a positive significant effect on product-service design, and that competitive advantage negatively moderates this relationship. While the relationship between education and training, competitive advantage, and product-service design involves complex interactions, the study sheds lighter by providing empirical evidence on the nature of the relationship between education and training and product-service design. The study contributes to a better understanding of the association between education and training and product-service design by including a moderating variable of competitive advantage.

The study recommends that it's important for organizations to foster a culture of continuous learning and innovation. Managers should communicate the importance of adapting to changes in the marketplace, even when a competitive advantage exists. Balancing the preservation of what makes the organization successful with an openness to new ideas is critical to long-term sustainability and continued success in product-service design.

VI 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.

ACKNOWLEDGEMENT

This article was not preliminarily sponsored by any organization and there is no conflict of interest to disclose. A special thanks goes to the editor and reviewers for their valuable time in reviewing this paper.

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

REFERENCES

Ang, C. L., Davies, M., & Finlay, P. N. (2000). Measures to assess the impact of information technology on quality management. *International Journal of Quality & Reliability Management*, *17* (1), 42-66. https://doi.org/10.1108/02656710010300135

Bayraktar, E., Tatoglu, E., & Zaim, S. (2008). An instrument for measuring the critical factors of TQM in Turkish higher education. *Total Quality Managementt*, *19*(6), 551-574.

Berhanu, N. (2019). *Total Quality Management (TQM), Competitive Advantage and Ownership in Ethiopian Construction Sector*, thesis, Addis Ababa University [online] http://etd.aau.edu.et/ handle/123456789/16056.

Chauhan, G., & Nema, G. (2017). Study of the Role of Total Quality Management in Productivity Enhancement in Indian Insurance Sector. *Pacific Business Review International*, *9*(11), 75-85.

Claver, E., Tari, J. J., & Molina, J. F. (2003). Critical factors and results of quality management: an empirical study. *Total quality management & business excellence*, *14*(1), 91-118. https://doi.org/10.1080/14783360309709

Coskun, S. (2011). Strategic management and total quality management: similarities, differences and implications for public administration. *Amme Idaresi Dergisi*, *44*(2), 43-69. 20.1001.1.22285067.1397.24.69.3.9

Damali, U., Miller, J. L., Fredendall, L. D., Moore, D., & Dye, C. J. (2016). Co-creating value using customer training and education in a healthcare service design. *Journal of Operations Management*, *47*, 80-97. https://doi.org/10.1016/j.jom.2016.10.001

Fan, K., O'Sullivan, C., Brabazon, A., & O'Neill, M. (2008). Non-linear principal component analysis of the implied volatility smile using a quantum-inspired evolutionary algorithm. *Natural computing in computational finance*, 89-107. Springer, Berlin, Heidelberg.

Furrer, O. (1997). Le rôle stratégique des services autour des produits. *Revue française de gestion*, (113), 98-108.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). Structural equation modeling: An introduction. *Multivariate data analysis. 6th Edition. New Jersey: Pearson Prentice Hall*, 752-753.

Hamburg, I. (2014). Improving education and training impact on competitive advantages in SMEs. *International journal of innovative research in electronics and communications (IJIREC)*, *1*, 54-60.

Hilmy, A. M. (2016). *Effect of total quality management practices on competitive advantage of transport and logistics firms in Mombasa County, Kenya* (Thesis, University of Nairobi). http://hdl.handle.net/11295/99414

Janelle, D. G., & Beuthe, M. (1997). Globalization and research issues in transportation. *Journal of Transport Geography*, *5*(3), 199-206.

Kotler, P. (2000). *Marketing Management*, New Jersey: Prentice Hall.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and psychological measurement*, *30*(3), 607-610.

Landau, S., & Everitt, B. S. (2003). *A handbook of statistical analyses using SPSS*. Chapman and Hall/CRC.

Mosadeghrad, A. M. (2014). Essentials of total quality management: a meta-analysis. *International Journal of Health Care Quality Assurance*,*27*(6), 544-58. DOI: 10.1108/IJHCQA-07-2013-0082.

Mourtzis, D., Angelopoulos, J., & Panopoulos, N. (2023). Metaverse and blockchain in education for collaborative product-service system (PSS) design towards university 5.0. *Procedia CIRP*, *119*, 456-461.https://doi.org/10.1016/j.procir.2023.01.008

Nunnally, J.D. (1978). *Psychometric Theory* (2nd ed), New York: McGraw-Hill.

Peillon, S., Medini, K., & Dubruc, N. (2016). An initial training program on Product-Service Systems and servitization for engineering students. *Procedia Cirp*, *47*, 282-287. https://doi.org/10.1016/j.procir.2016.03.074

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Peruzzini, M., Marilungo, E., & Germani, M. (2014). A QFD-based methodology to support product-service design in manufacturing industry. In *2014 International Conference on Engineering, Technology and Innovation (ICE)* (pp. 1-7). IEEE.

Porter, L. J., & Parker, A. J. (1993). Total quality management—the critical success factors. *Total quality management,4* (1),13-22.

Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance*. Simon and Schuster.

Prajogo, D. I., & Sohal, A. S. (2006). The relationship between organization strategy, total quality management (TQM), and organization performance—the mediating role of TQM. *European journal of operational research*, *168*(1), 35-50. https://doi.org/10.1016/j.ejor.2004.03.033

Rao, S. S., Solis, L. E., & Raghunathan, T. S. (1999). A framework for international quality management research: development and validation of a measurement instrument. *Total Quality Management,10,*(7),1047-1075.

Singh, S. K., Chen, J., Del Giudice, M., & El-Kassar, A. N. (2019). Environmental ethics, environmental performance, and competitive advantage: role of environmental training. *Technological Forecasting and Social Change,146,* 203-211.

Talib, F., & Rahman, Z. (2010). Studying the impact of total quality management in service industries. *International Journal of Productivity and Quality Management*, *6*(2), 249-268.

Terziovski, M. (2006). Quality management practices and their relationship with customer satisfaction and productivity improvement. *Management Research News,29*(7), 414-424. https://doi.org/10.1108/01409170610690871

Torkkeli, M., & Lallimo, J. (2019). Using Service Design in Teaching and Learning Support Services Development: Case Teaching Service Point and Student Analytics Dashboard. In *Edulearn19 Proceedings* (pp. 10209-10214). IATED.doi: 10.21125/edulearn.2019.2562

Tracey, M., Vonderembse, M. A., & Lim, J. S. (1999). Manufacturing technology and strategy formulation: keys to enhancing competitiveness and improving performance. *Journal of operations management*, *17*(4), 411-428. https://doi.org/10.1016/S0272-6963(98)00045-X

Wai, L. S. M. D. L., Seebaluck, A. K., & Teeroovengadum, V. (2011). Impact of information technology on quality management dimensions and its implications. *European Business Review,23*(6). 592-608. https://doi.org/10.1108/09555341111175426

Yangailo, T. (2022). Globalization on The Railway Transport Sector. *International Research Journal of Business Studies*, *15*(3), 283-292.

Yangailo, T. (2023a). Assessing the influence of transformational leadership on competitive advantage through important innovations and quality results: Case of railway industry. *Management Science Letters*, *13*(1), 41-50. doi: 10.5267/j.msl.2022.9.003

Yangailo, T. (2023b). The mediating effect of TQM practices on the relationship between strategic planning and productivity. *Management Science Letters*, *13*(2), 136-149.

Yangailo, T. (2024). The mediating and moderating effect of total quality management practices on the association between strategic planning and competitive advantage: the case of railway sector. *International Journal of Productivity and Quality Management,40*(4), 491-511.https://doi.org/10.1504/IJPQM.2023.135882

Yangailo, T., & Kaunda, M. (2021). Total quality management a modern key to managerial effectiveness. *LBS Journal of Management & Research*, *19*(2), 91-102.

Yangailo, T., & Mkandawire, R. (2023). Assessing the influence of education and training on important innovations through quality results: the case of railway sector. *International Journal of Knowledge Management in Tourism and Hospitality*, *3*(1), 31-49.

Yangailo, T., & Mpundu, M. (2023). Identifying Research Gaps in Literature related to studies of Strategic Planning on Competitive Advantage: A Systematic Review of Literature. *International Journal of Applied Research in Business and Management*, *4*(2), 47-70. https://doi.org/10.51137/ijarbm.2023.4.2.4

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Yangailo, T., Kabela, J., & Turyatunga, H. (2023). The Impact of Total Quality Management Practices on Productivity in The Railway Sector in African Context. *Proceedings on Engineering*, *5*(1), 177-188.

Zakaria, A. F., & Lim, S. C. J. (2016). A training and development skills to support product-service design from informatics perspective. In *2016 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 457-461). IEEE.

Zakaria, A. F., & Lim, S. C. J. (2017). Design and development of a training module for data-driven product-service design. In *2017 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)* (pp. 1149-1153). IEEE.