Vol. 2, Iss. 4 (2025) 174-183, DOI: 10.61552/JMES.2025.04.004

Journal of Management and Engineering Sciences

www.jmes.aspur.rs

# Linking Process Management and Competitive Advantage: The Mediation of Product-Service Design

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Keywords:

*Process Management*
*Product-Service Design*
*Competitive Advantage*
*Mediation*

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*Received: 09.08.2025.*
*Revised: 15.10.2025.*
*Accepted: 23.10.2025.*

A B S T R A C T

*Organisations need to understand customer needs in order to become and remain competitive in the twenty-first century. This study attempts to understand the importance of product-service design in the relationship between process management and competitive advantage. Regression and factor analysis were carried out using Jamovi software to analyse and test the validity, fit and reliability of the model. The results indicate that product-service design plays a role in mediating the positive and significant relationship between process management and competitive advantage. As organisations relentlessly strive to gain and maintain competitive advantage, they need to invest in product-service design processes. Replication of this study in other industries is strongly recommended, and future research should consider the inclusion of additional moderating and/or mediating variables.*



## 1. INTRODUCTION

Every industry in the modern, globally connected world is working diligently to stay afloat in the marketplace [1]. This is because businesses have realised that the only way to be successful is to maximise customer satisfaction by providing them with world-class goods and services. Businesses need to differentiate themselves from competitors to stay ahead of the competition and survive in today's unstable, dynamic environment [2]. Sharp [3] argues that individuals who take a long-term view of market conditions and make decisions based on what they want to do and where they are best positioned will succeed in the future. These individuals focus on achieving excellence in their chosen market position. When creating a new product or service, the design of the product or service is the most important factor to consider. Designs are created taking into account market competition, current product offerings, and customer preferences and needs. Today, managers understand the importance of retaining and attracting more customers. A best practice management approach that helps

organisations maintain a competitive edge is business process management, or BPM [4]. From a process improvement perspective, business process management (BPM) has entered the lexicon of many organisations [5].

### 1.1 Purpose of the study

Few empirical studies have included a contingency variable as a moderator or mediator to provide more in-depth insights into the nature of this relationship, although some have demonstrated the existence of a positive relationship between process management and competitive advantage [6-9]. The current study was conducted to fill this gap by including product-service design as a contingency variable and further investigating this relationship.

### 1.2 Research Objectives

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

- To relate process management with competitive advantage.
- To determine if product - service design mediates the relationship between process management and competitive advantage.

## 2. LITERATURE REVIEW

### 2.1 Process Management

Process management takes a comprehensive approach and aims to eliminate the piecemeal improvements in individual areas of a business process that often lead to less than ideal results. It discusses how people, processes, technology and strategy are all interdependent in achieving business goals [8]. One of the best management practices to help organisations maintain a competitive edge is business process management. The process management, which consists of a series of steps that convert inputs into outputs, is the standard definition of process. Because one process output can be used as an input for another, companies need to improve the process to improve quality.

### 2.2 Competitive Advantage

According to Kotler [10], an organisation's ability to do 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" [11]. Quality and cost/price are the competitive advantage capabilities that differentiate a firm from its competitors [12].

### 2.3 Product - Service Design

Furrer [13] defines the product-service concept as "the proposal of a mix of tangible products and intangible services that are designed and combined to optimise product use and performance". Innovation, research and development are critical components of the manufacturing process and because of the impact that product and service design can have on an organisation, the design process is encouraged to be a component of the organisation's strategy [14]. The design process involves forecasting, organisational skills, motivation and ideas for improvement. Development, innovation and research are essential steps in the production process. Given the potential impact that product and service design can have on an organisation, it is recommended that the design process be integrated into the business plan. Peruzzini et al. [15] describe product-service design as a novel strategy for conscious industrial innovation.

### 2.4 Process Management and Competitive Advantage

From a process perspective, the management of business processes is seen as a best practice management principle to help organisations sustain competitive advantage [16]. Business process management is seen as a more general approach to organisational improvement [8]. Process management is essential for organisations to gain and maintain a competitive advantage. A company's distinct advantages over its competitors, which enable it to outperform them and achieve superior business performance, are referred to as its competitive advantage.

The undeniable link between process management and competitive advantage has been demonstrated in previous studies [6-9]. It is clear from previous studies that there is a positive relationship between process management and competitive advantage.

Therefore, the current research includes the following hypothesis:
Hypothesis 1: Process management has a positive significant impact on competitive advantage.

### 2.5 Process Management and Product-Service Design

Process management and product-service design are both critical success factors of TQM, and have been shown to have a significant positive impact on an organisation's performance. Previous studies have presented process management and product-service design as one of the various practices of TQM [2, 17-23]. Therefore, the current research adopted the following hypothesis:
Hypothesis 2: Process management has a positive significant relationship with product service design.

### 2.6 Product - Service Design and Competitive Advantage

According to Rau et al. [24], service design thinking can help rethink value propositions to include solutions that meet customer needs while maintaining competitive advantage. In addition, it has emerged as a strategy used by competitors to pressure manufacturers to provide a wide range of goods and services [25]. Ferdousi et al. [26] investigated the relationships between competitive advantage, TQM and organisational characteristics. The results show a positive correlation between competitive advantage and the adoption of TQM practices, including product-service design.

Previous research has demonstrated the unbreakable link between product-service design and competitive advantage [27-32]. Based on previous research, it is undeniable that product-service design and competitive advantage are positively correlated. Accordingly, the present study adopts the following hypothesis:
Hypothesis 3: Product-service design has a positive significant impact on competitive advantage.

### 2.7 Conceptual Framework

The following hypothesised model was built based on the association between the variables used in this study and the literature review, as shown in Fig. 1.

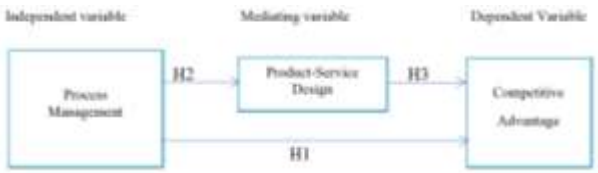


**Fig. 1.** Hypothesised Model.

### 2.8 Research Hypotheses

The hypotheses summarised below are based on the primary goal of this study, the findings of the literature review, and the hypothesised model.

- Hypothesis 1: Process management has a positive significant impact on competitive advantage.
- Hypothesis 2: Process management has a positive significant relationship with product service design.
- Hypothesis 3: Product-service design has a positive significant impact on competitive advantage.
- Hypothesis 4: Product-service design has a mediating effect on the relationship between process management and competitive advantage.

## 3. METHODOLOGY

The Tanzania Zambia Railway Authority (TAZARA) was the subject of this investigation. TAZARA is equally owned by two countries (Zambia and Tanzania) and has been in operation since its establishment in 1975. The questionnaire was sent to 210 managers out of a target population of 240. The questionnaire was completed by 154 people, giving a response rate of 73.33%. The data were analysed quantitatively using Jamovi software. The sample size of 154 out of a target population of 240 was the minimum recommended by [33] for conducting scientific research as shown in Table 1.

Five-point Likert scales with strongly agree (5) and strongly disagree (1) were used to measure the constructs. [18-23, 34] were used to develop the measures for process management, product service design and competitive advantage.

**Table 1.** Determining the Sample Size of a Given Population [33].

| 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 |
| N is population size, S is sample size | | | | | |

## 4. DATA PRESENTATION AND ANALYSIS

The quantitative research approach was used in the analysis, which was carried out using Jamovi software. The results of the study are presented in the form of descriptive statistics, tables, figures and hypothesis tests.

### 4.1 Response Rate

A total of 210 questionnaires were delivered to responders, with a population target of 240 managers. One hundred and fifty-four (154) of the original 210 respondents completed and submitted the questionnaire, representing a 73.33% response rate.

### 4.2 Descriptive Statistics

The mean, standard deviation, skewness, and kurtosis for the constructs employed in this investigation are shown in Table 2.

**Table 2.** Mean, Standard Deviation, Skewness, & Kurtosis of Constructs.

| | PSD | PM | CA |
|---|---|---|---|
| N | 154 | 154 | 154 |
| Mean | 3.18 | 3.33 | 2.91 |
| Standard deviation | 0.847 | 0.748 | 0.758 |
| Skewness | -0.324 | -0.494 | -0.0672 |
| Kurtosis | -0.0571 | 0.703 | -0.00505 |
| Std. error kurtosis | 0.389 | 0.389 | 0.389 |

The means of the three constructs suggest that respondents responded positively. The skewness and kurtosis were in the range of -2 to +2, indicating that there was no significant deviation from normality for any of the constructs.

### 4.3 Reliability and Validity

The data from the study were subjected to validity and reliability tests to ensure that the data could be analysed using factor analysis. Data must meet four assumptions in order to produce accurate results when using principal component analysis [35]. These assumptions include a linear relationship between variables, multiple variables scored at either ordinal or continuous levels, no major outliers, and sufficient sampling. After examination, the sample data collected met all four assumptions. In order to perform a Principal Component Analysis (PCA), the data must contain at least 150 examples [36].

As a result, the 150 cases met the minimum data requirements for PCA. A reliability test was conducted to provide reliable measures of consistency and internal validity of the measures

used. Cronbach alpha was calculated for all three construct scales using reliability analysis with a recommended minimum threshold of 0.6 [37-39].

The 11 items in the instrument were factored. Subsequently, it was found that all 11 items correlated at least three points (0.4) with another item, indicating good factorability. The Kaiser-Meyer-Olkin (KMO) indicator of sampling adequacy was 0.863 above the threshold of 0.6. The KMO measure of sampling adequacy shows the proportion of variance in variables that could be caused by underlying factors. Bartlett's sphericity test was statistically significant ($\chi 2$ (55) = 532, p < .001). Based on the results, PCA was considered appropriate for the 11 items presented in Table 3.

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

| KMO and Bartlett's Test | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | .863 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 532 |
| | Degrees of freedom | 55 |
| | Significance | .000 |

The analysis shows that the instrument's Cronbach's alpha was significantly higher than the needed minimum of 0.6 [37-39]. The alpha coefficient of the instrument ranged between .674 and .792. The process management scales had an alpha coefficient of .674, the competitive advantage scales had an alpha coefficient of .792, and the product-service design scales had an alpha coefficient of .765. Table 4 shows that the Cronbach alpha coefficients for all three components met the required minimum level of 0.6.

**Table 4.** Cronbach Alpha Test Results.

| Items | Cronbach's Alpha | Number of Items | Comment |
|---|---|---|---|
| Overall | .853 | 11 | Accepted |
| Process Management | .674 | 3 | Accepted |
| Product-Service Design | .765 | 3 | Accepted |
| Competitive Advantage | .792 | 5 | Accepted |

The relationship between the independent and dependent variables is linear. The computation of Pearson correlation coefficient, as shown in Table 5, validated this premise.

**Table 5.** Construct Correlation Matrix.

| | | CA | | PSD | | PM | |
|---|---|---|---|---|---|---|---|
| CA | Pearson's r | — | | | | | |
| | Spearman's rho | — | | | | | |
| | N | — | | | | | |
| PSD | Pearson's r | 0.497 | *** | — | | | |
| | Spearman's rho | 0.443 | *** | — | | | |
| | N | 154 | | — | | | |
| PM | Pearson's r | 0.466 | *** | 0.568 | *** | — | |
| | Spearman's rho | 0.424 | *** | 0.540 | *** | — | |
| | N | 154 | | 154 | | — | |
| * p < .05, ** p < .01, *** p < .001 | | | | | | | |

The findings reveal that there are considerable positive relationships between process management, product-service design, and competitive advantage. A positive significant correlation coefficient of .497 exists between product-service design and competitive advantage. A significant positive correlation coefficient of .568 exists between product-service design and process management. Process management and competitive advantage have a .466 significant positive association. The correlations suggest that there were no collinearity issues because they were all less than 0.85. The multicollinearity issue does not arise [40].

### 4.4 Model Fit

Before estimating the suggested model, the regression model was tested individually. The following hypothesis was used to examine the significance of the regression model.

$H : \beta 1=\beta 2=\ldots. Bi = 0$

Ha: At least one regression coefficients is $\neq 0$

The regression analysis revealed the existence of a strong significant relationship between the constructs. The first model in Table 6 shows an

excellent fit and substantial values of R (0.466), $R^2$ (0.217), and F-Value of 42.2, indicating the impact of process management on competitive advantage. According to the model, process management accounts for 22% of the variation in competitive advantage. The second model, which examined the impact of product-service design on competitive advantage, demonstrated a good fit and substantial values of R (0.497), $R^2$ (0.247), and F-Value (50.0). According to the concept, product-service design accounts for 25% of variation in competitive advantage. The final model, which demonstrated the impact of process management on product service design, had acceptable good fit values of R (0.568), $R^2$ (0.322), and a substantial F-Value of 72.3. According to the model, process management accounts for 32% of variation in product-service design.

**Table 6.** Regression Model Fit Measure Summary.

| Model | | R | $R^2$ | Adjusted $R^2$ | F | P |
|---|---|---|---|---|---|---|
| 1 | PM predicting CA | 0.466 | 0.217 | 0.212 | 42.2 | < .001 |
| 2 | PSD predicting CA | 0.497 | 0.247 | 0.242 | 50.0 | < .001 |
| 3 | PM predicting PSD | 0.568 | 0.322 | 0.318 | 72.3 | < .001 |
| CA = Competitive Advantage | | | | | | |
| PM=Process Management | | | | | | |
| PSD= Product-Service Design | | | | | | |

## 4.5 Hypothesis Testing

This study tested four hypotheses concerning a direct relationship and an indirect influence. Tables 7 and 8 show the outcomes of the hypotheses that were tested.

**Table 7.** Model Path and Mediation Estimates.

| Mediation Estimates | | | | | | |
|---|---|---|---|---|---|---|
| Effect | Label | Estimate | SE | Z | p | % Mediation |
| Indirect | a × b | 0.197 | 0.0525 | 3.76 | < .001 | 41.8 |
| Direct | c | 0.275 | 0.0831 | 3.30 | < .001 | 58.2 |
| Total | c + a × b | 0.472 | 0.0722 | 6.54 | < .001 | 100.0 |
| Path Estimates | | | | | | |
| | Label | Estimate | SE | Z | p | |
| PM→PSD | a | 0.643 | 0.0751 | 8.56 | < .001 | |
| PSD→CA | b | 0.307 | 0.0734 | 4.19 | < .001 | |
| PM→CA | c | 0.275 | 0.0831 | 3.30 | < .001 | |

**Table 8.** Summary of Hypothesis.

| No | Hypothesis | Results |
|---|---|---|
| 1. | Hypothesis 1: Process management has a positive significant impact on competitive advantage. | Supported |
| 2. | Hypothesis 2: Process management has a positive significant relationship with product service design. | Supported |
| 3. | Hypothesis 3: Product-service design has a positive significant impact on competitive advantage. | Supported |
| 4. | Hypothesis 4: Product-service design has a mediating effect on the relationship between process management and competitive advantage. | Supported |

Table 7 displays the model path coefficients and their significance results. The study's four-relationship hypotheses are all supported.

Hypothesis 1 on the effect of process management on competitive advantage is statistically significant ($\gamma$=0.472, p<0.001). As a result, H1 is supported. When product service design mediates, the link (direct effect) remains statistically significant at ($\gamma$=0.275, p<0.001). This suggests that product service design serves as a bridge between process management and competitive advantage. As a result, Hypothesis 4 is supported.

Process management has a significant positive relationship with product-service design ($\gamma$=0.643, p< .001). As a result, H2 is supported. Product service design has a positive significant influence on competitive advantage ($\gamma$=0.307, p< .001). As a result, H3 is supported.

Through product service design, the indirect influence of process management on competitive advantage is statistically significant (p<0.001, $\gamma$=0.197; ratio effect = 0.418). As a result of this indicating a partial mediation impact of product service design, hypothesis 4 is supported.

## 5. DISCUSSION

The findings offered excellent support for the theoretical paradigm of process management, product-service design, and competitive advantage.

The purpose of the study was to determine whether process management has a significant positive impact on competitive advantage. This study confirms and also supports the previous studies that presented a link between process management and competitive advantage [6-9]. Process management is essential to creating and maintaining a competitive advantage by improving operational efficiency, enhancing the quality of goods and services, driving innovation, increasing customer satisfaction and effectively managing risk. Companies that invest in process improvement are better equipped to overcome obstacles and seize opportunities in today's cut-throat business environment.

The results of the study also revealed that product-service design has a significant positive association with process management. This is consistent with previous studies that have found a positive significant link between product-service design and process management [2, 17-23]. The results of the study also showed that product-service design has a significant positive effect on competitive advantage. This is consistent with previous research that has found similar results [27-32].

The second and final objective of this study was to determine whether product service design mediates the relationship between process management and competitive advantage. The results indicated that product-service design partially mediates the relationship between process management and competitive advantage. This is the first study to empirically test the mediating effect of product-service design on the relationship between process management and competitive advantage. Further research is required to confirm these findings.

The empirical findings of this study provide valuable insights for both decision makers and practicing managers. The partial mediating effect of product service design on the relationship between process management and competitive advantage implies that organizations need to invest in product service design processes. The design of products and services is essential in mediating the relationship between competitive advantage and process management. A critical factor that directly affects how well a company's operations deliver value to customers and create long-term competitive advantage is the design of its goods and services.

## 6. CONCLUSION

Process management and competitive advantage are mediated by product and service design, which shapes the features, attributes and customer experiences that processes deliver. Strategic alignment of design improves process innovation, efficiency and customer centricity, helping the organization to differentiate itself and succeed in the marketplace.

This study is the first to empirically examine the relationship between process management, product-service design and competitive advantage. According to the findings, product-service design mediates the relationship between process management and competitive advantage. This study contributes to a better understanding of the nature of the relationship between process management and competitive advantage by providing empirical evidence. The study found that product-service design is essential for improving and maintaining customer satisfaction and promoting organizational competitiveness.

The study was conducted in a single organization, which limits the applicability of the findings to other industries. It is strongly recommended that this study be replicated in other industries. It is also suggested that future studies include other moderating and/or mediating variables.

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## APPENDICES

**Table 9.** Principal Component Analysis.

| Component Loadings | | | | |
|---|---|---|---|---|
| | Component | | | |
| | 1 | 2 | 3 | Uniqueness |
| PSD1 | | 0.687 | | 0.420 |
| PSD2 | | 0.773 | | 0.334 |
| PSD3 | | 0.799 | | 0.299 |
| CA1 | 0.713 | | | 0.399 |
| CA2 | 0.752 | | | 0.333 |
| CA3 | 0.655 | | | 0.404 |
| CA4 | 0.619 | | | 0.503 |
| CA5 | 0.738 | | | 0.428 |
| PM1 | | | 0.642 | 0.425 |
| PM2 | | 0.452 | 0.591 | 0.426 |
| PM3 | | | 0.779 | 0.336 |
| Note. 'varimax' rotation was used | | | | |

**Table 10.** Assumption Checks.

| Bartlett's Test of Sphericity | | |
|---|---|---|
| $\chi^2$ | df | p |
| 532 | 55 | < .001 |

**Table 11. KMO Measure of Sampling Adequacy**

| | MSA |
|---|---|
| Overall | 0.863 |
| PSD1 | 0.891 |
| PSD2 | 0.857 |
| PSD3 | 0.840 |
| CA1 | 0.894 |
| CA2 | 0.868 |
| CA3 | 0.859 |
| CA4 | 0.883 |
| CA5 | 0.826 |
| PM1 | 0.862 |
| PM2 | 0.838 |
| PM3 | 0.887 |

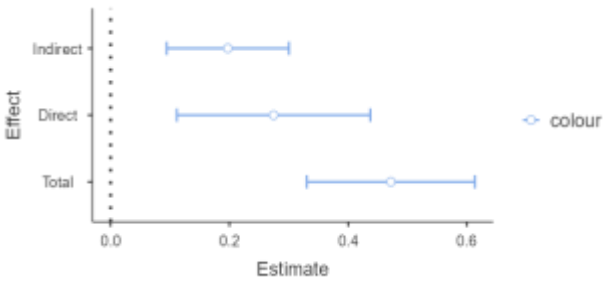


**Fig. 2.** Estimate Plot.

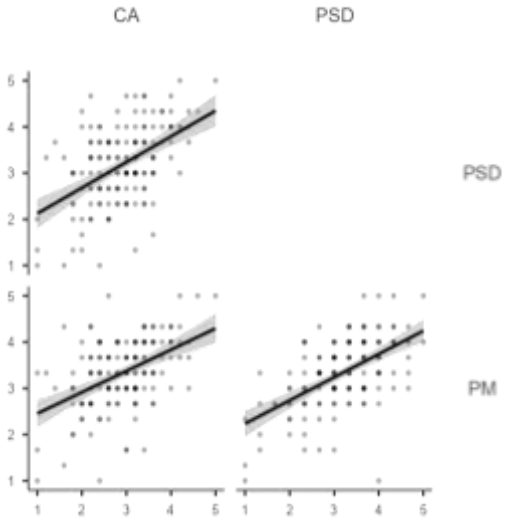


**Fig. 3.** Plot.