

# THE MEDIATING ROLE OF IMPORTANT INNOVATIONS IN THE RELATIONSHIP BETWEEN EDUCATION AND TRAINING AND PROCESS MANAGEMENT

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ABSTRACT

*This study examines the mediating role of important innovations in the relationship between education and training and process management, focusing on the Tanzania Zambia Railway Authority. Drawing on human capital theory, the resource-based view (RBV), and innovation diffusion theory, the research empirically tests how education and training influence process management, with innovation acting as a mediator. Using a quantitative approach and data collected from 152 management respondents, the study employs Jamovi software for statistical analysis. The results indicate that education and training significantly improve process management, with important innovations partially mediating this relationship. The study contributes to the literature by validating theoretical frameworks and providing practical recommendations for improving organizational performance through strategic investments in human capital, innovation, and process management. It highlights the importance of continuous professional development, fostering a culture of innovation, and using data-driven decision making to achieve operational excellence. The findings are particularly relevant to the rail industry, but have broader implications for organizations across industries seeking to optimize productivity and sustainability..*

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## 1. INTRODUCTION

In today's dynamic and highly competitive business environment, organizations are continuously seeking strategies to improve efficiency and productivity through effective process management. Process Management (PM) serves as a critical approach to achieving operational excellence by streamlining operations, integrating advanced technologies, and aligning strategic objectives (Hung, 2006). However, the extent to which PM drives innovation depends on an organization's adaptability and flexibility. PM is an interdisciplinary field that bridges technology and operational capabilities, enabling the design and management of business processes in a structured and efficient manner (Beverungen et al., 2021). Effective process management requires continuous monitoring, standardization, and

improvement to optimize performance in various sectors. For example, composting operations require meticulous process management, requiring the monitoring of key indicators and timely adjustments to ensure efficiency (Rynk et al., 2022). Similarly, BPM, similar to Lean Management (LM), has emerged as a key approach to enhancing organizational performance through continuous improvement (Maldonado et al., 2020). A key driver of improved process management is education and training, which equips individuals with the skills, knowledge, and competencies necessary to optimize organizational processes. Comprehensive education and training programs provide employees with the expertise (Yangailo & Mkandawire, 2023) to effectively implement and sustain process management strategies. A well-trained and skilled workforce improves task performance, leading to increased productivity and

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ensuring long-term organizational sustainability (Banureka et al., 2021). Education and training are fundamental not only to organizational efficiency, but also to global development and societal progress. They contribute to crime reduction, foster political participation, and promote critical thinking for informed decision-making. At the individual level, education facilitates personal growth by improving skills, knowledge, and overall professional development. According to Kumar and Bayram (2025), education and training have a transformative impact on employability, enabling individuals to make meaningful contributions to society. Well-structured training programs create dynamic and engaging learning experiences that allow participants to develop practical skills in a controlled environment, thereby enhancing their ability to apply knowledge effectively.

However, the impact of education and training on process management is not always direct; rather, it is often mediated through innovation, which translates knowledge into practical applications that improve operational efficiency, quality, and overall organizational performance. Innovation is critical in today's volatile and dynamic business landscape, where consumer demands and preferences are constantly evolving. Understanding how education and training foster process management through innovation is essential for businesses, policymakers, and educators seeking to create sustainable and adaptable work environments. Quality improvement has long been recognized as a key factor in organizational success, with Raynor (1992) predicting that organizations that fail to adopt quality practices will struggle to maintain market relevance. Innovation, particularly in response to changing market dynamics, plays a critical role in ensuring that organizations remain competitive and adaptable.

This study examines the relationship between education and training, process management, and important innovations. Specifically, it examines how education and training influence process management, with important innovations serving as a mediating factor. For the first time, this research empirically tests the mediating effect of important innovations on the relationship between education and training and process management. By analyzing this relationship, the study aims to provide valuable insights into the mechanisms through which human capital development contributes to organizational success.

## **2. LITERATURE REVIEW**

### **2.1 Business Process Management and Organizational Performance**

Business Process Management (BPM) is a well-established approach to improving organizational efficiency through structured process optimization. Hung (2006) emphasizes that BPM integrates technological advances and strategic goals to achieve operational excellence. BPM is inherently interdisciplinary, drawing

from fields such as operations management, information systems, and organizational behavior (Beverungen et al., 2021). Effective BPM involves continuous monitoring and standardization, facilitating improved efficiency in various industries, including manufacturing and services. Maldonado et al. (2020) suggest that BPM is closely aligned with lean management (LM) principles, which emphasize waste reduction and continuous improvement. The adoption of BPM and LM has been shown to increase productivity by streamlining operations and minimizing inefficiencies. In specialized fields such as composting, effective process management is essential to maintain efficiency and ensure consistent quality outcomes (Rynk et al., 2022). These findings underscore the critical role of BPM in optimizing operational processes.

### **2.2 Education and Training as Drivers of Process Management**

Education and training have long been recognized as critical factors in improving employee skills and organizational effectiveness. Formal education provides a foundational knowledge base, while ongoing training ensures that employees stay abreast of emerging trends, technologies, and methodologies relevant to their roles. Process management—the design, implementation, monitoring, and continuous improvement of business processes—requires a workforce with problem-solving and analytical skills. Empirical studies suggest that organizations that invest in education and training demonstrate improved process efficiency and an increased ability to adapt to market changes (Yangailo & Mkandawire, 2023).

Education and training play an integral role in process management by equipping employees with the necessary competencies to increase efficiency, standardization, and continuous improvement. Structured training programs facilitate the adoption of methodologies such as Lean, Six Sigma, and Total Quality Management (TQM), which help reduce operational errors and increase productivity. In addition, training enables employees to integrate technological advances, including automation and artificial intelligence (AI)-driven processes, into their workflows, further enhancing organizational effectiveness.

Yangailo and Mkandawire (2023) argue that continuous professional development enhances the ability of employees to adapt to changing organizational needs. Training initiatives contribute to a skilled workforce, which promotes higher productivity and efficiency (Banureka et al., 2021). Beyond organizational efficiency, education plays a broader role in societal progress. Kumar and Bayram (2025) emphasize that education not only improves employability, but also fosters critical thinking and decision-making skills. Well-designed training programs provide employees with hands-on learning experiences that enhance their ability to apply theoretical knowledge in practical scenarios.

Given the established relationship between education, training and process management, this study formulates the following hypothesis:

*Hypothesis 1: Education and training have a significant positive association with process management.*

### 2.3 Education and Training as Catalysts for Innovation

Education and training also serve as fundamental drivers of innovation by fostering critical thinking, creativity, and problem-solving skills in employees. Research shows that organizations that prioritize human capital development are more likely to cultivate a culture of innovation, fostering continuous improvements in processes and technologies. Employees trained in emerging fields such as digital transformation, artificial intelligence, and lean management are better positioned to drive process innovations that improve organizational performance (Gupta & Sahu, 2021; Manresa et al., 2019). A growing body of literature provides strong empirical evidence supporting the positive relationship between education, training, and innovation. Studies suggest that formal training within organizations has a significant impact on innovation outcomes (Yangailo & Mkandawire, 2023). Based on these findings, this study proposes the following hypothesis:

*Hypothesis 2 (H2): Education and training have a significant positive impact on important innovations.*

### 2.4 The Role of Innovation in Enhancing Process Management

Innovation, particularly process innovation, is a critical driver of process management because it introduces new methods, tools, and technologies that improve efficiency and effectiveness. Innovative approaches enable organizations to optimize work processes, minimize waste, and improve the quality of products and services. Damanpour and Aravind (2012) emphasize that innovation is a key driver of organizational prosperity, which relies not only on technological advancements but also on effective management practices. Moreover, Rizhamadze and Ābeltiņa (2021) argue that companies that foster continuous learning and skills development tend to have higher rates of innovation, as employees become adept at identifying inefficiencies and suggesting strategic improvements.

Innovation serves as a mechanism for translating acquired knowledge into tangible improvements in operational efficiency and quality. Raynor (1992) predicted that organizations that do not embrace innovation and quality improvements will struggle to maintain market relevance. Ang et al. (2000) further support the notion that innovation-driven quality improvements are essential in today's rapidly evolving business environment.

Innovation is especially critical in volatile markets where consumer preferences change frequently. By fostering a culture of continuous learning and knowledge application, organizations can improve their ability to innovate and respond effectively to market demands.

Understanding this mediating role is essential for organizations seeking to optimize their process management strategies through investments in education and training.

Recognizing the essential relationship between innovation and process management, this study proposes the following hypothesis:

*Hypothesis 3: Important innovations have a significant positive impact on process management.*

### 2.5 Gaps in the Literature

While the existing literature underscores the significant role of education and training in improving process management, there remains a notable gap in empirical research examining the mediating effect of innovation in this relationship. To our knowledge, no study has empirically examined how innovation mediates the relationship between education and training and process management. This study addresses this gap by examining the interrelationship between education, training, process management, and innovation. Specifically, it seeks to determine how education and training influence process management, with important innovations acting as a mediating factor. By empirically testing this mediation effect, the study aims to provide valuable insights into the mechanisms through which human capital development contributes to organizational success.

### 2.6 Summary

The literature highlights the interconnectedness of education, training, process management, and innovation. PM provides a structured framework for operational efficiency, while education and training equip employees with the necessary skills to implement and sustain process improvements. However, innovation plays a critical role in bridging the gap between knowledge acquisition and practical application. This study aims to empirically examine these relationships and contribute to a deeper understanding of how human capital development influences organizational success.

### 2.7 Conceptual Framework

Based on the association between the variables used in this study and the literature review, a hypothesized model was formulated as shown in Figure 1. Based on the association between the variables used in this study and the literature review, a hypothesized model was formulated as shown in Figure 1.



Figure 1. hypothesized Model

Source: Author (2026)

Figure 1. Hypothesized model

## 2.8 Hypotheses

The following hypotheses are based on the aim of this study, the results of the literature review and the hypothesised model.

*Hypothesis 1:* Education and training have a significant positive association with process management.

*Hypothesis 2:* Education and training have a significant positive impact on important innovations.

*Hypothesis 3:* Important innovations have a significant positive impact on process management.

*Hypothesis 4:* Important innovations have a mediating effect on the relationship between education and training, and process management.

## 3. METHODOLOGY

The Tanzania Zambia Railway Authority (TAZARA) was selected for this study. Since its establishment in 1975, TAZARA has operated under a 50:50 ownership between Tanzania and Zambia.

A structured questionnaire was administered to 215 management respondents out of a target population of 240. The questionnaire was completed and returned by 152 respondents. The data was analyzed using a quantitative research approach and due to the nature of the study, calculations were performed using Jamovi software.

The sample size of 152 out of 240 met and exceeded the minimum required to conduct a scientific study as recommended by Krejcie and Morgan (1970). For further confirmation of the recommended sample size based on the Krejcie and Morgan (1970) formula, see Table 1:

**Table 1.** Determine Size of the sample of a given Population 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	100000	384

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

*Measures:* Five-point Likert scales were adopted and used to assess the constructs, with strongly agree (5) and strongly disagree (1). Education and training, important innovations, and process management were adopted from quite a number of studies (Coşkun, 2011; Aquilani et al., 2017; Siu Mane David Lai Wai et al., 2011; Prajogo & Sohal, 2006; Bayraktar et al., 2008; Ang et al., 2000).

## 4. RESULTS

The analysis of the results of this study was based on statistical methods using Jamovi software. The results are presented in the form of descriptive statistics, figures, tables and hypothesis tests.

### 4.1 The Response Rate

Of the 215 questionnaires distributed to the target population of 240, a total of 152 respondents completed and returned the questionnaire, representing a response rate of 70.70%.

### 4.2 Demographic Characteristics

The demographic profile of the 152 respondents who participated in the study based on gender and experience is shown in Table 2. Of the 152 respondents, 25 (16.4%) were female and 127 (83.6%) were male.

**Table 2.** Demographic Profile

Description	Frequency	Percentage
<b>Gender</b>		
Male	127	83.6
Female	25	16.4
<b>Total</b>	<b>152</b>	<b>100</b>

### 4.3 Descriptive Statistics

The mean, skewness, kurtosis, and standard deviation of the three constructs are shown in Table 3.

The mean values for all constructs indicate that respondents responded favorably. Both kurtosis and skewness are within the recommended range of -2 to +2, indicating no serious deviation from normality for the three constructs.

### 4.4 Validity and Reliability

The Cronbach alpha for the three construct scale was calculated by conducting reliability analysis with the required threshold of (0.6) point six (Gallais et al., 2017; Straub et al., 2004) to obtain reliable measures to determine good internal fit and consistency of the measures.

The instrument factorability of 12 items was measured, and it was found that all items correlated at least 0.4 with another item, indicating good factorability. The measure of sampling adequacy (Kaiser Meyer Olkin) was 0.868 above the value of 0.6, while Bartlett's test of sphericity was significant ( $\chi^2 (66) = 665, p < .001$ ). Principal component analysis of the 12 items was appropriate, as shown in Table 4.

**Table 3.** Mean, Kurtosis and Skewness of Constructs

	Gender	PM	ET	II
N	Female	25	25	25
	Male	127	127	127
Mean	Female	3.08	2.53	2.74
	Male	3.39	2.84	3.04
Median	Female	3.00	2.50	2.60
	Male	3.33	3.00	3.00
Standard deviation	Female	0.964	1.01	0.808
	Male	0.695	0.906	0.767
Minimum	Female	1.00	1.00	1.00
	Male	1.00	1.00	1.00
Maximum	Female	4.33	4.25	4.40
	Male	5.00	4.75	5.00
Skewness	Female	-0.496	0.0966	0.134
	Male	-0.346	-0.0719	-0.0249
Std. error skewness	Female	0.464	0.464	0.464
	Male	0.215	0.215	0.215
Kurtosis	Female	-0.718	-0.970	0.00517
	Male	0.984	-0.410	0.566
Std. error kurtosis	Female	0.902	0.902	0.902
	Male	0.427	0.427	0.427

**Table 4.** Test results of Kaiser-Meyer-Olkin and Bartlett's

Kaiser-Meyer-Olkin and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.868
Bartlett's Test of Sphericity	Approx. Chi-Square	665
	Degrees of freedom	66
	Significance	.000

Source: Jamovi computation

The Cronbach's alpha for the instrument was way above the required threshold of 0.6. The instrument Alpha coefficients ranged between 0.677 and 0.818. Alpha coefficient for important innovations scales was 0.796, alpha coefficient for education and training scales was 0.818, and alpha coefficient for process management scales was 0.677. All three Cronbach alpha coefficients were in the required acceptable range of above 0.6 as shown in Table 5.

**Table 5.** Test Results of Cronbach Alpha

Items	Cronbach's Alpha	Number of Items	Comment
Overall	.870	12	Accepted
Important Innovations	.796	5	Accepted
Education and Training	.818	4	Accepted
Process Management	.677	3	Accepted

Source: Jamovi computation

*Linearity:* The linearity assumption was verified by the computation of Pearson correlation coefficients as presented in Table 6.

**Table 6.** Correlation Matrix

Correlation Matrix		ET	PM	II
ET	Pearson's r	—		
	df	—		
	p-value	—		
	Spearman's rho	—		
	df	—		
PM	Pearson's r	0.484	***	—
	df	150	—	
	p-value	< .001	—	
	Spearman's rho	0.452	***	—
	df	150	—	
II	Pearson's r	0.492	0.630	***
	df	150	150	—
	p-value	< .001	< .001	—
	Spearman's rho	0.431	0.607	***
	df	150	150	—
	p-value	< .001	< .001	—

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

The results show significant positive correlations between education and training, process management and important innovations. Important innovations and education and training have a positive significant Pearson coefficient of 0.492, important innovations and process management have a positive significant Pearson correlation coefficient of 0.630. Training and process management have a positive significant Pearson correlation coefficient of 0.484. The correlations show that there are no multicollinearity problems, as the correlations are below the required acceptable cut-off of 0.85 (Hair et al., 2010).

**4.5 Fitness of the Model**

A regression model test was run before estimating proposed model of this study.

*Overall Regression Model Test:* Regression models were tested on the following hypotheses.

$H_0 : \beta_1 = \beta_2 = \beta_3 \dots \dots \dots B_i = 0$

$H_a :$  One regression coefficients is at least not equal to zero

Table 7 shows that there were strong significant relationships between the constructs based on the regression analyses performed. The first model, which shows the proposed effect of education and training on process management, has a good fit with significant values of R(0.484), R<sup>2</sup>(0.235) and a significant F-value of 46. This indicates that education and training explains 23.5% of the variation in process management.

The second model, which suggests the impact of education and training on important innovations, shows a good fit with significant values of R(0.492), R<sup>2</sup>(0.242) and a significant F-value of 47.9. This means that education and training explain 24.2% of the variation in important innovations. The third model, which suggests the impact of important innovations on process management, shows good fit significant values of R(0.630), R<sup>2</sup>(0.396) and a significant F-value of 98.5. This shows that important innovations explain 39.6% of the variation in process management.

**Table 7.** Summary of Regression Model Fit Measure

Mode l	R	R <sup>2</sup>	Adjusted R <sup>2</sup>	Overall Model Test	
				F	P
1	0.48	0.23	0.229	46.	<.00
2	0.49	0.24	0.237	47.	<.001
3	0.63	0.39	0.392	98.	<.00

II= Important Innovations  
PM = Process Management  
ET= Education and Training

Source: Jamovi computation

**4.6 Testing of the Hypotheses**

The study tested four hypotheses regarding direct and mediated effects. Tables 8 and 9 present the results of the hypotheses tested.

**Table 8.** The Mediation and model estimates

Mediation Estimates						
Effect	Label	Estimate	SE	Z	p	% Mediation
Indirect	a × b	0.206	0.0406	5.07	<.001	52.4
Direct	c	0.187	0.0566	3.29	<.001	47.6
Total	c + a × b	0.392	0.0575	6.82	<.001	100.0

Path Estimates						
		Label	Estimate	SE	Z	p
ET	→	II a	0.413	0.0594	6.97	<.001
II	→	PM b	0.498	0.0674	7.38	<.001
ET	→	PM c	0.187	0.0566	3.29	<.001

The significance and path coefficients for the model of this study are presented in Table 8. All hypothesized relationships are supported.

The first hypothesis 1, on the effect of education and training on process management (ET ⇒ PM), shows that it is statistically significant ( $\gamma = 0.392, p < .001$ ), so hypothesis 1 is supported. After the mediation effect of important innovations takes place, the direct effect is also statistically significant ( $\gamma = 0.187, p < .001$ ).

Second, education and training have a significant positive effect on important innovations ( $\gamma = 0.413, p < 0.001$ ), so hypothesis 2 is supported. Third, important innovations have a significant positive effect on process management ( $\gamma = 0.498, p < 0.001$ ), therefore supporting Hypothesis 3.

*The analysis of mediating effects:* The indirect effect of education and training on process management through important innovations (ET ⇒ II ⇒ PM) is positive and statistically significant ( $p < .001, \gamma = 0.206$ ; ratio effect=0.524). This indicates a partial mediation effect of important innovations, supporting Hypothesis 4. Overall, the model indicates that the mediator (important innovations) partially mediates the relationship between education and training and process management.

**Table 9.** Hypotheses

No	Hypothesis	Results
1.	Hypothesis 1: Education and training have a significant positive association with process management.	Supported
2.	Hypothesis 2: Education and training have a significant positive impact on important innovations.	Supported
3.	Hypothesis 3: Important innovations have a significant positive impact on process management.	Supported
4.	Hypothesis 4: Important innovations have a mediating effect on the relationship between education and training, and process management.	Supported

**4.7 Discussion**

The results of the study provided strong support for the theoretical model of the links between education and

training, important innovations, and process management.

The first objective of the study was to determine whether education and training have a significant impact on process management. This study confirms and also supports the previous studies presented that have linked education/training to process management such as that of Yangailo and Mkandawire (2023).

The results of the study also show that education and training have a positive significant impact on process management and also that important innovations have a significant positive impact on process management. This is consistent with previous studies that have found positive links between these relationships, such as Gupta and Sahu (2021), Yangailo and Mkandawire (2023), and Rizhamadze and Ābeltiņa (2021).

The second and final objective of this study was to determine whether important innovations have a mediating effect on the relationship between 'education and training' and process management. The results showed that important innovations partially mediate the relationship between 'education and training' and process management. This is the first study to empirically test the mediating effect of important innovations on this relationship. Further research is needed to verify the validity of these findings in other industries.

#### **4.8 Theoretical and Practical Managerial Implications**

This study makes significant contributions to both theoretical understanding and practical applications in the areas of human capital development, innovation, and process management. By examining the relationships between education and training, important innovations, and process management, it provides valuable insights for organizations seeking to improve productivity and operational efficiency.

**Theoretical Implications:** The study confirms and extends several important theoretical frameworks. First, it validates human capital theory and the resource-based view (RBV) by demonstrating that investment in education and training enhances firm performance by improving employees' skills and capabilities. This is consistent with the argument that human capital development is critical to achieving competitive advantage through structured process management practices. The findings also support innovation diffusion theory by empirically demonstrating that important innovations act as a partial mediator between education and training and process management. This suggests that while education and training directly improve process management, the introduction of new and relevant innovations strengthens this relationship. By integrating innovation as a mediating factor, the study provides a more comprehensive understanding of the mechanisms through which education and training impact process management.

In addition, the study contributes to the growing literature on knowledge management and organizational learning, particularly in sectors such as rail transportation, which

have received limited empirical attention. It highlights that process management is not only a function of structural and procedural changes, but also highly dependent on human resource capabilities. Methodologically, the study demonstrates the robustness of quantitative research in assessing organizational performance metrics and encourages the use of advanced statistical tools such as Jamovi in future research.

**Practical Implications:** The findings provide actionable insights for policymakers, organizational leaders, and stakeholders, particularly in the rail transportation sector. First, organizations should prioritize continuous professional development by designing and implementing structured training programs that focus on operational efficiency, technology utilization, and management best practices. These programs should be tailored to industry-specific needs to maximize their impact on productivity and competitiveness.

Second, fostering an environment conducive to innovation is critical. Organizations should invest in modern technologies, automation, and digitalization to drive process improvements. For example, rail authorities such as TAZARA can adopt cutting-edge technologies to improve operational performance. Policymakers can support these efforts by creating frameworks that incentivize training initiatives and technological advancements within the sector.

Third, the study highlights the importance of data-driven decision making. Organizations should integrate robust data analytics frameworks to continuously monitor and evaluate the impact of training programs and innovations on operational performance. This approach ensures that resources are allocated effectively and that strategies are aligned with organizational goals.

Fourth, addressing gender disparities in the workforce is essential to improving organizational effectiveness. Targeted efforts should be made to increase the participation of women in management and technical roles through tailored training programs and career advancement opportunities. This not only promotes diversity, but also enhances the overall skill pool within the organization.

Finally, the study highlights the value of public-private partnerships (PPPs) in driving innovation and training initiatives. For example, TAZARA, which is jointly owned by Tanzania and Zambia, can work with educational institutions, technology providers, and logistics companies to introduce cutting-edge process management solutions. These partnerships can help bridge resource gaps and accelerate the adoption of best practices.

## **5. CONCLUSION**

This study is the first to examine the relationship between education and training, important innovations and process management. The study presents a partial mediating effect of important innovations on the relationship between education and training and process

management. This study provides compelling evidence that education and training significantly influence process management, with important innovations acting as a partial mediator. By empirically testing the mediating role of innovation, the research bridges the gap between human capital development and operational efficiency, contributing to the fields of organizational management, innovation studies, and process optimization.

The study supports key theoretical frameworks, including human capital theory and the resource-based view (RBV), by demonstrating that investment in education and training improves firm performance. It also supports innovation diffusion theory by showing that innovation partially mediates the relationship between education, training and process management (Appendices).

This highlights the role of innovation in translating skills into practical improvements. In addition, the study contributes to knowledge management and organizational learning, particularly in the under-researched rail transport sector. Methodologically, it highlights the value of data-driven research using advanced statistical tools such as Jamovi, and encourages their adoption in management studies.

From a practical perspective, the findings provide actionable insights for policy makers and organizational leaders. Organizations should prioritize continuous professional development and promote industry-specific training programs to improve operational efficiency and competitiveness. Creating an innovation-friendly environment through investments in technology,

automation, and digitalization can improve process management. Data-driven decision making should be integrated to assess the impact of training and innovation to ensure resource optimization. In addition, addressing gender disparities in technical and managerial roles can improve workforce diversity and skills. The study also highlights the importance of public-private partnerships (PPPs) in promoting innovation and training, as exemplified by organizations' potential collaboration with educational institutions and technology providers.

Beyond rail, the study's findings are applicable to other industries, including manufacturing, healthcare and services, where education, training and process management are critical to improving productivity. It provides a benchmark for railway operators to encourage wider adoption of best practices to improve service delivery and efficiency.

Future research should explore these relationships in different industries and geographic contexts to increase the generalizability of the findings. Longitudinal studies could provide deeper insights into how these relationships evolve over time. In addition, researchers could examine the role of different types of innovation (e.g., process, product, or organizational) in mediating the relationship between education/training and process management.

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**Appendices**

**Principal Component Analysis**

Component Loadings

	Component			Uniqueness
	1	2	3	
II1		0.768		0.369
II2		0.703		0.341
II3		0.700		0.409
II4		0.443	0.508	0.452
II5		0.485	0.567	0.443
ET1	0.763			0.351
ET2	0.810			0.285
ET3	0.733			0.409
ET4	0.744			0.342
PM1			0.741	0.335
PM2			0.684	0.397
PM3			0.628	0.511

Note. 'varimax' rotation was used

**Assumption Checks**

Bartlett's Test of Sphericity

$\chi^2$	df	p
665	66	<.001

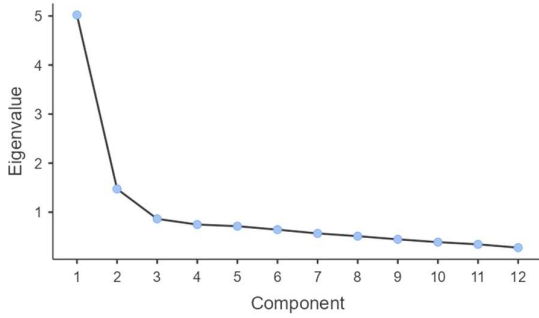
**KMO Measure of Sampling Adequacy**

MSA	
Overall	0.868
II1	0.857
II2	0.877
II3	0.910
II4	0.907
II5	0.803
ET1	0.852
ET2	0.855
ET3	0.852
ET4	0.871
PM1	0.881
PM2	0.856
PM3	0.891

The Mediating Role of Important Innovations in the Relationship Between Education and Training and Process Management

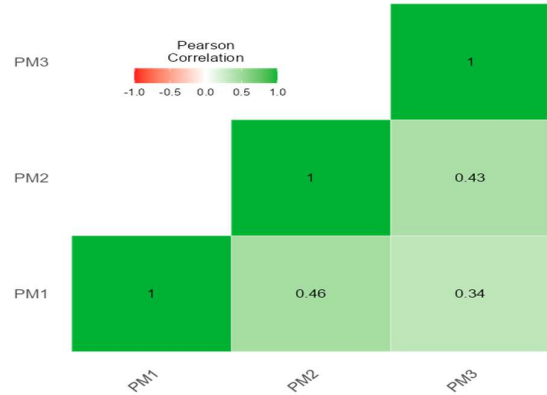
Eigenvalues

Scree Plot



Scale Reliability Statistics for process management

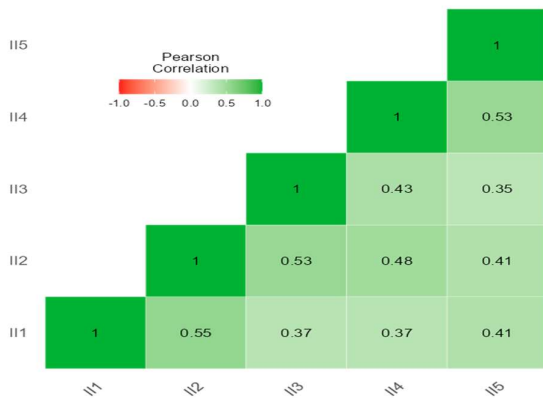
	Mean	SD	Cronbach's $\alpha$	McDonald's $\omega$
scale	3.34	0.751	0.677	0.681



Reliability Analysis

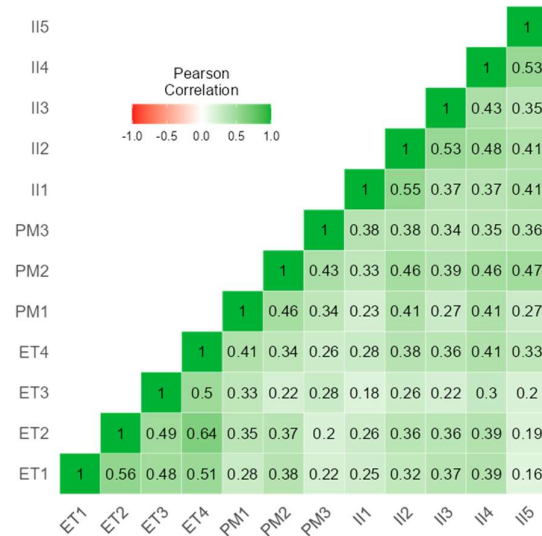
Scale Reliability Statistics for important innovations

	Mean	SD	Cronbach's $\alpha$	McDonald's $\omega$
scale	2.99	0.779	0.796	0.801



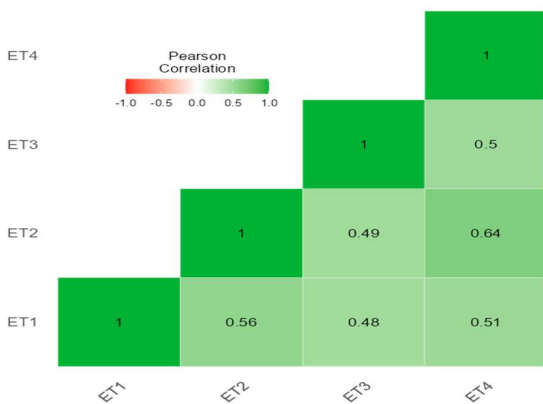
Scale Reliability Statistics for all constructs

	Mean	SD	Cronbach's $\alpha$	McDonald's $\omega$
scale	3.01	0.684	0.870	0.873



Scale Reliability Statistics for education and training

	Mean	SD	Cronbach's $\alpha$	McDonald's $\omega$
scale	2.79	0.927	0.818	0.820



Estimate Plot

