Business Education Journal 11 (2025)

journal homepage: https://bej.cbe.ac.tz

The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania

Augustino Yohana[a*], France Shayo[a], and Sophia Mbura[a]

[a] Department of Marketing, The Open University of Tanzania, PO Box 23409, Kinondoni, 14110, Tanzania
*Corresponding author
E-mail address: augustinoyohana3@gmail.com

Abstract

This study applied the innovation diffusion theory to examine the impact of the Adoption Relative Advantage of Technology on firm performance in the Gas Energy Sector of Dar es Salaam, Tanzania. The study employed a quantitative research design and collected data from several gas energy firms in Dar es Salaam using a questionnaire survey. Krejcie and Morgan's formula (1970) was used to determine the sample size; therefore, the entire sample of 302 respondents involved in this study was analysed using structural equation modelling (SEM) to examine the relationships between relative advantage and company performance. The results showed a noteworthy and favourable relationship between relative advantage and performance, indicating that businesses using innovation achieve better cost control, regulatory compliance, and production efficiency. According to the report, increasing the relative advantage through sustainable energy solutions and digital transformation will significantly enhance the efficiency and competitiveness of gas energy corporations.

Keywords: *Relative Advantage; Innovation Diffusion Theory; Firm Performance; Technology; Adoption.*

1.0 Introduction

The gas energy sector is crucial to Tanzania's economic growth, serving as a significant source of energy for domestic, commercial, and industrial use. As global energy demands continue to rise, businesses in this sector must develop innovative ways to promote sustainability, reduce operating costs, and increase efficiency. Primarily, the performance of gas energy companies depends on relative advantage, which refers to the apparent superiority of an innovation over current options (Cook, 2021). Othman and Alamsyah (2022) defined relative advantage of technology as the degree to which an innovation is perceived as being better than the idea it supersedes. Thus, companies are increasingly ready to adopt modern technologies that benefit their operations, including digital monitoring systems, automation, and renewable energy solutions (Aithal, 2023).

Among numerous domains of Tanzania's environment, operational efficiency, cost-effectiveness, environmental sustainability, and market competitiveness clearly demonstrate a relative advantage. Companies that implement modern technologies and creative concepts often experience faster operations, improved regulatory compliance, and increased productivity (Lin & Wang, 2023). Companies claiming cheaper operational costs, that is, those claiming less, have taken advantage of artificial intelligence-driven predictive maintenance and smart metering systems (Cavus et al., 2025). Moreover, applying sustainable practices and renewable energy sources not only increases operational efficiency but also aligns with global sustainability goals, which is becoming a competitive advantage in the sector (Hartmann, Inkpen, & Ramaswamy, 2021).

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

Although various aspects restrict gas companies in Tanzania from embracing technical innovation at least at the basic level, overall, it has definite benefits. The key challenges include insufficient resources, contradictory rules, resistance to change, and inadequate technology knowledge (TPDC, 2024). Some businesses oppose government environmental regulation of the energy industry; however, many struggle with the high initial costs associated with alternative energy sources (Liu et al., 2023; Smirnova et al., 2021). Reluctant to adopt new technologies, some companies also suffer from worker adaptability, integration difficulties, and return on investment (Eisend, Evanschitzky, & Calantone, 2016). These challenges inspire this study of how relative advantage influences the running performance of specific gas energy sources in Dar es Salaam, Tanzania.

Applied to industry, companies, and households, the gas energy sector primarily determines Tanzania's rate of economic development (Byaro & Msafiri, 2021). Companies in this field must find innovative ways to enhance sustainability, reduce operational costs, and increase efficiency as global energy demand continues to rise. Relative advantage, that is, the supposed genius of an invention above current substitutes, is one of the primary determinants of the performance of gas energy companies (Along et al., 2023; Rustine et al.,2022). Companies are increasingly eager to implement new technologies, digital monitoring systems, automated tools, and renewable energy solutions that benefit their operations (Mndzebele, 2013).

Relative advantage can be demonstrated through operational efficiency, cost-effectiveness, environmental sustainability, and market competitiveness from various angles in the Tanzanian context (Mzingula et al., 2024). Companies that welcome new ideas and modern technologies tend to operate more efficiently, exhibit higher levels of regulatory compliance, and achieve better results (Lin & Wang, 2023). Companies claiming reduced downtime and improved service quality, for example, have applied smart meters and artificial intelligence-driven predictive maintenance. Moreover, environmentally friendly regulations and renewable energy sources not only enhance operational efficiency but also contribute to fulfilling global sustainability goals, thereby strengthening the sector's competitive edge (Hartmann, Inkpen, & Ramaswamy, 2021).

Although numerous reasons prevent many gas businesses in Tanzania from adopting technical innovations at a low rate, they have their advantages. Among the primary obstacles are limited resources, complex legislation, resistance to change, and a lack of technological understanding. While some companies fight with the governmental environment monitoring the energy sector, many suffer from the expensive initial outlay needed for modern energy solutions (TPDC, 2024). Some businesses that are also cautious about adopting new technologies have concerns about worker adaptability, integration challenges, and return on investment (Eisend, Evanschitzky, & Calantone, 2016). These difficulties motivate this study to learn how relative advantage affects the performance of particular gas energy suppliers in Dar es Salaam, Tanzania.

2.0 Literature review

2.1 Theoretical Review: Innovation Diffusion Theory

Originally put forward by Rogers (1995), Innovation Diffusion Theory (IDT) is widely used to explain the spread of ideas within a social system or industry. IDT claims that five basic elements define the acceptability of a new technology: Relative Advantage, Compatibility, Complexity, Trialability, and Observability.

Among the five criteria, relative value proves to be the most crucial factor influencing the acceptance of innovation. New technologies are more likely to be adopted by a company when they benefit from them, such as through cost savings, operational efficiency, improved customer satisfaction, and regulatory compliance (Aithal, 2023). Especially in the gas energy industry, relative advantage is quite crucial since businesses compete and existence depends on the economy of cost and efficiency. Companies that integrate IoT-based energy management, digital monitoring systems, and AI-driven analytics are more likely to enhance operational efficiency and reduce unnecessary expenses (Hartmann,

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

Inkpen, & Ramaswamy, 2021). Income-generating and regulatory compliance have also shown significant improvements among users of early blockchain-based energy trading and smart grid technology (Dong, Karhade, Rai, & Xu, 2021). Blockchain is a decentralised digital ledger that securely records transactions across a network of computers, making the data tamper-resistant and transparent (Ahmed, 2025).

Another essential element of IDT is the influence early adopters and opinion leaders have on the dissemination of innovation. According to Rogers (2003), leading companies in various fields set the standard for innovation, which later inspires other companies to adopt the same approach. This is especially relevant in Tanzania's gas energy sector, as some forward-looking businesses have adopted digital supply chains, renewable energy integration, and automation. In contrast, others remain resistant due to technological and financial constraints (Lyakurwa, 2023). Understanding how relative advantage affects technology adoption enables companies to stay ahead of their competitors and make informed strategic decisions aligned with industry best practices.

For the Tanzanian gas energy company, implementing new technologies presents various challenges, including high capital investment costs, inadequate staff, and regulatory ambiguity (Yohana et al., 2024). Companies that correctly apply relative advantage through digital transformation and energy-efficient technologies, however, can enhance their market position and achieve long-term growth (Lin & Wang, 2023).

Another key aspect of IDT is the role of early adopters and opinion leaders in influencing the diffusion of innovation. In many industries, leading firms set the pace for innovation adoption, which later encourages other companies to follow suit (Mohamadabadi, 2023). This is particularly relevant in Tanzania's gas energy sector, where a few forward-thinking companies have embraced renewable energy integration, digital supply chains, and automation. In contrast, others remain hesitant due to financial and technical barriers (Chuwa & Perfect-Mrema, 2023). By understanding how relative advantage drives technology adoption, companies can make informed strategic decisions to stay ahead of competitors and align with industry best practices. The Tanzanian gas energy sector faces multiple challenges in adopting modern technologies, including high capital investment costs, a shortage of skilled labour, and regulatory uncertainties (Bishoge et al., 2021). However, firms that effectively leverage relative advantage through digital transformation and energy-efficient technologies have the potential to enhance their market position and achieve long-term growth (Lin & Wang, 2023).

2.2 Empirical review

2.2.1 Relative advantage of technology and the performance of gas energy companies

Relative advantage is relatively important for raising company performance. Businesses claiming to have implemented technical innovations have been shown to have significantly increased customer satisfaction, cost control, sustainability, and efficiency (Çağlıyan et al., 2022). Those who adopted smart technology and automation achieved higher productivity levels, reduced operational expenditures, and improved market positioning, as noted by Lin and Wang (2023) in their comparison of specialised and diversified energy enterprises. These results suggest that companies relying on technological innovations have a significant competitive advantage over those relying on established energy consumption policies.

Conversely, Eisend, Evanschitzky, and Calantone (2016) examined the relationship between technical innovation and business performance. Their study shows that businesses that actively support marketing and digital transformation initiatives often outshine their competitors. The study also revealed that companies offering consumer-centric digital solutions first have more profitability and market exposure.

In the context of the digital revolution, Hartmann et al. (2021) also examined developments in the global oil and gas industry. Their study indicates that companies that claim better regulatory

compliance and increased efficiency are turning to IoT-enabled monitoring systems, blockchain-based energy trading, and artificial intelligence-driven predictive analytics. These results validate the theory that relative advantage directly affects technology acceptability, therefore affecting commercial performance.

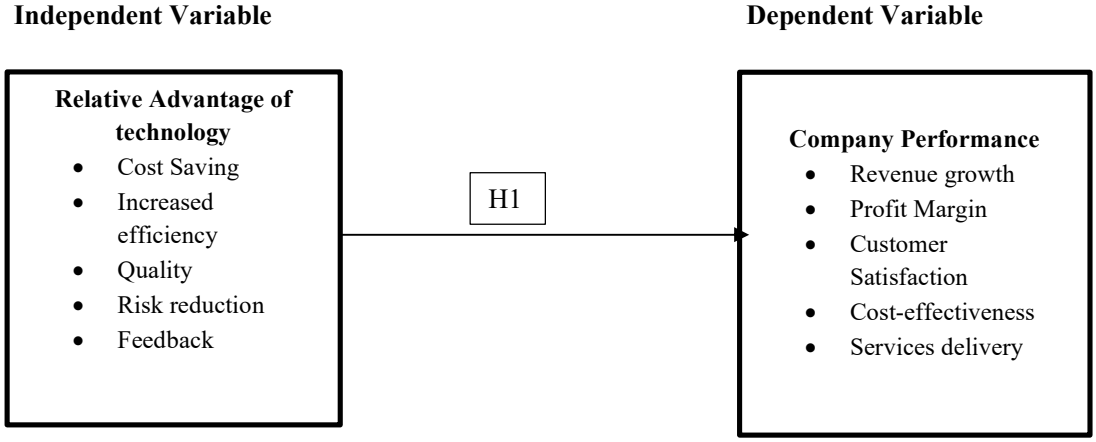
Xu et al. (2019) investigated real-time monitoring and operational performance under smart metering systems. This study demonstrates that companies utilising digital supply chain management and energy-efficient technologies experience reduced operational expenses, decreased downtime, and increased customer satisfaction. Additionally, Sheikh and Shahzad (2016) examined the impact of e-marketing and digital engagement techniques on business success. Research on businesses utilising digital media for customer communication and service management has found improved income and market share. Studies by Ou and Zhang (2025) support this, showing that merging financial shared services and enterprise resource planning (ERP) systems significantly improves cost efficiency and decision-making processes in energy companies.

Furthermore, Nayal et al. (2022) examined the impact of sustainable development policies on corporate performance. They concluded that digital transformation is crucial for maintaining competitiveness in sectors, including those in the energy-intensive industry. Studies by them have generally revealed better performance and sustainability results for companies that implement automated systems, artificial intelligence-driven analytics, and renewable energy technology.

Thus, relative advantage has become somewhat well-known as the primary factor influencing the acceptability of innovation in the gas energy sector. Companies that combine digital transformation plans with technological advances are better equipped to increase efficiency, reduce costs, and enhance sustainability, ultimately enabling improved performance in an increasingly competitive market.

2.3 Conceptual Framework

Essentially, the conceptual framework comprises exogenous variables (such as the relative advantage of technology) and endogenous variables, which are companies' performance. Based on a theoretical and empirical literature review, it is hypothesised that the adoption of electronic marketing directly improves the performance of gas energy companies.



2.4 Hypothesis

It has been hypothesised under Alternative H1 that "*Adoption relative advantage of technology has positive and significant effects on the performance of gas energy companies in Tanzania.*"

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

3.0 Materials and Methods

This study examined the Adoption Relative Advantage of Technology and Its Impact on firm performance, applying innovation diffusion theory in the Gas Energy Sector of Dar es Salaam, Tanzania. The study area was the Dar es Salaam region, focusing on Gas Company Tanzania Ltd., Tifa Gas Ltd., Lake Gas Ltd., Oryx Gas Ltd., and Pan African Energy Ltd. The sample size of 302 was determined from a target population of 1,400, based on the guidelines provided by Krejcie and Morgan (1970). The target population of 1,400 employees was drawn from five departments: Marketing, Sales, Distribution, and ICT of gas energy companies, including Gas Company Tanzania Ltd, Tifa Gas Ltd, Lake Gas Ltd, Oryx Gas Ltd, and Pan African Energy Ltd, as provided by the management of these companies, particularly their Human Resources departments. The study employed self-administered questionnaires, adapted from Alford and Page (2015), to collect data. Adopting a positivist research philosophy with a deductive approach, the study emphasised an objective and scientific assessment of how the relative advantage of technology influences company performance.

To ensure a representative sample suitable for generalising the research findings, a probability sampling approach employing multiple stages and random sampling techniques was implemented (Acharya et al., 2013). The sampling frame was derived from registered gas companies operating in Dar es Salaam, specifically encompassing districts such as Ilala, Kinondoni, and Kigamboni. Companies were selected using a multistage stratified sampling approach, taking into account factors such as the level of technological adoption, size, and market presence. This multi-stage stratified sampling method was utilised to provide representative coverage of employees across various departments and companies, thereby minimising bias and enhancing the accuracy and generalisability of the results. Structural equation modelling (SEM) was employed for data analysis, as its confirmatory approach facilitates the identification of correlations between variables. SEM is particularly effective in clarifying complex relationships between performance outcomes and innovation acceptance. It provides a robust framework for hypothesis testing and assessing the strength of causal relationships between the relative advantages of technology and business performance, distinguishing it from other multivariate methods.

The analysis and interpretation of the measurement model concerning the individual construct of relative advantage of technology, in relation to the performance of gas energy companies in Tanzania, aligns with scholarly justifications for testing constructs individually. Jöreskog et al. (2016), who pioneered the application of Structural Equation Modelling (SEM), underscored the importance of evaluating individual constructs to gain a deeper understanding of their measurement properties and explanatory power. This perspective supports the examination of constructs such as relative advantage within the SEM framework, which facilitates more precise insights into their contributions to organisational performance. For instance, Mwakatage et al. (2024) employed this methodology in their study, which examined the impact of perceived vulnerability on enhancing prevention intentions against fire outbreaks in public markets in Dar es Salaam, Tanzania.

4.0 Findings and discussion

4.1 *Procedure and Output of Exploratory Factor Analysis*

As a prerequisite for factor analysis, the researcher assessed the adequacy of the sample using the KMO. A KMO value of 0.6 or above indicates that the sampling is adequate for a factor analysis. Additionally, I checked the correlation of variables using Bartlett's test of sphericity. Bartlett's test with a p-value less than 0.05 indicates that the data exhibit a significant correlation.

The KMO value of 0.771 in Table 4.1 indicates that the sample is adequate for conducting factor analysis. The KMO statistic evaluates the proportion of variance in the variables that could be attributed to common factors. Values closer to 1 indicate that the patterns of correlations are relatively compact, making factor analysis a suitable approach for analysis. A KMO value above 0.7 is considered middling

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

and acceptable for factor analysis, as per Kaiser (1974). The value of 0.771 demonstrates that the sample meets this requirement, confirming its suitability for the planned statistical techniques.

Bartlett's test evaluates whether the correlation matrix is significantly different from an identity matrix, indicating that the variables are uncorrelated. In this case, the approximate chi-square value is 2.766E3 (or 2766), with a degree of freedom (df) of 378 and a significance value (Sig.) of 0.000. A significant result ($p < 0.05$) indicates that the correlations among variables are sufficient for factor analysis., The p-value of 0.000 confirms that the correlation matrix is not an identity matrix, further supporting the appropriateness of factor analysis.

Table 4.1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.771**
Bartlett's Test of Sphericity	Approx. Chi-Square	2.766E3
	df.	378
	Sig.	.000

The items under the Relative Advantage and Company Performance variables show good fit, with loadings above the threshold for retention. Items such as RA3, RA4, RA1, RA5, and RA2, and CP1, CP2, CP3, CP4, CP5 exhibit strong and clear relationships with their respective factors.

Table 4.2: The EFA Rotated Component Matrix

	Component	
	1	2
RA3	.744	
RA4	.738	
RA2	.727	
RA5	.508	
RA1	.503	
CP2		.704
CP4		.675
CP5		.618
CP1		.609
CP3		.570
Extraction Method: Principal Component Analysis.		
Rotation Method: Varimax with Kaiser Normalisation**.**		
a. Rotation converged in 5 iterations.		

4.2 *Confirmatory Analysis Results*

IBM SPSS Amos 23 was used to evaluate the measurement model fit for the RA construct, which consisted of five factors: RA1, RA2, RA3, RA4, and RA5. By the first step of confirmatory factor analysis (CFA), one may determine the degree to which the proposed model fits the observed data. Although several indices fell within appropriate standards, the overall findings showed a poor model fit when compared to the benchmark levels provided in Table 4.1. With CMIN/DF = 3.616, GFI = 0.976, AGFI = 0.928, CFI = 0.966 and RMSEA = 0.094. Thus, further refinement and modification of the model required improvements in the validity of the construct and acceptable fit indices.

The refining process to address the low model fit was conducted following the recommendation

of Schumacker and Lomax (2004), who stress that items with high covariance and large regression weights in the modification indices (MI) should be prioritised for deletion to improve model performance. Candidates for deletion were also items with standardised regression weights (SRW) less than the critical criterion of 0.5. This stage ensured that the final model retained exactly those items that offered the most value to the construct.

The AMOS output was initially examined for problematic items to refine the model. For instance, e5↔e1e exhibited an RA1 factor parameter change of 0.083 and a modification index (MI) of 8.981. Subsequent deletion of this item resolved the issue with the model fit. Following this change, the overall model fit improved significantly. The refinement strategy ensured that the remaining components accurately represented the latent variable by carefully removing elements that compromised the construct. These adjustments facilitated further model testing to verify the enhanced fit of the modified measurement model.

Table 4.3: Model Fit Assessment Indices

Indices	Recommended value	References
Absolute Fit Indices		
Goodness of Fit Index GFI	GFI > .0.95 Is a Good Fit 0.85 < GFI < 0.95 Acceptable fit	Schumacker & Lomax, 2004
Adjusted Goodness of Fit Index AGFI	AGFI Closer to 1 Good Fit AGF > 0.80 Acceptable Fit	Byrne, 2013 Hooper, et al, 2008
Root Mean Square Error Approximation	RMSEA <0.05 Is Good Fit 0.05 < RMSEA <0.1 Acceptable Fit	Byrne, 2013 Schumacker and Lomax, 2004
Incremental Fit Indices		
Normed Fit Index NFI	NFI > 0.95 Is a Good Fit 0.9 < NFI < 0.95 Acceptable fit	Byrne, 2013 Schumacker and Lomax, 2004
Comparative Fit Index CFI	CFI > 0.95 Is a Good Fit 0.9 < CFI < 0.95 Acceptable fit	Byrne, 2013 Schumacker and Lomax, 2004
Average Variance Extracted AVE	AVE > 0.5 Is Acceptable	Fornell and Larcker, 1981

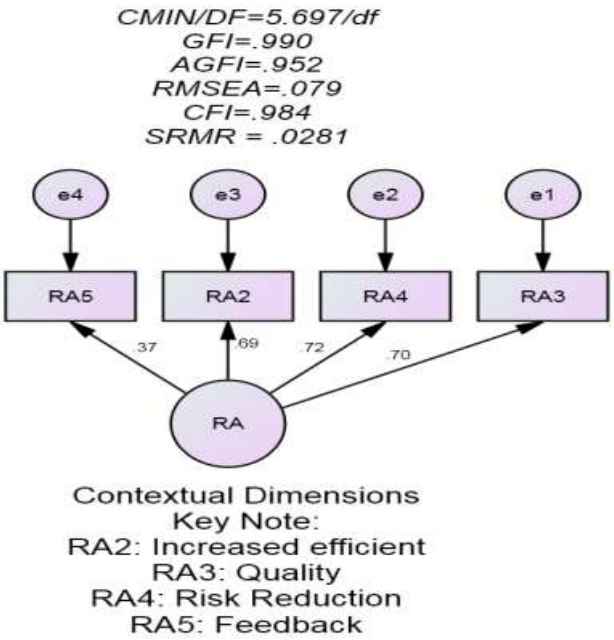


Figure 4.1 Measurements Model for RA

After the problematic item was removed, IBM SPSS Amos 23's confirmatory factor analysis (CFA) yielded results indicating a significant improvement in model fit. By achieving and surpassing the necessary criteria for appropriate fit indices, the modified model confirmed the validity and dependability of the maintained components in reflecting the construct. Especially CMIN/DF = 0. 265, GFI = 0. 999, AGFI = 0.995, CFI = 1.000, RMSEA = 0.000 and SRMR = 0.0281 were the fit indices for the improved model. These results reveal a suitable model and the success of the applied improvements throughout the refining process.

Based on the settings provided, the model fits the observed data essentially exactly. For example, the fit is relatively strong considering the value of the Root Mean Square Error of Approximation (RMSEA), 0.000, which falls much below the usually accepted criterion of 0.08. The Standardised Root Mean Residual (SRMR) value of 0.0281 also indicates a good match, as it is significantly below the 0.05 threshold. With a value of 1.000, the Comparative Fit Index (CFI) indicates an optimal level of fit, suggesting that the revised model accurately describes the observed covariance structure.

4.3 *Measurement Model for the Company Performance (CP)*

IBM SPSS Amos 23 was used to assess the measurement model's fitness for the CP construct, which comprised five factors: CP1, CP2, CP3, CP4, and CP5. The analysis involved conducting Confirmatory Factor Analysis (CFA) to evaluate how well the proposed measurement model aligned with the observed data. The CFA process produced the following fit indices: CMIN/DF = 1.934, GFI = 0.937, AGFI = 0.961, CFI = 0.978, RMSEA = 0.056 and SRMR = 0.0260. Each of these indices fell within the acceptable range or exceeded the thresholds specified in Table 4.3, providing strong evidence that the measurement model achieved a good fit.

The CMIN/DF value of 1.934 indicates an appropriate level of parsimony, suggesting that the model strikes an adequate balance between goodness of fit and model complexity. The Goodness-of-Fit Index (GFI) of 0.937 and the Adjusted Goodness-of-Fit Index (AGFI) of 0.961 are both well above the

conventional minimum threshold of 0.90, signifying excellent alignment between the model and the data. The Comparative Fit Index (CFI) of 0.978 further underscores the model's strong performance, as values above 0.95 indicate a near-perfect fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) value of 0.056 lies within the acceptable upper limit of 0.08, confirming minimal error in approximating the population covariance matrix. Finally, the Standardised Root Mean Square Residual (SRMR) value of 0.0260, being well below the threshold of 0.05, underscores the negligible differences between the observed and predicted correlations.

As the model met the necessary fit criteria, no further refinement or modification was required. Typically, as recommended by Schumacker and Lomax (2004), model refinement involves identifying and removing items with high covariance or low standardised regression weights (SRW) based on the modification indices (MI). Items that fail to meet these criteria can detract from the model's fit and are considered for deletion. However, in this instance, the model exhibited a strong fit without the need for such adjustments, indicating that all five factors (CP1, CP2, CP3, CP4 and CP5) contributed effectively to the overall construct.

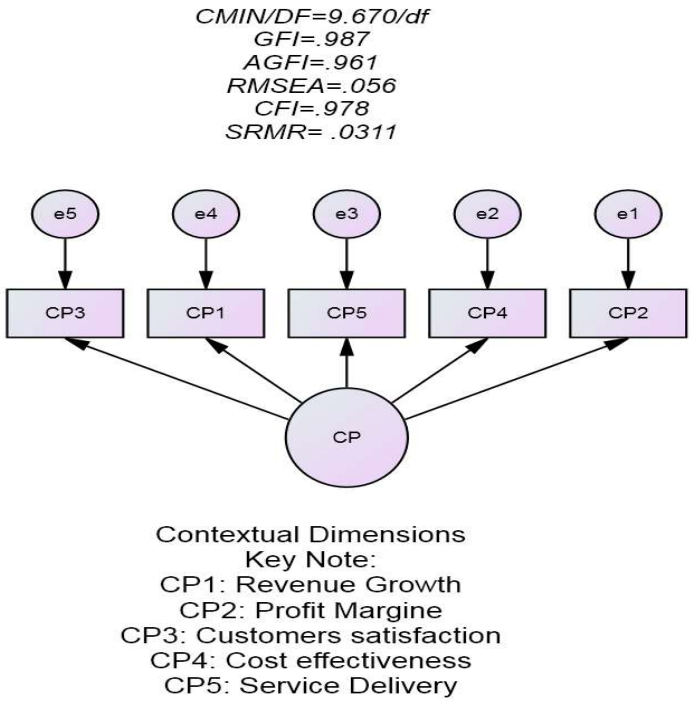


Figure 4.2 Measurements Model for CP

Table 4.4 Basic Model Standardised Estimate and SRW

Path			Estimate	S.E.	C.R.	P	Label	SRW	Remarks
CP	<---	RA	.333	.180	1.967	.047	par_19	.251	Accepted
RA2	<---	RA	2.302	.481	4.785	***	par_4	.704	Accepted
RA3	<---	RA	2.320	.485	4.787	***	par_5	.708	Accepted
RA5	<---	RA	1.000					.343	Accepted

The results show a clear and favourable connection between relative advantage and business performance, with a standardised path coefficient (A) of 0.251. This implies that companies that maximise relative advantages, that is, those that apply innovative ideas, simplify procedures, or enhance customer service, may show outstanding performance results. This outcome aligns with the findings of Al-Omoush et al. (2019), who emphasised that a standardised path coefficient exceeding 0.2 is statistically significant and therefore crucial in discussions of causal links.

All four conserved objects showed standardised regression weights (SRW) of 0.5 or more, therefore validating their contribution to the latent construct. Strong and clear links between the surviving objects and the underlying factor indicate that they meet the required retention criteria. The changes carried out during the refining procedure ensured that the model accurately represents the interactions among the observable variables.

Figure 4.1 graphically displays the latent variable-retained item linkages, along with the final model. The graph underlines how precisely and orderly the development process has been produced. The results indicate that the modified model provides a solid foundation for interpretation and further research, as it falls within the acceptable range.

These findings underscore the importance of relative advantage in driving economic success in the Tanzanian gas energy industry. The p-value (0.047) and the critical ratio (C.R. = 1.967) further justify the relevance of this link. This suggests that relative advantage has a positive and statistically significant effect on the performance of gas energy companies in Tanzania, with a C.R. over the threshold of 1.96 and a p-value substantially below the conventional cut-off of 0.05.

The item-level study adds more evidence of this link. Higher efficiency (RA2), for instance, revealed an estimated coefficient of 2.302 with a standard error of 0.481, a critical ratio of 4.785, and a p-value of less than 0.001, therefore generating a strong standardised estimate of 0.704. Relative advantage (RA) and the observed variable (RA) exhibit a favourable association here. In line with this, the assessment of quality (RA3) revealed an expected coefficient of 2.320 with a normalised estimate of 0.708, therefore underscoring the considerable importance of quality on corporate success. Though a reference point, feedback (RA5) generated a somewhat linked standardised estimate of 0.343.

These results emphasise the need for relative advantage in enhancing the performance of Tanzanian gas energy companies. Businesses that prioritise efficiency, quality, and feedback improvement not only enhance their operational performance but also boost their market competitiveness. Through improved efficiency, companies can reduce costs, streamline processes, and offer better products, thereby increasing profitability, customer satisfaction, and worker morale. Good businesses optimise the available resources without waste, ensuring that operations are maximised.

Therefore, both job performance and satisfaction depend on keeping high standards of quality. Good work reduces the need for corrections, boosts employee performance, and frees more time to focus on other critical tasks (Kim, 2024). Frequent high-quality work would most likely enable employees to feel greater job security and satisfaction, while also helping to satisfy clients and promote the company's expansion. Emphasising quality boosts morale throughout the business, fostering a culture of excellence and teamwork that ultimately yields higher performance results.

Feedback is also fairly significant for enhancing company performance as part of relative advantage. Findings highlight areas that need improvement and point out benefits that may have been missed. It provides perceptive analysis of consumer preferences and industry trends, thereby enabling companies to remain competitive through adaptability (Sandra, 2024). Workers who receive constructive criticism become clear about expectations, align their efforts with the business goals, and contribute to establishing a continually growing culture. Feedback also enables staff members to become more empowered, enhances teamwork, and fosters organisational commitment, thereby affecting performance.

The findings of this research support empirical investigations in different environments. Many studies, for example, have examined relative advantage as a key factor in company performance.

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

Velasco-Morente et al. (2025) in their analysis of technology adoption models emphasised that the perceived relative advantage of adopting new technologies plays a crucial role in the successful implementation and performance outcomes of adopting these technologies. Likewise, Lin et al. (2020) revealed that in many industries, the acceptance of technology improvements with unambiguous relative benefits resulted in better operational efficiency and competitive advantage.

Additional studies, such as those by Hu et al. (2019), also reveal that the adoption of technology depends largely on relative advantage, which in turn shapes the performance of gas energy companies. Their studies suggest that businesses that derive greater benefits from current technologies are more likely to outperform their competitors in terms of customer satisfaction, quality, and efficiency. In line with this, companies that focused on enhancing efficiency through innovative ideas and technology adoption exhibited impressive improvements in operational and financial performance (Mpinganjira, 2018).

Moreover, studies by Nguyen. (2024) in the framework of digital transformation in renewable energy businesses supports the theory that relative advantage results in enhanced performance outcomes, especially when businesses understand the advantages of technological innovations in lowering operational expenses and so improving service delivery. Recent research by Lee et al. (2021) on the value of innovation in the energy sector confirms these findings, as technological developments with proportionate benefits are crucial in improving profitability and efficiency. Similarly, studies by Tan et al. (2022) reveal notable changes in general performance and market positioning among energy sector organisations that adopt relative advantages through process optimisation and enhanced customer service.

Furthermore, research by Patel et al. (2013) highlights the crucial role of feedback loops in achieving a relative advantage, particularly in the energy sector, which relies on continuous technological and operational advancements. This is especially true in sectors needing constant operational stability and technical innovation. Their findings suggest that businesses that apply comments for continuous innovation and service enhancement maintain a competitive edge in ever-globalised markets. The study findings also align with Rogers' (1962) Innovation Diffusion Theory, which explains that the adoption of new ideas or technologies depends on how knowledge about them spreads over time and on perceived factors, such as the relative advantage of the technology.

This research further underscores the ubiquitous nature of relative advantage, as well as its relevance in various spheres. This uniformity in surroundings, especially in Tanzania's gas energy sector, helps to support the need for relative advantage in affecting performance outcomes. By utilising efficient, quality-driven, and feedback-oriented systems, businesses can significantly enhance their competitive edge, shift their market position, and achieve improved overall performance.

5.0 Conclusion and Recommendations

This paper has revealed a clear and favourable association between the performance of relative advantage (RA) and gas energy companies. First, the model displayed poor fit, with indices ranging from CMIN/DF = 3.616, GFI = 0.976, AGFI = 0.928, CFI = 0.966, and RMSEA = 0.094, as revealed by IBM SPSS Amos 23, which also fell short of the prescribed limitations. Methodically deleting problematic objects, relying on standardised regression weights (SRW) and modification indices (MI), helped improve the model. Using Schumacker and Lomax's (2016) guidelines, this process enhanced model validity and reliability.

The superior model closely matched the final indices: CMIN/DF = 0.265, GFI = 0.999, AGFI = 0.995, CFI = 1.000, RMSEA = 0.000, and SRMR = 0.0281. These results confirm a good model fit, particularly the RMSEA value of 0.000, which is significantly below the usually accepted criterion of 0.08, and the CFI value of 1.000, indicating that the revised model accurately reflects the observed covariance structure. Additionally, every maintained item displayed consistent regression weights (SRW $\geq$ 0.5), confirming their central relevance to the relative advantage concept. These findings, along

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

with the theoretical framework of Innovation Diffusion Theory (IDT), support the notion that companies with a larger relative advantage in technological adoption usually demonstrate better operational efficiency, cost control, and market competitiveness.

Overall, this analysis concludes that a relative advantage in both directions helps gas energy companies in Tanzania to perform effectively. Companies that apply innovative technology and efficient operational techniques are more likely to enter the energy sector with higher production, regulatory compliance, and long-lasting competitive advantage. Furthermore, the study signals a positive correlation between the performance of Tanzania's gas energy firms and relative advantage. Thus, careful application of relative advantage should help to increase operational efficiency and technical acceptance in the domain of gas energy. To boost output, economic growth, and market competitiveness through new ideas, companies should focus on incorporating digital energy management, smart monitoring systems, and automation.

6.0 Study implications

6.1 Theoretical Implications

Grounded in the Innovation Diffusion Theory, this study has both theoretically and empirically evaluated a research framework incorporating its dimensions, including relative advantage. By testing this dimension within the Tanzanian gas sector, the study provides a more holistic understanding of the impact of the relative advantage of technology on company performance. Beyond a theoretical perspective, the findings offer valuable insights into how this dimension manifests in practical applications within the local context. The results of this study, derived through exploratory and confirmatory factor analysis, contribute to the development of a new model that elucidates the effects of adopting the relative advantage of technology on the performance of gas companies in Tanzania.

6.2 Policy Implications

Based on these insights, it is recommended that policy-making efforts focus on fostering a culture of relative advantage of technology adoption, particularly emphasising the importance of relative advantage of technology. This can be achieved through targeted political and institutional interventions that create an environment that enables innovation and digital transformation. Policy makers should prioritise initiatives to strengthen critical infrastructure, including ensuring reliable network availability and stable electricity supply, as these are foundational to enhancing creativity and innovation.

6.3 Practical Implications

At the managerial level, management within gas companies can leverage the framework presented in this study to enhance the performance of employees, sections and departments. The insights derived from this research provide a better reference point for management and employees, not only within the gas energy sector but also for other private sector entities offering services in the respective regions. Specifically, the findings suggest that by incorporating the significant dimension of relative advantage into their operational and strategic plans, gas companies can achieve notable improvements in performance.

6.4 Limitations and areas for further research

In conducting this study, the researcher faced various limitations, including financial constraints, as a lack of sufficient funds to conduct the study in larger areas was a significant challenge. Due to this challenge, the researcher considered a few gas companies located in Dar es Salaam region. Although this study focused on a small number of specific gas energy suppliers in the Dar es Salaam Region, it remains unknown whether the tested approach and findings can be applied elsewhere in the broader energy industry. Future studies should incorporate the gas energy companies operating in various regions of Tanzania and other East African nations, thus providing a more comprehensive understanding

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

of the effect of the relative advantage of technology on company performance. Future research should also investigate how organisational culture, financial incentives, and laws could either help or impede the acceptance of technology developments in the energy business. Further research on the long-term effects of the digital revolution and the acceptance of renewable energy sources on the performance of gas energy businesses would greatly benefit legislators, investors, and industry players.

Reference

Ahmed, S. (2025). Enhancing Data Security and Transparency: The Role of Blockchain in Decentralized Systems. *International Journal of Advanced Engineering, Management and Science, 11*(1), 59–98.

Aithal, P. S. (2023). How to create business value through technological innovations using ICCT underlying technologies. *International Journal of Applied Engineering and Management Letters (IJAEML), 7*(2), 232–292.

Alonge, E. O., Eyo-Udo, N. L., Ubanadu, B. C., Daraojimba, A. I., Balogun, E. D., & Ogunsola, K. O. (2023). Leveraging business intelligence for competitive advantage in the energy market: A conceptual framework. *Energy Market Dynamics Journal, 8*(2), 22–36.

Alshaher, A., Alkhaled, H. R., & HH, M. M. (2025). The impact of adoption of digital innovation dynamics in reduce work exhaustion in SMEs in developing countries: The case of cloud of things services. VINE Journal of Information and Knowledge Management Systems, 55(1), 113–134.

Bishoge, O. K., Kombe, G. G., & Mvile, B. N. (2021). Energy consumption efficiency behaviours and attitudes among the community. *International Journal of Sustainable Energy Planning and Management, 31*, 175–188.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen and J. S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage.

Byaro, M., & Msafiri, D. (2021). The uncertainty of natural gas consumption in Tanzania to support economic development. Evidence from Bayesian estimates. *African Journal of Economic Review, 9*(4), 168-182.

Çağlıyan, V., Attar, M., & Abdul-Kareem, A. (2022). Assessing the mediating effect of sustainable competitive advantage on the relationship between organisational innovativeness and firm performance. Competitiveness Review: An International Business Journal, 32(4), 618-639.

Cavus, M., Dissanayake, D., & Bell, M. (2025). Next generation of electric vehicles: AI-driven approaches for predictive maintenance and battery management. Energies, 18(5), 1041.

Chuwa, L., & Perfect-Mrema, J. (2023). Strengths, weaknesses, and opportunities of local content policy, legal, and institutional framework in the upstream natural gas sector in Tanzania. Resources Policy, 81, 103304.

Cook, M. (2021). Trends in global energy supply and demand. In Developments in Petroleum Science 71(1), 15–42.

Dong, J. Q., Karhade, P. P., Rai, A., & Xu, S. X. (2021). How firms make information technology investment decisions: Toward a behavioral agency theory. Journal of Management Information Systems, 38(1), 29-58.

Eisend, M., Evanschitzky, H., & Calantone, R. J. (2016). The relative advantage of marketing over technological capabilities in influencing new product performance: the moderating role of country institutions. Journal of International Marketing, 24(1), 41–56.

Hartmann, J., Inkpen, A. C., & Ramaswamy, K. (2021). Different shades of green: Global oil and gas companies and renewable energy. Journal of International Business Studies, 52, 879–903.

Hu, Z., Ding, S., Li, S., Chen, L., & Yang, S. (2019). Adoption intention of fintech services for bank users: An empirical examination with an extended technology acceptance model. Symmetry, 11(3), 340.

Joreskog, K. G., Olsson, U. H., & Wallentin, Y. (2016). Multivariate analysis with LISREL. Springer International Publishing.

Kaiser, H.F. (1974). An index of factorial simplicity. *Psychometrika, 39,* 31-36. http://dx.doi.org/10.1007/BF02291575

Kim, K. (2024). Moderating effect of socioeconomic status on nonlinear relationship between job quality and quality of life. Current Psychology, 43(17), 15737–15756.

Lin, B., & Wang, S. (2023). The performance of specialized and oriented diversified firms: A comparative analysis from the targeted expansion of renewable energy business of listed companies. International Review of Financial Analysis, 89(1), 27-42.

Liu, W., Shen, Y., & Razzaq, A. (2023). How renewable energy investment, environmental regulations, and financial development drive the renewable energy transition: Evidence from G7 countries. Renewable energy, 206, 1188–1197.

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

Lyakurwa, F. S. (2023). Drivers for, and barriers to solar energy use by manufacturing Micro Small and Medium Enterprises (MSMEs) in Tanzania. *Renewable Energy & Sustainable Development, 9*(1), 21-30.

Mohamadabadi, M. (2023). Review of Innovation Diffusion Strategies in Engineering: Accelerating Adoption and Scaling. *Management Strategies and Engineering Sciences, 5*(1), 42-54.

Morgan, K. (1970). Sample size determination using the Krejcie and Morgan table. Kenya Projects Organization (KENPRO), 38, 607–610.

Mzingula, E. P., Massawe, F., & Salanga, R. (2024). Effects of Perceived Relative Advantage and Complexity on Sustained Adoption of Indigenous Weather Forecasts in the West Usambara Mountains, Tanzania. *African Journal of Empirical Research, 5*(3), 988–1000.

Nayal, K., Raut, R. D., Yadav, V. S., Priyadarshinee, P., & Narkhede, B. E. (2022). RETRACTED: The impact of sustainable development strategy on sustainable supply chain firm performance in the digital transformation era. *Business Strategy and the Environment, 31*(3), 845–859.

Nguyen, T. H. (2024). Investigating Driving Factors of Digital Transformation in the Vietnam Shipping Companies: Applied for the TOE Framework. *SAGE Open, 14*(4), 215–238.

Othman, N. A., & Alamsyah, D. P. (2022). Model of Relative Advantage on Mobile Payment. *Innovation in Consumer Technologies, 2*(1), 128-133.

Ou, P., & Zhang, C. (2025). Exploring the contextual factors affecting financial shared service implementation and firm performance. *Journal of Enterprise Information Management, 38*(1), 152–175.

Patel, P. C., Messersmith, J. G., & Lepak, D. P. (2013). Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity. *Academy of Management Journal*, 56(5), 1420–1442.

Qalati, S. A., Ostic, D., Sulaiman, M. A. B. A., Gopang, A. A., & Khan, A. (2022). Social media and SMEs' performance in developing countries: Effects of technological-organizational-environmental factors on the adoption of social media. *Sage Open, 12*(2), 2158–2180.

Rabe-Hesketh, S., Skrondal, A., & Zheng, X. (2007). Multilevel structural equation modeling. In *Handbook of latent variable and related models* (209–227). North-Holland.

Rogers, E. M. (1962). *Diffusion of Innovations*. Free Press, New York.

Rogers, E. M. (2003). *Diffusion of Innovations* (5th ed.). New York: Free Press.

Rustine, M., Ratnapuri, C. I., Karim, N. A., & Alamsyah, D. P. (2022, January). The antecedent of relative advantage in mobile payment e-wallet. In 2021 International Seminar on Machine Learning, Optimization, and Data Science (ISMODE) (278–282). IEEE.

Sandra, A. (2024). Adapting to Rapid Change in Consumer Demands, 2 (5), 34–57.

Schumacker, R. E., & Lomax, R. G. (2016). *A Beginner's Guide to Structural Equation Modeling* (4th Ed.). New York: Routledge.

Sheikh, A. A., & Shahzad, A. (2016). The Effects of E-Marketing Uses, Market Orientation, Relative Advantage and Trading Partners Pressure on the Performance of Textile Business in Pakistan: A Mediated-Moderation Analysis. *International Journal of Economic Perspectives, 10*(4), 59–71.

Sijabat, R. (2024). The Effect of Perceived Relative Advantage and E-Commerce Knowledge on The Behavior of Doing Online Business Among Undergraduate Students in Indonesia. *Jurnal Ecodemica: Jurnal Ekonomi Manajemen dan Bisnis, 8*(1), 38-47.

Smirnova, E., Kot, S., Kolpak, E., & Shestak, V. (2021). Governmental support and renewable energy production: A cross-country review. *Energy, 230,* 120-903.

Subagja, A. D., Ausat, A. M. A., & Suherlan, S. (2022). The role of social media utilisation and innovativeness on SMEs' performance. *Jurnal iptekkom Jurnal Ilmu Pengetahuan & Teknologi Informasi, 24*(2), 85-102.

Tan, K., Siddik, A. B., Sobhani, F. A., Hamayun, M., & Masukujjaman, M. (2022). Do environmental strategy and awareness improve firms' environmental and financial performance? The role of competitive advantage. *Sustainability, 14*(17), 106-132.

TPDC (2024). The future of the LPG Sector in Tanzania: Opportunities and Challenges for Investors and Entrepreneurs. *Tanzania Petroleum,* September 12. https://tanzaniapetroleum.com/2024/09/12/the-future-of-the-lpg-sector-in-tanzania-opportunities-and-challenges-for-investors-and-entrepreneurs/

Velasco-Morente, F., Berbegal-Zaragoza, V., & Srivastava, S. (2025). Efficiency of information and communication technology adoption by entrepreneurs. *Management Decision, 8*(2), 78-102.

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37

Xu, X. L., Sun, C., & Chen, H. H. (2019). How diversified fuel-fired power enterprises keep their competitive advantages to reach sustainable development. *Environmental Progress & Sustainable Energy, 38*(1), 137-142.

Yohana, A., Magali, J., & Shayo, F. (2024). Social Media Marketing and Performance of Gas Energy Companies: A Systematic Literature Review. *Pan-African Journal of Business Management, 8*(2), 225-237.

Mwakatage, B. J., Gwahula, R., & Shayo, F. (2024). Effects of Perceived Vulnerability on Enhancing Prevention Intention of Fire Outbreaks in Public Markets in Dar es Salaam, Tanzania. *Pan-African Journal of Business Management, 8*(2), 260-281.

Cite paper: Yohana, A. et al. (2025). The Impact of Adoption Relative Advantage of Technology on Firm Performance: Applying Innovation Diffusion Theory in the Gas Energy Sector of Dar es Salaam, Tanzania. *Business Education Journal, vol*(11), Issue 1: 23-37