

The Moderating Role of Organisational Contextual Factors on the Relationship Between Sustainable Technology Applications and Performance: Evidence from 4 and 5 Star-Rated Hotels in Kenya

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Abstract

Although organisational contextual factors (OCF) play a critical role in determining the extent to which sustainable technology (ST) applications affect hotel performance, they remain underexplored in hospitality research. Drawing on the Technology–Organisation–Environment (TOE) framework, this study examined the moderating role of OCF in the relationship between ST applications and hotel performance among 4 and 5 star-rated hotels in Kenya. The study employed both descriptive and explanatory research designs. Using census data collected from 151 hotel general managers through an online questionnaire, the study applied SPSS and PROCESS Macro to test the proposed relationship. The findings indicated that both ST applications ($B=0.285$, $p<.001$) and OCF ($B=0.344$, $p<.001$) were significant predictors of hotel performance, with the model explaining 56.1% of the variance. However, OCF did not significantly moderate the relationship between ST applications and hotel performance ($B=0.062$, $t=0.805$, $\Delta R^2=0.002$, $p=0.422$). The findings therefore demonstrate that OCF function more as direct performance drivers than as moderators in the Kenyan hospitality context. The findings provide evidence that OCF do not moderate the post-adoption effectiveness of STs in 4 and 5 star-rated hotels in Kenya. The study recommends that hotel managers place more emphasis on OCF as direct predictors of hotel performance rather than moderators and prioritise them at the pre-adoption stage. The findings provide valuable practice and policy insights on the role of OCF in the sustainable technology and hotel performance nexus.

Keywords: Organisational Contextual Factors, Sustainable Technology Applications, Hotel Performance, 4 and 5 Star-rated Hotels, Kenya

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Introduction

In Kenya, the hospitality and tourism industry is a significant contributor to the national economy. According to the World Travel and Tourism Council (2026), the industry contributed \$12.7 billion to Kenya's economy in 2025, representing 9.3% of national GDP and supported 1.8 million jobs, equivalent to 8.3% of total employment. Therefore, enhancing hotel performance is imperative for sustaining the industry's economic impact. The hospitality industry is undergoing significant transformation as hotels increasingly utilise STs to improve both business and environmental performance (Caprian et al., 2023). OCF have long been recognised as key determinants of firm performance within hospitality management research (Yoopetch & Chareanporn, 2024). Despite investment in STs, organisations often realise different performance outcomes even when implementing similar technological solutions (Li & Hao, 2026). These differences suggest that OCF may determine how effectively STs integrated into hotel operations translate into performance outcomes.

Hotel performance is a multidimensional concept that entails a hotel's effectiveness in achieving its objectives (Sampaio et al., 2025). The Balanced Scorecard (BSC) framework anchored performance composite conceptualisation in this study (Kaplan & Norton, 1992). Its financial perspective measures include return on investment (ROI), revenue, operating costs, and profitability. The customer perspective evaluates room occupancy, retention rates, online ratings, complaints, and market share metrics. The internal process perspective assesses quality, productivity, cycle times, safety, and operational efficiency. The learning and growth perspective emphasises product and service improvement, employee training and empowerment, technology integration, and change management (Kaplan & Norton, 1992).

Sustainable technology refers to environmentally friendly technological and scientific innovations used to improve business productivity and performance (Akbari et al., 2020). STs include electronic key cards and room occupancy sensors, HVAC and smart lighting systems, web

conferencing, solar technology, and eco-rated appliances for energy efficiency (Maitra, 2024). Smart taps and showers, water-efficient appliances, leak detection systems, smart meters, outdoor water and greywater recycling systems enhance water conservation (Songur et al., 2023). In addition, digital menus, reservation, menu engineering and inventory control software, food digesters and composters, smart waste bins and cloud technology enable waste management (Saura et al., 2022; Singh et al., 2024). In Kenya's 4 and 5 star-rated hotels, ST application is visible but uneven (Githenduka & Fwaya, 2024). Many properties use conventional STs, while more advanced or smart STs such as occupancy sensors and smart water systems remain moderately widespread.

Organisational contextual factors includes the internal situational variables and conditions that affect a business's functioning, structure, and strategic decisions (Kotuwage et al., 2020). Although literature identifies a wide range of OCF, this study focused specifically on organisation's size and scale of operations, staff skills and competencies, financial resources, employee attitude, and hotel culture. Organisation size and scale of operations denote the scope, complexity, and resource base of the hotel; staff skills and competencies refer to employees' knowledge and abilities; financial resources indicate the availability of funds to implement technologies; employee attitude captures staff willingness to support innovation change; and hotel culture denotes the shared values and norms that encourage innovative practices (Lucas et al., 2024).

These factors influence the process of integrating, implementing, and utilising technology to its fullest extent for its intended purpose (Nikopoulou et al., 2023). They determine how STs are integrated into business operations, workflows, and strategies in ways that

benefit hotels (Chen et al., 2023). Importantly, the factors influence the complex relationship between ST and hotel performance (Kusa et al., 2023; Sun & Nasrullah, 2024) through their potential to modify the form and strength of the relationship (Ahmad et al., 2023). They can shape the extent to which hotel performance is impacted by either enhancing or diminishing the effect of ST (Chen et al., 2023). Therefore, their strategic understanding is essential for effectively leveraging ST to maximise potential hotel performance benefits (Yoopetch & Chareanporn, 2024). Indeed, due consideration of OCF in the strategic application of STs has the potential to improve hotel business efficiency (Ahmed et al., 2023).

OCF are conceptualised as moderators rather than mediators because they are viewed as existing organisational conditions under which the ST–performance relationship may vary and not as intervening mechanisms through which ST applications relate to performance.

Pateli et al. (2020) remark that hotels characterised by supportive organisational settings are generally better positioned to coordinate resources, respond to changing market conditions, and implement strategic initiatives successfully. Within the context of ST application, OCF facilitate performance improvements through employee acceptance of technological innovations, effective resource allocation, continuous learning and improvement, management commitment, and employee engagement. Conversely, inadequate organisational support can constrain the realisation of expected technology benefits (Ahmad et al., 2023). The implementation of STs extends beyond technology acquisition to include organisational processes that support effective utilisation.

Despite this, Yoopetch and Chareanporn (2024) argue that the role of OCF in the relationship between ST and hotel performance has been underexplored in existing research. While most studies have focused on predictor relationships, the moderating influence of these factors remains underexamined. This is even though the multidimensional and multifaceted nature of hotel performance suggests that organisational capabilities may influence the effectiveness of STs (Bekele et al., 2024; Lucas et al., 2024). Indeed, empirical evidence remains inconsistent and inconclusive regarding the organisational conditions under which these STs are associated with performance gains. While some studies report positive interactions between OCF, ST, and performance, others suggest that STs deliver performance benefits regardless of organisational characteristics variations.

Further, although organisational context has received considerable attention within TOE framework research, most studies conceptualise it as an antecedent of technology adoption rather than as a condition that shapes performance outcomes after technology implementation (Chen et al., 2023; Tanuwijaya et al., 2021). Existing literature provides limited evidence regarding whether OCF strengthen the relationship between ST applications and hotel performance (Nikopoulou et al., 2023). Comparatively fewer studies have investigated whether the factors continue to influence performance outcomes after STs have been successfully integrated (Lucas et al., 2024). This distinction is important because the capabilities required to adopt STs may differ from those required to realise performance benefits from their use (Pizam et al., 2022). This imbalance presents an opportunity to extend the TOE framework beyond pre-adoption toward

understanding post-adoption performance.

Consequently, there is limited understanding of whether OCF enhance, weaken, or have no effect on the performance benefits derived from ST application, particularly within developing hospitality markets like Kenya. In light of this, the study investigated the moderating role of OCF in the relationship between ST applications and hotel performance among 4 and 5 star-rated hotels in Kenya.

This study is important at three levels. Theoretically, it extends TOE by examining the role of OCF in the technology post-adoption stage. Practically, it helps hotel managers in Kenya understand how ST applications and OCF relate to hotel performance. From a policy standpoint, it provides policymakers with insights relevant to strengthening organisational structures and ST use in support of hotel sector performance in Kenya.

Empirical Review and Hypothesis Development

Organisational contextual factors have drawn a tremendous amount of attention from researchers. The following studies detail how various scholars have conceptualised and analysed the role of OCF in the application of technology within the hotel industry. El-Kassar and Singh (2019) studied the role that management commitment and human resource practices play in overcoming technological challenges, achieving competitive advantage, and enhancing the organisational and environmental performance of the firm. Data was collected using questionnaires from a sample of 215 respondents working in the Middle East and North Africa region and Gulf Cooperation Countries. Data was analysed using partial least squares structural equation modelling (PLS-SEM).

Findings revealed that successful implementation of innovations requires a higher level of top management commitment, proper human resource practices, and employee training. These requirements help in achieving a proper balance of higher organisational and environmental performance.

Kusa et al. (2023) studied the impact of greening on hotel performance and identified the factors that can strengthen this relationship. Using PLS-SEM and Fuzzy-set Qualitative Comparative Analysis, they examined a sample of 101 one or two-star hotels operating in Poland. Results showed that greening has a significantly positive impact on hotel performance. Moreover, this impact is moderated by flexibility and inter-organisational cooperation, while proactiveness and innovativeness do not moderate the examined relationship. Guided by the TOE framework, Yoopetch and Chareanporn (2024) also investigated the impacts of organisational factors on the financial and non-financial performance of hospitality firms. The results indicated that organisational factors had significant effects on both financial and non-financial performance.

Pateli et al. (2020) in their study sought to explore the determinant factors that affect a hospitality firm's decision to adopt social media by following a theoretical approach that integrates the Diffusion of Innovation Theory with the TOE framework. Using survey data from 106 hospitality firms operating in Greece, and by applying SEM, they identified factors that influenced organisational social media use. Of the factors, organisational features were not considered important in terms of their predictive power. Nikopoulou et al. (2023) conducted a study to investigate the factors that affect hotels' decision to adopt digital technologies with a theoretical grounding of the TOE research

framework. The research model was validated through a survey of 502 Greek hoteliers and managers using the PLS-SEM statistical method. The results indicated that the intention to adopt digital technology was positively and significantly influenced by the digital maturity of organisations and the availability of financial resources.

Likewise, drawing on the TOE framework, Chen et al. (2023) investigated determinants of performance of Artificial Intelligence (AI) adoption in the hospitality industry and identified the importance of each determinant. A two-stage approach that integrates PLS-SEM with Artificial Neural Network was used to analyse data from 290 hospitality managers in China. Findings revealed that management support and innovativeness significantly influence the performance of AI adoption. Pizam et al. (2022) examined the effects of TOE factors on hotel managers' intentions to adopt robotic technologies in their hotels. The study was conducted with 1077 hotel managers in 11 countries in North and South America, Europe, Asia, and the Middle East. SEM was utilised to test the study's hypotheses. The results indicated that intention to adopt robotic technologies was positively influenced by top management support, and that the impact of leadership support on intention to adopt was moderated by innovativeness.

Ezzaouia and Bulchand-Gidumal (2020) investigated the factors influencing the adoption of information and communication technology (ICT) in Morocco's hotel industry. The research model incorporated four constructs, namely organisational characteristics, individual characteristics, perceived benefits, and external factors. Questionnaires were sent to hotel general managers to collect data. A sample size of 233 hotels and riads was used, and hypotheses were tested using a partial

least squares approach. The results revealed that organisational characteristics had no significant impact. Ayoobkhan and Kaldeen (2020) explored the impact of Diffusion of Innovation Theory and TOE factors and business benefits of cloud computing adoption on hotel sectors' competitive capabilities. The study was conducted among 30 randomly selected star-graded hotels in Sri Lanka. Self-administered questionnaires were distributed to managerial and ICT professionals. Results revealed that top management support and cost savings influenced cloud computing adoption.

Vu et al. (2023) study aimed at unravelling the factors that impact the intention of adopting social media in 2 and 3-star hotels in Hanoi, Vietnam. A mixed-methods research design was adopted. Qualitative insights from in-depth interviews revealed participants' perspectives on technology, organisational, and environmental contexts. Quantitative findings from structured questionnaires affirmed that employee skills and management support positively influence adoption intentions.

Tanuwijaya et al. (2021) assessed the effect of top management commitment on firm performance through green purchasing and supplier relationship management. The study used a census survey of all 71 three-star hotels in Indonesia. Data collection was done using questionnaires, and data analysis via the smart partial least squares technique. The results demonstrated that top management commitment affects supplier relationship management and hotel performance. However, top management commitment does not affect green purchasing, although green purchasing significantly improves firm performance.

Ahmed et al. (2023) research aimed to evaluate the moderation of

management commitment and human resource practices in the association between green innovation and organisational and environmental performance. The study used 320 employees via a self-administered questionnaire in the textile industry of Pakistan. Confirmatory factor analysis and SEM were used to analyse data. The findings revealed that green innovation significantly impacts environmental and organisational performance. A two-way moderation of human resource practices and green innovation did not have a cogent moderating effect on organisational and environmental performance. However, management commitment had a significant moderation between green innovation and organisational performance. Lucas et al. (2024) investigated the role of sustainability practices in enhancing competitive advantage among hotels in Africa and Asia through the TOE framework. Drawing on data from 155 hotel managers across emerging markets, the study applied SEM-PLS to evaluate six key variables linking sustainability to competitiveness. Findings suggested that technological adoption and organisational commitment drive sustainability in the hospitality sector. Specifically, the implementation of eco-innovative technologies and integration of sustainable organisational strategies collectively reinforce competitive positioning.

Goni et al. (2023) examined the effect of green innovations on the environmental performance of Nigeria's hotel industry and the moderating role of green transformational leadership. Data from 649 hotel staff were analysed using SEM. Results showed that green innovation and transformational leadership positively and significantly influence environmental performance. Furthermore, green transformational

leadership significantly moderated the green innovation effect on the hotel industry's environmental performance. Lastly, Li et al. (2022) analysed 119 articles about the drivers and effects of green innovation in top international journals from 2006 to 2021. They explored the consistencies and contradictions in research conclusions and explored the possible research opportunities. The findings showed that the drivers of green innovation include organisational factors. The practice of green innovation has an internal impact on both financial performance and non-financial performance. The major moderating factors of the drivers and effects of green innovation include internal factors such as cultural factors, learning and organisational ability, and managers' characteristics.

In summary, the literature shows mixed evidence on the role of OCF in hotels. For instance, El-Kassar and Singh (2019) found that management commitment and HR practices are important for innovation performance. Ayoobkhan and Kaldeen (2020), Nikopoulou et al. (2023, 2024), Tanuwijaya et al. (2021) and Vu et al. (2023) showed that organisational resources, innovativeness, management support, and commitment can influence performance. In contrast, Pateli et al. (2020) and Ezzaouia and Bulchand-Gidumal (2020) reported that organisational features had little or no effect on technology adoption.

Other studies found stronger organisational conditional influence. Chen et al. (2023), Pizam et al. (2022), Kusa et al. (2023), Yoopetch and Chareanporn (2024), Ahmed et al. (2023), Goni et al. (2023), Lucas et al. (2024), Alkatheeri et al. (2021), and Mugambi et al. (2025) all reported that organisational or leadership-related factors significantly shape performance or strengthen

technology effects. Related work by Li et al. (2022), Zhang et al. (2020), Sun and Nasrullah (2024), Rukmiyati et al. (2025), and Pastor (2025) further suggests that organisational, cultural, and capability factors can condition the success of technological innovations.

The existing literature reveals three important gaps. Firstly, OCF have predominantly been examined as an antecedent of technology adoption rather than as a moderator of post-adoption hotel performance. As such, limited empirical evidence explains whether organisational capabilities continue to shape ST related performance outcomes. Secondly, previous studies report inconsistent findings regarding the influence of internal organisational factors on hotel performance, suggesting the need for additional investigation. Thirdly, insights on the organisational conditions and technology-oriented performance in developing economies like Kenya and the wider East African hotel industry remain largely unexplored. This contextual gap therefore justifies the present study, as most such studies have been conducted in other parts of the world. Fourthly, most existing literature focuses on OCF in relation to general digital technologies such as AI, robotics, social media, and cloud computing, while limited attention has been given to energy, water and waste STs. Lastly, there is limited evidence of studies that have examined the specific set of OCF as moderators between ST applications and multidimensional hotel performance in Kenya.

Accordingly, the following null hypothesis was formulated;

H₀₁ *Organisational contextual factors do not have a significant moderating effect on the relationship between sustainable technology applications and performance in 4 and 5 star-rated hotels in Kenya.*

Theoretical Review

The Technology–Organisation–Environment (TOE) framework, developed by Tornatzky and Fleischer in 1990, guided the moderator variable selection. Its organisational context encompasses the internal characteristics of the firms in which a technology is used (Tornatzky & Fleischer, 1990). The context represents the distinctiveness, structures, processes, and resources that constrain or facilitate the effectiveness of technology implementation and utilisation (Badghish & Soomro, 2024). These characteristics are organisation size and operations complexity, employee competence and attitude, financial resources, and innovation culture.

Organisational readiness and culture ensure that adequate financial, technical, and human resources are available to support implementation. The organisation's size also influences technology integration. Large hotels are usually in a better position to invest in technology and facilitate its use (Nikopoulou et al., 2024) because they have adequate human and financial resources and vital infrastructure (Badghish & Soomro, 2024). The employees are also a crucial factor in the use of technology to improve performance. Employee development training and upskilling can effectively provide the workforce with the essential skills, culture, and attitude required for the effective application of ST (Li, 2020). Effectively, the presence of competent human capital is imperative in ensuring firms gain performance benefits from ST applications (Zhang et al., 2020).

OCF is theorised as a moderator because while STs provide the technical potential for performance improvement, OCF influence the extent to which that potential is realised. From this perspective, hotels characterised by stronger organisational capabilities are

expected to derive greater performance benefits from the application of STs than hotels with weaker capabilities.

Several TOE framework strengths inform its choice in guiding this study. Firstly, unlike behavioural theories that are used to explain technology use at an individual level, the TOE is commonly applied in explaining implementation at an organisational level (Li, 2020). Secondly, the TOE framework provides a holistic perspective on innovation implementation. Rather than focusing solely on the technology itself, the framework recognises that OCF are important in shaping the technology effect (Badghish & Soomro, 2024). Lastly, the framework focuses on higher-level organisational attributes instead of detailed behaviours of individual employees (Li, 2020).

Notably, in the Kenyan hotel context, TOE remains useful, but its organisational factors may not operate in the same way as in developed economies. This indicates that the framework may require contextual adaptation when applied to developing countries' hotel settings, especially where resource constraints and organisational structures differ.

Additionally, the Resource-Based View (RBV) also supports the study's argument by explaining organisational contextual factors as strategic resources that can create sustained performance advantages (Mehmood et al., 2023). From an RBV perspective, hotels are more likely to gain superior returns from ST applications when they possess valuable, rare, inimitable, and well-organised internal capabilities such as skilled staff, managerial support, financial resources, and an innovation-oriented culture. In this sense, OCF can be understood not only as conditions that shape technology implementation, but also as internal

resources that influence how effectively hotels convert ST into performance outcomes (Abdou, 2025). RBV therefore complements TOE by clarifying why some hotels benefit more than others from similar technology investments.

The moderating effect of OCF can be explained by the resource complementarity mechanism, where STs perform better when combined with internal resources such as skilled staff and leadership commitment (Abdou, 2025). Absorptive capacity further explains that hotels with stronger learning culture and knowledge-processing abilities are better able to recognise, assimilate, and apply STs effectively (Salem et al., 2025).

Methodology

Institutionally and geographically, the study concentrated on 4 and 5 star-rated hotels in Kenya, particularly in Greater Nairobi, Coast, Naivasha/Nakuru, Mt Kenya/Central and Western/North Rift tourism regions. To ensure comprehensive coverage, the study adopted an integrated hybrid classification approach that combined the Tourism Regulatory Authority's (TRA) official ratings with verified hotel reviews from Booking.com. This enabled the inclusion of numerous newer hotel entrants that were not listed in the official 2020 TRA classification. The two hotel categories were chosen as they possess more formal organisational structures and have greater financial, managerial, and operational capacity to integrate STs. The study was grounded in a post-positivist research philosophy, as the relationships among the variables under study are not universally fixed and may vary depending on contextual factors (Maksimovic & Evtimov, 2023). This accounted for the possibility that the relationship between ST and hotel performance is conditional and context-dependent rather than absolute.

An explanatory research design was employed to examine the relationships between ST and hotel performance within the context of OCF, allowing for analysis of associations and directional associations consistent with causal inferences (Hair Jr. et al., 2023). The target population comprised 151 hotel general managers from 4 and 5 star-rated hotels across Kenya. A census approach was employed to collect data from managers of all the hotels between August 2025 and December 2025. Only one manager represented each hotel to avoid duplication of responses, as the hotel constituted the unit of analysis. A Google Form-generated online questionnaire was employed to collect data virtually from the geographically dispersed hotels and respondents. Where needed, reminders were sent to the general managers on a weekly basis to encourage completion. No incentive was offered to respondents for completing the questionnaire. Pretesting was done by virtually administering questionnaires to 10 general managers from hotels listed on booking.com with 4 and 5-star reviews that were deliberately excluded from the final constituent.

Organisational contextual factors was operationalised as the moderating variable, sustainable technology applications as the independent variable, and hotel performance as the dependent variable (Table 1). The construct measurement items were adapted from established instruments used in prior studies, rather than being fully self-developed. In particular, ST application items were informed by previous hospitality technology and sustainability studies (Chan et al., 2017; Songur et al., 2023; Youssef & Zeqiri, 2022). Organisational contextual factors and hotel performance items were adapted from (Baker, 2012; Tornatzky & Fleischer, 1990) and (Kaplan & Norton, 1992), respectively. All factors were measured

using a 5-point Likert scale. ST applications and hotel performance constructs were assessed using an agreement scale [strongly disagree (1), disagree (2), neither

(3), agree (4), strongly agree (5)], while an extent scale [very low (1); low (2); moderate (3); high (4); very high (5) was used for OCF.

Table 1. Measurement of Variables

Construct	Dimensions	Description	Number of items
Organisational contextual factors	Hotel size and operations complexity, Staff skills, competencies and attitudes, Innovation culture, financial/resource availability.	Captures internal organisational capabilities that support or constrain operations.	4
Sustainable technology applications	Energy management technology, Water conservation technology, Waste management technology.	Measures the extent of use of sustainable technologies in hotels.	25
Hotel performance	Financial, customer, internal processes, learning and growth perspectives.	Measures overall hotel performance metrics.	24

Content validity was established through a satisfactory level of agreement among panel academics and industry experts to ensure items represented the constructs. Exploratory Factor Analysis (EFA) was used to assess construct validity by evaluating how well the measured items represented the underlying constructs. Reliability was evaluated using Cronbach's alpha coefficients for internal consistency. Mean, standard deviation, skewness, and kurtosis were used to descriptively analyse data, while frequency tables were employed for graphical visualisation and presentation. OCF was treated as a reflective composite variable by aggregating and averaging the observed items into a single index for moderation analysis, rather than estimating separate effects for each sub-dimension.

Potential biases were minimised in several ways. Because data was collected from self-reporting hotel general managers using a single questionnaire, common method variance, single-source bias, and social desirability bias were

possible. To reduce these risks, the questionnaire sections were separated, different extent scale formats were used for the moderator variable, and respondents were assured of anonymity, confidentiality, and aggregate reporting only. The online form did not require hotel identification or email sign-in, and the wording avoided leading or judgmental items. Further, Harman's single-factor test using Principal Components Analysis (PCA) was also conducted to assess common method bias.

With the help of SPSS version 31 software, moderation analysis was conducted using Hayes' PROCESS Macro, with confidence intervals estimated using bootstrapping with 5,000 samples. PROCESS Macro was considered appropriate because the study tested a single moderation model with an observed composite score, not a complex latent-variable system. It was employed to model, analyse, and test for the moderation effects of organisational contextual factors on the relationship

between ST and hotel performance as follows;

$$HP = \alpha + \beta_1 ST + \beta_2 OCF + \beta_3 (ST * OCF) + \varepsilon \dots \dots \dots \text{Model 1}$$

Where:

HP = Hotel performance

α = Y-intercept (a constant term)

$\beta_1 \dots \beta_3$ = Slope parameters
(partial/regression coefficients)

ST = Sustainable Technology
applications

OCF = Organisational Contextual
Factors

*ST*OCF* = Interaction of ST and
Organisational Contextual Factors

ε = Residual (error term)

To minimise multicollinearity in the moderation model, the predictor and moderator variables were mean-centred before the interaction term (*ST*OCF*) was computed. PROCESS Model 1 was selected because the study tested a simple moderation relationship between ST applications, OCF and hotel performance. The model was appropriate because OCF was assessed as a composite construct,

with its multiple factors treated as indicators of one higher-order contextual construct rather than as separate moderators.

Results

As shown in Table 2, the OCF construct demonstrated acceptable reliability ($\alpha=.795$) across five items. Exploratory Factor Analysis (EFA) was used to assess construct validity by evaluating how well the measured items represented the underlying construct. The Kaiser–Meyer–Olkin (KMO) value of 0.737 indicated adequate sampling adequacy, while Bartlett’s test of sphericity was significant, $\chi^2(10)=292.090$, $p<.001$, confirming the suitability of the data for factor analysis. All five items recorded factor loadings of at least 0.691, providing evidence of adequate convergent validity. The items also loaded distinctly on their respective component without substantial cross-loadings, supporting discriminant validity.

Table 2. Reliability and Validity

Construct	Number of items	Cronbach’s α	KMO	Bartlett’s χ^2 (df)	Factor loadings
Organisational contextual factors	5	.795	.737	292.090 (10), $p < .001$	≥ 0.691
Sustainable technology applications	25	.907	.759	2538.581 (300), $p < .001$	$\geq .551$
Hotel performance	24	.933	.815	3151.797 (351), $p < .001$	$\geq .596$

Likewise, ST applications and hotel performance demonstrated strong reliability, with Cronbach’s alpha values of .907 and .933 for the twenty-five and twenty-four items, respectively. The KMO values of 0.759 and 0.815 indicated adequate sampling adequacy, while Bartlett’s tests of sphericity were significant, $\chi^2(300) = 2538.581$, $p < .001$

and $\chi^2(351) = 3151.797$, $p < .001$, correspondingly, confirming the suitability of the data for factor analysis. All items recorded factor loadings of at least 0.551 and 0.596, respectively, providing evidence of adequate convergent validity. The items also loaded distinctly on their respective components without

substantial cross-loadings, supporting discriminant validity.

Harman's single-factor test was also performed to evaluate the potential presence of common method variance arising from the use of self-reported online questionnaire data. The results of the

unrotated PCA revealed that the first factor accounted for 31.709% of the total variance, which is below the recommended threshold of 50% (Table 3). This indicates that common method variance was unlikely to pose a significant threat to the study's validity.

Table 3. Harman's Single-Factor Test Statistics

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	17.123	31.709	31.709

OCF was operationalised as the moderating variable, and respondents were asked to indicate their levels of agreement or disagreement on a scale of 1 to 5. The mean response score of 4.35 (SD=0.63) reflected high agreement among respondents with the contextual aspects (Table 4), which suggests that the surveyed hotels possess relatively strong internal organisational capabilities. Specifically, the findings indicated that staff skills and competencies are

developed through training programmes (M=4.61, SD=0.553) and the intricacy of hotel operations necessitates continual improvement (M=4.52, SD=0.540). Likewise, the hotel culture encourages the embrace of new ideas (M=4.44, SD=0.638), hotel employees have a positive attitude towards organisational changes (M=4.18, SD=0.590), and hotels possess adequate financial resources to support necessary projects (M=4.00, SD=0.808).

Table 4. Descriptive Statistics for Organisational Contextual Factors

	Mean	Std. Dev.	Skewness	Kurtosis
Staff skills and competencies are developed through training programs	4.61	.553	-1.041	.085
The complexity of our hotel's operations necessitates continual improvement	4.52	.540	-.453	-1.013
Our hotel culture encourages the embracement of new ideas	4.44	.638	-.695	-.504
Hotel employees have a positive attitude towards organisational changes	4.18	.590	-.061	-.299
The hotel has adequate financial resources to support necessary projects	4.00	.808	-.461	-.297
	4.35	0.63	-0.54	-0.41

The standard deviation of 0.63 suggests low variability in responses, inferring that most respondents held similar views regarding the organisational contextual aspects. The distribution statistics show an average skewness of -0.54, indicating that responses were slightly skewed toward agreement. The

average kurtosis of -0.41 suggests a slightly flatter distribution than a normal distribution. Both the skewness and kurtosis values suggest that the data was reasonably normally distributed.

From a similar agreement rating scale to OCF, hotel performance, the dependent variable, recorded a high

overall mean of 4.18 (Table 5), indicating general agreement that the hotels performed well across the measured indicators. Strongest ratings were given to

well-defined SOPs (M=4.62), prompt service delivery (M=4.56), service-quality-supporting processes (M=4.45), and product/service improvement (M=4.45).

Table 5. Descriptive Statistics for Hotel Performance

	Mean	Std. Dev.	Skewness	Kurtosis
The hotel achieves its RevPAR targets	3.87	.780	-.872	.827
The hotel realises its profit targets	4.01	.622	-.009	-.369
The hotel operates within the set cost limits	3.94	.777	-.935	1.091
The hotel's sales growth rate is optimal	3.81	.844	-.715	.807
The hotel meets its projected return on investment %	3.84	.713	.017	-.561
The hotel attains its room occupancy level goals	3.74	.744	-.035	-.407
There is a high number of guest reservations	4.12	.663	-.414	.353
The hotel receives a high number of repeat guests	4.27	.553	.025	-.447
The hotel records and analyses guest tastes and preferences	4.34	.610	-.874	2.384
The hotel's online ratings and reviews are positive	4.26	.658	-.330	-.738
The hotel follows well-defined standard operating procedures	4.62	.527	-.892	-.368
There is prompt delivery of services	4.56	.498	-.229	-1.974
Cycle times (time required to deliver services or products) have reduced	4.23	.647	-1.459	6.754
Processes in the hotel support service quality	4.45	.525	-.079	-1.375
The hotel's preventive maintenance schedules are adhered to	4.23	.707	-1.282	4.302
There is cross-departmental operational efficiency	4.38	.608	-.419	-.649
Staff work output matches the resources and time used	4.20	.721	-.643	.263
The hotel offers new products and services	4.24	.746	-.908	.892
The hotel makes product and service improvements	4.45	.499	.202	-1.986
Innovative technologies are integrated into operations	4.36	.646	-.504	-.667
The employee turnover rate is low	3.79	.954	-.649	-.021
Employees are trained on emerging trends	4.31	.579	-.159	-.599
Staff proposals are incorporated into operations	4.10	.630	-.078	-.477
The hotel has change management initiatives	4.09	.632	-.069	-.483
	4.18	0.66	-0.47	0.27

Operational, customer, and learning indicators were also rated positively, including operational efficiency, innovative technology integration, guest analysis, repeat guests, online ratings, and employee training. Financial indicators

such as profit, cost control, RevPAR, ROI, sales growth, and occupancy were also above the midpoint, though slightly lower than the operational measures. The responses showed low variability (SD=0.66) and were approximately

normally distributed (skewness =-0.47; kurtosis=0.27).

Table 6 represents findings on the extent to which hotels utilised STs on a 1 to 5 scale. The results indicated a moderate to high level of energy management technologies utilisation, with an overall mean of 3.70. Energy-efficient appliances (M=4.29) recorded

the highest mean, followed by LED lights (M=4.07) and solar energy technology (M=3.99). In contrast, guest room occupancy sensors (M=2.96) recorded the lowest mean, suggesting comparatively limited utilisation. The overall negative skewness (-0.71) indicated a tendency for responses to cluster towards higher levels of utilisation.

Table 6. Descriptive Statistics for Sustainable technology applications

	Mean	Std.	Skewness	Kurtosis
Energy Management Technology				
Electronic room key card	3.85	1.494	-0.987	-0.605
Guest room occupancy sensors	2.96	1.409	-0.001	-1.168
Smart HVAC Systems	3.52	1.483	-0.48	-1.219
LED lights	4.07	1.123	-1.018	0.238
Outdoor motion sensor lights	3.52	1.38	-0.62	-0.76
LED signage	3.29	1.32	-0.482	-0.765
Energy-efficient appliances	4.29	0.861	-0.92	-0.186
Solar energy technology	3.99	1.186	-0.983	-0.029
Web conferencing platforms	3.83	1.193	-0.903	0.061
	3.7	1.27	-0.71	-0.49
Water Conservation Technology				
Smart taps	3.46	1.29	-0.466	-0.865
Smart showers	2.88	1.101	0.3	-0.546
Low-flow shower heads	3.7	1.076	-0.422	-0.82
Water-efficient toilets	4.02	0.976	-0.65	-0.633
Water-efficient laundry systems	3.66	1.142	-0.611	-0.361
Smart water meters	3.42	1.128	-0.02	-1.096
Grey-water recycling technology	3.27	1.514	-0.308	-1.427
Outdoor irrigation systems	3.3	1.414	-0.24	-1.18
	3.46	1.21	-0.3	-0.87
Waste Management Technology				
Computerised reservation system	3.69	1.511	-0.809	-0.868
Inventory control system	4.2	1.071	-1.495	1.649
Food waste composters	3.19	1.204	-0.121	-0.938
Food waste digesters	2.86	1.249	0.184	-1.08
Smart waste bins	3.11	1.344	-0.074	-1.276
Digital menus	3.77	1.186	-0.756	-0.19
Cloud technology	3.87	1.343	-1.039	-0.068
Digital Check-in and out systems	3.51	1.177	-0.136	-1.051
	3.53	1.26	-0.53	-0.48

For water conservation technologies, the overall mean was 3.46, indicating moderate implementation. Water-efficient toilets (M=4.02) had the

highest mean, low-flow shower heads (M=3.70), and water-efficient laundry systems (M=3.66) in descending order. Smart showers (M=2.88) had the lowest

mean, highlighting a potential gap in the use of smart water technologies. The overall skewness (-0.30) suggests a relatively balanced distribution of responses.

Waste management technologies recorded an overall mean of 3.53. Inventory control systems (M=4.20) showed the highest level of usage, then cloud technology (M=3.87) and digital menus (M = 3.77). Conversely, food waste digesters (M=2.86) had the lowest mean, followed by smart waste bins (M = 3.11) and food waste composters (M=3.19).

Bivariate correlation analysis revealed significant positive relationships

among ST, OCF, and hotel performance (Table 7). ST was strongly and positively correlated with hotel performance ($r=.669$, $p<.001$), while OCF also demonstrated a strong positive relationship with hotel performance ($r=.627$, $p<.001$). Moreover, ST was moderately and positively correlated with OCF ($r=.507$, $p<.001$). This indicated that higher levels of ST and stronger OCF are associated with better hotel performance. The correlations were below the commonly used threshold of .80, providing no evidence of serious multicollinearity among the study variables.

Table 7. Bivariate Correlation

Variables	1	2	3
1. Sustainable technology applications	1.000		
2. Organisational contextual factors	.507**	1.000	
3. Hotel performance	.669**	.627**	1.000
N	151	151	151

Note: $p < .01$ (2-tailed).

The hypothesis postulated that OCF do not significantly moderate the relationship between sustainable technology applications and performance in 4 and 5 star-rated hotels in Kenya. To examine this, a moderation model was estimated with sustainable technology (ST) applications as the independent variable, organisational contextual factors (OCF) as the moderator, and their interaction term (Int_1 = ST $\times$ OCF) representing the moderating effect.

The overall model was statistically significant ($R=0.7490$, $R^2=0.5610$, $F(3,147)=62.6160$, $p<0.001$), indicating that ST, OCF, and their interaction explained 56.1% of the variance in hotel performance (Table 8). This represents a substantial explanatory effect in the hospitality context. In contrast, the interaction term (Int_1) was not statistically significant ($B=0.0623$,

$t=0.8046$, $p=0.4223$, 95% CI [-0.0907, 0.2153]). The R^2 change associated with the interaction was minimal ($\Delta R^2=0.0019$, $F(1,147)=0.6474$, $p=0.4223$), indicating that the interaction accounted for less than 0.2% of additional variance in hotel performance. This means that OCF did not significantly improve the model beyond the main effects of ST applications and OCF.

Notably, the p-value (0.4223), which is greater than 0.05, meant organisational contextual factors did not significantly moderate the relationship between sustainable technology applications and hotel performance. Consequently, the hypothesis was not rejected, and the moderation model was specified as follows; $HP = 4.1649 + 0.2849(ST) + 0.3443(OCF) + 0.0623(ST*OCF) + \epsilon$Model 2

Table 8. Model Summary for Organisational Contextual Factors Interaction Effects

R	R-sq	MSE	F	df1	df2	p
.7490	.5610	.0793	62.6160	3.0000	147.0000	.0000
Model						
	coeff	se	t	p	LLCI	ULCI
constant	4.1649	.0263	158.5054	.0000	4.1130	4.2168
ST	.2849	.0381	7.4734	.0000	.2096	.3603
OCF	.3443	.0570	6.0413	.0000	.2317	.4570
Int_1	.0623	.0774	.8046	.4223	-.0907	.2153
Test(s) of highest order unconditional interaction(s)						
	R2-chng	F	df1	df2	p	
X*W	.0019	.6474	1.0000	147.0000	.4223	

Int_1: ST x OCF

Discussion

The descriptive results show that the hotels generally perform well across the Balanced Scorecard performance dimensions, with especially strong ratings for internal processes, customer metrics, and learning and growth. Financial indicators were positive but slightly lower, which supports Sampaio et al. (2025) claim that hotel performance is driven more by operational efficiency and customer responsiveness than by financial outcomes alone.

Further, the findings demonstrate that energy management technologies were utilised to a relatively high level in surveyed hotels. This shows a growing commitment to using technology for energy efficiency within various departments. This finding aligns with Salami et al. (2022) results that hotels are prioritising energy-efficient technologies due to their dual benefits of environmental sustainability and operational cost reduction.

Water conservation technologies were moderately used in the studied hotels, suggesting that utilisation is present but not yet widespread. Hotels appeared to prioritise relatively simple, low-maintenance options such as water-efficient toilets and water-efficient laundry systems, consistent with Gabarda-Mallorquí et al. (2024) assertion that

hotels favour technologies offering immediate savings and short payback periods.

Waste management technologies were used to a fairly high extent ($M = 3.53$), suggesting that hotels were actively using technological tools to reduce waste. High use of inventory control systems, digital menus, and digital reservation and check-in systems indicated a preference for operationally integrated technologies that support both efficiency and waste reduction. This aligns with studies showing growing digitalisation in star-rated hotels (Shashwat & Rani, 2023).

The findings indicated a supportive hotel business internal environment, which suggests that the hotel managers in charge of 4 and 5 star-rated hotels recognise the role OCF play in hotel management. Specifically, the findings showed that hotels prioritise employee training, managing changing attitudes and fostering a culture that supports innovation. Adequate financial resources are essential in ensuring that organisational processes run efficiently. Additionally, hotels' operational complexity necessitates continual improvement, which implies that hotels operate in environments that demand constant and ongoing enhancement. These responses reflect a strong

awareness of the internal conditions that influence operations within hotels.

The findings further show that ST applications and OCF are both significant positive predictors of hotel performance. Specifically, ST applications positively and significantly influence hotel performance, while OCF also make an independent and statistically significant contribution. This indicates that hotels derive performance benefits not only from utilising STs, but also from having stronger internal organisational conditions.

However, the study findings indicated that OCF do not moderate the relationship between ST applications and hotel performance in 4 and 5 star-rated hotels in Kenya. This suggests that internal factors do not alter the relationship's strength and direction, or substantially alter the effect of STs on performance. Some explanations account for this scenario. Firstly, most STs in these hotels operate in a relatively standardised and technology-configured manner, thereby reducing the influence of internal organisational dynamics. Technologies such as energy management software and smart water-saving systems often rely on automated processes, meaning their efficiency can be realised regardless of variations in hotel size, structures, management styles and decision-making, or internal policies. Once embedded within hotel operations, they require relatively limited managerial intervention, and consequently, organisational differences may become less influential after implementation.

Further, the findings reflect the possibility that organisational factors such as staff competence, attitudes and culture play a more critical role in the pre-adoption stages of ST implementation rather than in shaping their moderation effect after deployment. This suggests that their role may be direct or antecedent rather than moderating in nature. The

findings partially correspond with Rukmiyati et al. (2025) study results that firm size and the ensuing scale of operations do not moderate the relationship. Notably, their study focused on energy-conservation technology and financial performance, whereas this study examines sustainable technology and multidimensional hotel performance. This demonstrates that the degree of operational complexity does not shape the relationship between innovations and performance outcomes.

Thirdly, the absence of a significant moderation effect may also reflect the relatively homogeneous organisational characteristics of the surveyed hotels in Kenya. 4 and 5 star-rated hotels possess comparable levels of managerial capability, financial resource availability, and operational activities, potentially reducing variability in organisational contextual conditions. Consequently, the factors may not provide sufficient differentiation to influence the strength of the ST–performance relationship.

However, several studies contradict the current study's OCF insignificant moderation results. For instance, Demir and Demir (2025) qualitative findings demonstrate that hotel owners' and managers' views on how technology investments and innovation strategies are required for competitiveness. Moreover, Pastor (2025) findings indicate that smart technologies only amplify the impact of sustainability strategies on competitiveness if hospitality firms invest in dynamic capabilities, governance, and human capital. Kusa et al. (2023) also note that the impact of greening on hotel performance in Poland is strengthened and moderated by staff flexibility and inter-organisational cooperation.

Likewise, Dianawati et al. (2024) results reveal that user competency

significantly influences guests' perceptions of the benefits and convenience of smart hotel technology, which in turn shapes both satisfaction and loyalty levels. Alkatheeri et al. (2021) found that top management support moderates the relationship between Information Technology (IT) capabilities and operational performance of the UAE's hospitality firms. Mugambi et al. (2025) correspondingly argue that, although IT tools are essential enablers of hotel performance, their benefits are maximised when integrated with staff training and guest engagement.

Prior studies may have mixed findings because of boundary conditions such as technology type, performance measures, and hotel category. Findings from general ICT, financial-only outcomes, or all-star samples may not transfer directly to ST in hotels. These differences help explain why this study found a direct effect of OCF but no moderation. Although this study closes the empirical gap on post-adoption moderation in the Kenyan 4 and 5 star-rated hotel context, it also redefines the gap by showing that OCF operate more clearly as direct performance drivers than as moderators. This means the broader theoretical question remains open in other settings, but in this context, the evidence does not support a moderating role for OCF.

Conclusion

The findings show that ST and OCF are both significant positive predictors of hotel performance, indicating additive rather than null effects. However, OCF do not significantly moderate the ST–performance relationship. This suggests that organisational conditions affect performance directly, but do not strengthen or weaken the returns from ST use. Theoretically, this is important because it shows OCF matter more as

direct enablers of performance than as interaction effects in these hotels.

The finding that OCF do not moderate the relationship between ST applications and hotel performance provides a supportive theoretical implication. This is despite evidence that suggests that 4 and 5 star-rated hotels possess substantially robust internal organisational structures. Whereas OCF are important for the general functioning and management of hotels, they do not shape the strength of the relationship. This markedly supports the TOE framework's theoretical operationalisation of the factors as pre-adoption antecedents rather than post-adoption moderators in the current study's context. From a Resource-Based View perspective, organisational capabilities remain consequential hotel resources because they directly enhance performance, even if they do not shape the performance returns of ST.

Contribution to Knowledge

The study contributes to new knowledge in two important ways. Theoretically, the study introduces a reconceptualised view on the application of the TOE framework's organisational contextual factors beyond pre-adoption postulations. It provides evidence that while internal organisational capabilities, structures and policies may influence ST pre-adoption decisions and directly affect performance, they do not function as moderators of the relationship. This enriches the framework by providing a more nuanced understanding of how organisational contextual factors operate solely as antecedents of technology adoption rather than post-adoption boundary conditions. Contextually, it provides empirical evidence from Kenya's hotel industry, thereby addressing the limited availability of research on the OCF

Recommendations, Limitations and Future Research Directions

Hotels should place greater emphasis on OCF during the pre-adoption stage of ST application, where such factors are more likely to function as enablers or barriers to initial adoption. Rather than treating OCF as moderators of the relationship between ST applications and hotel performance, hotel managers should focus on improving the organisation's readiness, willingness, and capacity to adopt the technologies in the first place. This approach will enable hotels to address organisational constraints before implementation and enhance the subsequent utilisation and performance outcomes of sustainable technologies.

Managers should not treat ST as a conditional investment whose return depends on OCF. Since OCF also have a strong direct effect on performance, hotels should invest in capability building in parallel with ST implementation. In practice, this means pairing ST spending with targeted investments in staff training, building an innovation culture and attitude, and resource planning. Ultimately, managers should acknowledge OCF tools that impact hotel performance directly and unconditionally, and not conditionally by amplifying or constraining ST returns.

Policymakers should intervene before adoption, rather than trying to manipulate organisational conditions to amplify performance effects after adoption. Accordingly, the Ministry of Tourism and Wildlife, through the National Green Fiscal Incentives Policy

Framework, should prioritise strengthening hotels' organisational

readiness for ST implementation through targeted training and structured financial incentives such as subsidies, tax rebates, exemptions and reliefs, concessional loans and grants.

Each OCF dimension was measured using a single item, which may have reduced measurement precision and limited the ability to detect moderation. The relatively high OCF mean also suggests possible ceiling effects, and the single-source design means common method bias could not be fully ruled out.

Future studies should test each organisational contextual factor separately rather than as a composite and use multi-item measures to test interaction effects more robustly. OCF should be reconsidered using mediating variable roles rather than moderating roles, which may provide a different understanding of how they influence performance outcomes. Alternatively, studies conducted in different hotel categories or geographical contexts may reveal conditions under which these factors become significant moderators.

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