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Effects of Smart Energy Management Systems on Financial Performance in Economy Hotels

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Abstract

Smart Energy Management Systems (SEMS) are innovative technologies designed to monitor and optimize energy consumption in real time, enabling businesses to reduce operational costs. In the hotel industry, SEMS play a vital role in improving energy efficiency, particularly in economy hotels where energy expenses constitute a significant portion of overall costs. This study, which employed a descriptive research design, aimed to evaluate the impact of SEMS on the financial performance of economy hotels in Nairobi City County, Kenya. The Balance Scorecard Model was employed to evaluate key financial aspects, including cost management and profitability, offering a comprehensive framework for assessment. Data were collected using Likert scale questionnaires from 24 hotel managers and 300 guests and analyzed using both descriptive and inferential statistics to provide a detailed understanding of SEMS's effects. Results revealed that the adoption of SEMS enables hotels to access real-time energy data, significantly improving energy efficiency by reducing unnecessary energy consumption and costs. Furthermore, regression analysis showed a moderate positive correlation (0.529) between SEMS adoption and financial performance, indicating that increased SEMS usage contributes to better financial outcomes. This suggests that SEMS not only help economy hotels optimize their energy consumption but also enhance overall operational efficiency and profitability. Based on these results, the study recommends that economy hotel managers adopt SEMS to enhance energy efficiency and reduce energy costs, thereby improving financial performance.

Key words: *Smart Energy Management Systems, Financial Performance, Economy Hotels, Energy Efficiency*

1. Introduction

Hotels of all categories are striving to reduce energy consumption to cut energy costs, meet legislative or self-imposed targets, and enhance their reputation. Economy hotels, which aim to offer quality accommodation at affordable prices, often face high operational costs, with energy expenses being a significant burden (Gennitsaris et al., 2023). Managing these costs effectively is crucial for maintaining profitability and competitiveness in the market (Chi et al., 2020). Further, economy hotels operate with slim profit margins, making cost control vital. Energy expenses constitute a substantial portion of hotels operating costs (Filimonau & Magklaropoulou, 2020; Pang et al., 2020; Salehi et al., 2021). Additionally, it is estimated that 90% of energy systems operate inefficiently (Pang et al., 2020).

The global hospitality sector is increasingly embracing advanced energy management technologies to improve sustainability and reduce costs (Singh et al., 2024). Smart Energy Management Systems (SEMS) leverage advanced technologies such as smart sensors, Internet of Things (IoT) devices, and sophisticated analytics to monitor and control energy usage in real-time (Tiwari et al., 2022). Studies conducted in U.S. hotels revealed that hotels are adopting smart energy management systems as a strategy to reduce energy costs and enhance sustainability (Walker & Jones, 2019; Singh & Goh, 2022). Kumar and Raghavan (2019) posit that innovate technologies such as smart energy management offer possible solution lowering energy consumption and operational expenses.

Nairobi City- County, Kenya, boasts a burgeoning hospitality industry that significantly contributes to the region's economic development (Ndiba & Mbugua, 2018). The county's economy hotels cater to a diverse clientele, including international tourists and local travellers (Osiako & Szente, 2021). These hotels face the dual challenge of maintaining affordability while managing rising operational costs (Nguku et al., 2022). Energy consumption is a major operational expense, and inefficient energy use can erode profitability (Magro & Borg, 2023). SEMS provide a practical solution by enabling hotels to monitor and control energy usage effectively, thereby reducing costs and supporting environmental sustainability initiatives (Ogola et al., 2023). This not only enhances the competitive edge of economy hotels but also aligns with national sustainability goals.

2. Statement of the Problem

The hotel industry faces significant financial challenges due to high-energy costs, particularly in economy hotels, where energy expenses account for 50% of total operational costs. These high operational costs negatively affect financial performance, reducing profit margins. Despite the potential of Smart Energy Management Systems (SEMS) to lower energy consumption by up to 15%, there is limited knowledge on how economy hotels in Kenya are utilizing these systems. As a result, many economy hotels are forced to reduce guest amenities and services to maintain profitability. This study explored the effects of SEMS adoption on the financial performance of economy hotels in Nairobi County.

3. Literature Review

The term 'smart' refers to innovative and intelligent solutions that harness technology (Wang et al., 2018). When applied to energy management, "smart" technologies leverage innovations such as Internet of Things (IoT) devices, sensors, and automation to enable real-time monitoring, analysis, and control of energy usage (Li et al., 2018). A study by Mancarella et al. (2015) noted that Smart Energy Management Systems (SEMS) integrate IoT devices and sensors to monitor energy consumption in real time. This capability allows SEMS to accurately assess energy demand patterns and adjust operations accordingly, thereby maximizing efficiency and minimizing wastage. A study on energy use and its key factors in 45 international hotel chains in Brazil indicated that hotels consume 37.7% of energy per occupied room (Arenhart et al., 2022). As a result, this led to a reconsideration and upgrading of existing hotel energy management systems with the aim of reducing energy costs. This upgrade enabled real-time monitoring of weather conditions and adjusting heating and lighting accordingly.

SEMS provide real-time insights into energy usage, allowing for immediate adjustments and long-term strategic planning (Filimonau & Magklaropoulou, 2020). The integration of SEMS aligns with global trends toward sustainability and cost efficiency. (Sun & Nasrullah, 2024). Studies have shown that hotels implementing SEMS can achieve substantial energy savings (Kuo et al., 2021). Past reports indicate that international hotel chains such as Marriott International, Intercontinental Hotel Group and Wyndam Destinations have realized significant reduction in energy costs as a result of implementing smart energy management systems (Ahmed et al., 2020).

Financial performance is widely regarded as the primary metric for assessing firm performance, often quantified by reductions in operational costs, return on investment and increases in profits (Singal, 2017). A study by Bonilla et al. (2018) found that SEMS have monitoring capabilities that enable hotels to reduce energy costs by 40%. Furthermore, the study noted that the use of energy management systems enhances effective management decisions and decreases utility costs. A previous study conducted in the Kenyan coastal region on 4-star and 5-star hotels demonstrated that EMS implementation led to a significant reduction in operational costs (Gaturu et al., 2022). Additionally, a study conducted in China found that hotels that implemented SEMS had a payback period of 2.96 years (Wang et al., 2022). Filimonau and Magklaropoulou (2020) found that despite the high costs of implementing a SEMS, the benefits accrued are greater.

The Balanced Scorecard (BSC) Model is a strategic management tool developed by Kaplan and Norton in the early 1990s to measure and improves organizational performance (Kaplan & Norton, 1992). The BSC incorporates four perspectives: Financial, Customer, Internal Business Processes, and Learning and Growth. Financial performance is a major metric that emphasizes on aspects such as return on investment, energy costs saving and profit margin. This helps organizations align their strategic goals with operational activities to achieve better performance outcomes. Past study by Tsai and Wu (2016) explored the application of the BSC in Taiwanese hotels and found that it improved organizational performance through better strategic alignment and operational efficiency. Based on these findings, the current study adopted the BSC model to analyze the effect of Smart Energy Management Systems (SEMS) on financial performance, assessing key financial aspects such as cost reduction, and return on investment, and profit growth.

4. Research Methodology

Reports from Kenya Tourism Board and Kenya Association of Hotelkeepers and Caterers (2022), indicate that Nairobi City – County has a wider range of economy hotels. The study adopted descriptive research design to describe the effects of smart energy management systems on financial performance of economy hotels. The study population consisted of 24 hotel managers and 300 guests derived from economy hotels within Nairobi City. Survey questionnaires were used as the primary data collection tool. The study employed a linear regression analysis to test the relationship between SMES and hotel financial performance.

5. Results

The descriptive analysis of SEMS effectiveness in Table 1 and Figure 1 revealed mixed results regarding their financial impact on economy hotels. The mean score for the statement "Implementation of SEMS has significantly reduced our organization's energy costs" was 2.5 (SD = 0.59877), indicating a general tendency towards agreement among 54.2% of respondents. However, 41.7% disagreed, suggesting variability in effectiveness, possibly due to implementation challenges. For the statement "SEMS have helped us identify and eliminate unnecessary energy consumption," the mean score was 2.625 (SD = 0.71094), showing mixed perceptions with half of the respondents agreeing and 45.8% disagreeing.

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Table 1: Descriptive Statistics on Financial Performance

Statement	Mean	S.D.
Implementation of SEMS has significantly reduced our organization's energy costs.	2.50	0.5988
SEMS have helped us identify and eliminate unnecessary energy consumption.	2.63	0.7109
SEMS have provided real-time data that has led to actionable insights for reducing energy costs.	2.25	0.4423
Our energy costs are more predictable and stable since adopting SEMS.	2.38	0.4945
The financial investment in SEMS has been justified by the savings we have realized.	2.25	0.4423
Our organization has achieved a positive return on investment from SEMS within the expected timeframe.	2.42	0.5036
SEMS have allowed us to allocate savings to other areas of our business, thereby improving profitability.	2.79	0.9771

The statement "SEMS have provided real-time data that has led to actionable insights for reducing energy costs" had a mean score of 2.25 (SD = 0.44233), reflecting predominant disagreement, with 75% of respondents reporting that SEMS did not offer actionable real-time data. For "Our energy costs are more predictable and stable since adopting SEMS," the mean score was 2.375 (SD = 0.49454), suggesting that SEMS had not significantly influenced cost predictability and stability for most respondents, with 62.5% disagreeing. The financial evaluation based on "The financial investment in SEMS has been justified by the savings we have realized" had a mean score of 2.25 (SD = 0.44233), showing predominant disagreement from 75% of respondents. Similarly, "Our organization has achieved a positive return on investment from SEMS within the expected timeframe" had a mean score of 2.4167 (SD = 0.50361), with 58.3% of respondents disagreeing.

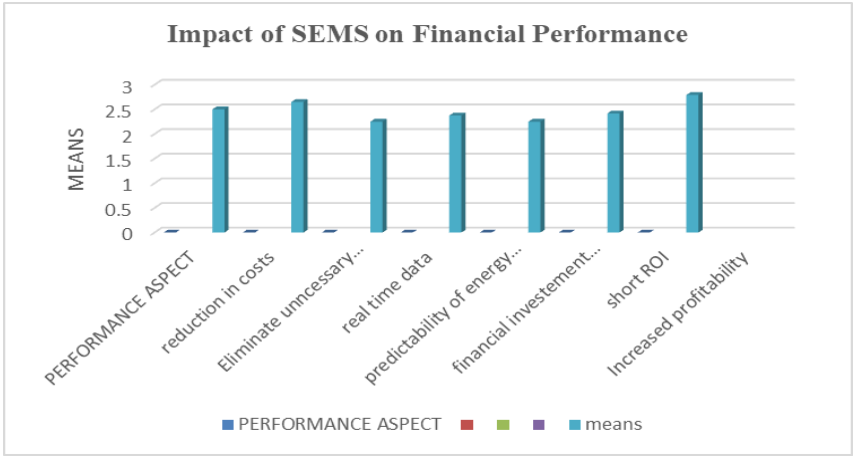

Figure 1: Rates of Financial Performance Aspects

Table 2: Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.529[a]	.280	.247	.28581

a. Predictors: (Constant), SEMS adoption
b. Dependent Variable: Financial Performance

The model summary in Table 2 showed an R-value of 0.529, indicating a moderate positive correlation between SEMS adoption and financial performance. The R-square value of 0.280 suggests that SEMS adoption explains 28% of the variance in financial performance.

Table 3: ANOVA

Model	Sum of squares	df	Mean Squares	F	Sig.
Regression	.698	1	.698	8.548	.008[b]
Residual	1.797	22	.082		
Total	2.495	23			

a. Dependent Variable: Financial Performance
b. Predictors: (Constant), SEMS adoption

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The ANOVA results in Table 3 showed an F-statistic of 8.548 with a p-value of 0.008, indicating statistical significance of the model.

Table 4: Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.461	0.337		4.337	0.000
	Job Rotation	0.388	0.133	0.529	2.924	0.008

a. Dependent Variable: Financial Performance

The regression coefficients in Table 4 revealed that SEMS adoption had a positive impact on financial performance, with a coefficient of 0.388 and a Beta coefficient of 0.529.

6. Discussion and Implication

6.1 Discussion on Findings

The findings from this study indicate that while Smart Energy Management Systems (SEMS) offer potential financial benefits, their effectiveness varies significantly across economy hotels. This variability highlights the complexity of SEMS adoption and its impact on financial performance.

The mixed results regarding the financial impact of SEMS are consistent with previous research that SEMS can lead to significant cost reductions, but the extent of these benefits depends on factors such as the quality of implementation and organizational readiness. Pereira et al. (2021) emphasized that while SEMS can enhance energy efficiency, the financial benefits realized by hotels often depend on how well these systems are integrated into existing operations. Similarly, Bonilla et al. (2018) observed that the effectiveness of SEMS varies based on the scale and scope of their deployment, which can result in different financial outcomes.

In contrast, some studies report limited financial benefits from SEMS. Choi et al. (2020) found that while SEMS implementation might improve energy efficiency, anticipated financial savings were often not realized due to high initial costs and suboptimal system performance. This discrepancy is reflected in this study, as a significant portion of respondents disagreed that SEMS had justified the financial investment or provided a positive return on investment.

The finding that SEMS did not provide actionable real-time data for cost reduction is consistent with some research in the field. Li and Wang (2019) highlighted that while SEMS can collect extensive data, the challenge lies in effectively translating this data into actionable insights. This aligns with the study's results, where a large majority of respondents reported dissatisfaction with the real-time data capabilities of SEMS. However, other studies suggest that SEMS can be effective in providing actionable insights if properly utilized. Zhang et al. (2021) demonstrated that integrating SEMS with advanced analytics tools could enhance the ability to generate actionable insights from real-time data, leading to more effective energy management and cost reduction. The discrepancy between these findings and this study finding could indicate that while SEMS have the potential to offer valuable insights, this potential may not be fully realized without additional tools or expertise.

The study's finding that SEMS had not significantly influenced cost predictability and stability aligns with earlier research by Xu et al. (2018), who reported similar limitations in SEMS capabilities. Further, their findings noted that while SEMS can monitor and report energy usage, their impact on cost predictability and stability is limited by factors such as fluctuations in energy prices and external economic conditions. Conversely, other studies have shown that SEMS can enhance cost predictability and stability under certain conditions. Wang and Yang (2020) found that SEMS, when integrated with predictive analytics, could significantly improve cost forecasting and stability. This suggests that while SEMS alone may have limited impact, their effectiveness in cost management can be enhanced through integration with other technologies or improved implementation strategies.

6.2 Correlation between SEMS Adoption and Financial Performance

The moderate positive correlation between SEMS adoption and financial performance observed in this study is consistent with the findings of Alhashmi et al. (2020), who reported that effective implementation of Smart Energy Management Systems (SEMS) could lead to substantial financial improvements. Similarly, Windapo and Moghayedi (2020) highlighted that SEMS adoption enhances financial outcomes through better energy management.

However, Saleem et al. (2023) suggest that while SEMS can improve financial performance, the impact is not always uniform across different types of hotels or operational contexts. Saleem et al. (2023) reported that the positive effects of SEMS are

moderated by factors such as the scale of implementation and the hotel's operational environment, which corresponds with the present study findings that SEMS adoption explains only 28% of the variance in financial performance. Although SEMS have the potential to improve financial performance in economy hotels, their impact is influenced by various factors, including implementation quality, organizational readiness, and integration with other systems. The variability in results highlights the need for hotels to carefully consider their preparedness, internal factors and requirements to maximize the benefits of SEMS.

7. Conclusion

The present study explores the financial impact of Smart Energy Management Systems (SEMS) on economy hotels and finds a complex relationship between SEMS adoption and financial performance. Although SEMS generally correlates positively with improved financial outcomes, its effectiveness varies significantly among hotels. Many respondents report mixed benefits, citing challenges in achieving cost reductions and realizing a positive return on investment. These findings align with existing research, which underscores SEMS' potential to enhance financial performance while also indicating that other factors play a significant role. To optimize SEMS effectiveness and financial impact, hotel managers should improve SEMS implementation and associated training. Addressing integration challenges and investing in comprehensive staff training will enhance the system's ability to identify and reduce energy inefficiencies. Regular monitoring and evaluation are crucial to ensure SEMS provide actionable insights and contribute to stable energy costs. Emphasizing these areas can help achieve the anticipated financial benefits and improve the return on investment.

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