Eco-Friendly Practices in Housekeeping through Smart Technology

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Abstract- The integration of smart technology in hotel housekeeping has emerged as a transformative approach to promoting eco-friendly practices. This paper explores the adoption of smart devices, automation, and data-driven solutions to minimize the environmental impact of housekeeping operations while enhancing efficiency. Key practices include optimizing energy and water usage, reducing waste through digital inventory management, and utilizing AI-powered systems for predictive maintenance and cleaning schedules. The implementation of eco-friendly cleaning products and IoT- enabled devices ensures sustainability while maintaining guest satisfaction. This study also highlights the challenges and benefits of incorporating smart technology into housekeeping operations, emphasizing its role in achieving a sustainable hospitality industry.

Keywords: Eco-friendly housekeeping, smart technology, sustainable hospitality, green hotel practices.

1. Introduction

The hospitality industry is increasingly adopting eco-friendly practices to reduce its environmental footprint while maintaining high service standards. Housekeeping, a crucial department in hotel operations, plays a significant role in implementing sustainable initiatives. With the advent of smart technology, hotels can now integrate energy-efficient and resource-saving solutions to enhance housekeeping operations (Kontis & .Skoultsos, 2018)

Smart technology, including automated energy management systems, IoT-enabled devices, and AI-powered housekeeping management software, helps optimize resource usage, reduce waste, and improve operational efficiency (Raj et al., 2024). These innovations contribute to sustainability goals by minimizing water and energy consumption, reducing chemical waste, and promoting eco-conscious practices among staff and guest (Mandal et al., 2025).

This review paper explores the intersection of eco-friendly housekeeping and smart technology, highlighting advancements in digital tools, their impact on environmental conservation, and the benefits they bring to both hotel operators and guests (Nam et al., 2021). It also examines challenges in implementing these technologies and potential strategies for maximizing their effectiveness in the hospitality sector (Kalsi et al., 2023).

The hospitality industry is under increasing pressure to adopt sustainable practices due to growing environmental concerns and changing consumer preferences. Housekeeping, as one of the most resource-intensive departments in a hotel, plays a pivotal role in achieving sustainability goals (Chen et al., 20217). Traditional housekeeping operations often involve high consumption of water, energy, and chemical-based cleaning agents, leading to significant environmental impact. To address these challenges, hotels are integrating smart technology into their housekeeping operations to enhance efficiency while minimizing ecological harm (Ibrahim et al., 2024).

Smart technology offers innovative solutions such as Internet of Things (IoT)-enabled sensors,

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automated energy management systems, AI-driven housekeeping scheduling, and eco-friendly cleaning robots (Poyyamozhi et al., 2024). These advancements not only improve operational efficiency but also help hotels reduce waste, lower costs, and provide a healthier environment for guests and staff. For instance, IoT-enabled occupancy sensors can optimize lighting and HVAC systems, while smart water meters help monitor and control water usage more effectively (Srivastava & Tyagi, 2024).

This review paper aims to explore the integration of smart technology in hotel housekeeping to promote eco-friendly practices. It examines the latest technological advancements, their impact on environmental conservation, and the operational benefits they provide. Additionally, it discusses the challenges faced in implementing these solutions and suggests strategies to maximize their effectiveness in achieving sustainability goals in the hospitality sector.

Objectives of the study:

1. To assess the role of smart technology in sustainable housekeeping.

2. To identify challenges and best practices in eco-friendly housekeeping.

2. Literature Review:

The integration of eco-friendly practices in housekeeping through smart technology has been extensively studied, emphasizing sustainability, operational efficiency, and guest satisfaction. This section reviews existing literature on smart technology's role in reducing resource consumption, improving housekeeping operations, and addressing implementation challenges (Zhichao & Yashu, 2024) .

2.1 Sustainable Housekeeping Practices in the Hospitality Industry

Traditional housekeeping operations significantly contribute to high resource consumption, particularly in water, energy, and chemical cleaning agents. To mitigate this environmental impact, hotels have implemented sustainable housekeeping measures, such as water-saving linen reuse programs, biodegradable cleaning products, and waste reduction initiatives integrating eco-friendly practices not only reduces a hotel's carbon footprint but also enhances brand reputation and attracts environmentally conscious travellers (Chung & Tan, 2025).

2.2 Role of Smart Technology in Eco-Friendly Housekeeping

Advancements in smart technology have introduced innovative solutions for energy and resource management in housekeeping. Internet of Things (IoT)-enabled sensors, artificial intelligence (AI)-driven housekeeping schedules, and automated inventory tracking systems have transformed hotel operations (Bajwa et al., 2012). It indicates that smart energy management systems, such as occupancy-based lighting and HVAC controls, significantly reduce electricity consumption in hotels. Additionally, IoT-based water monitoring systems contribute to efficient water management, reducing overall usage and preventing wastage (Mcginn et al., 2022).

2.3 Smart Cleaning Equipment and Robotics

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The adoption of AI-powered cleaning robots and smart cleaning devices has gained traction in the hospitality industry and robotic vacuum cleaners and UV-C disinfection robots not only improve cleaning efficiency but also reduce dependency on chemical-based cleaning solutions (Jayanti, 2024). Automated housekeeping management software further enhances operational efficiency by optimizing cleaning schedules, minimizing labour-intensive tasks, and ensuring sustainable resource utilization (Kalefia & Gado, 2024).

2.4 Impact on Operational Efficiency and Cost Reduction

Studies suggest that implementing smart technology in housekeeping leads to long-term cost savings and improved operational efficiency. Automated housekeeping solutions reduce labour costs, enhance staff productivity, and minimize resource wastage. Research found that hotels integrating smart technology experience a 20–30% reduction in energy costs, contributing to economic and environmental sustainability (Oduro, 2024).

3. Challenges and Barriers to Implementation

Despite its benefits, adopting smart technology in housekeeping presents challenges such as high initial investment costs, staff resistance, and technical integration issues. To overcome these challenges, training programs and awareness initiatives are essential for facilitating the transition to technology-driven housekeeping. Moreover, data privacy and cybersecurity risks associated with IoT-based housekeeping solutions require careful consideration

Facts & Figures

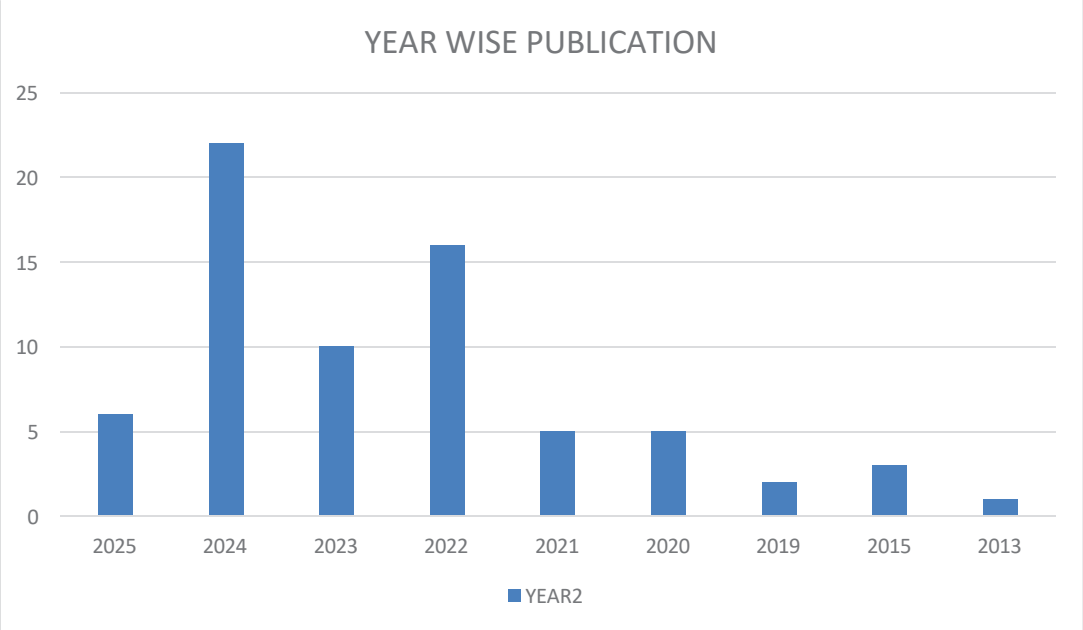

Figure 1 Year Wise Publication Source: Scopus data base

The bar chart titled "YEAR WISE PUBLICATION" illustrates the number of publications

across different years. The x-axis represents the years, ranging from 2013 to 2025, while the y-axis represents the number of publications. The data shows a fluctuating trend in the number of publications, with the highest peak in 2024, reaching over 20 publications. The second-highest publication count is in 2022, followed by 2023. The number of publications in 2025 is lower than in the previous years but still noticeable. In contrast, years like 2013, 2015, 2019, 2020, and 2021 have relatively fewer publications. The chart highlights an overall increase in publications in recent years, with a significant surge in 2024.

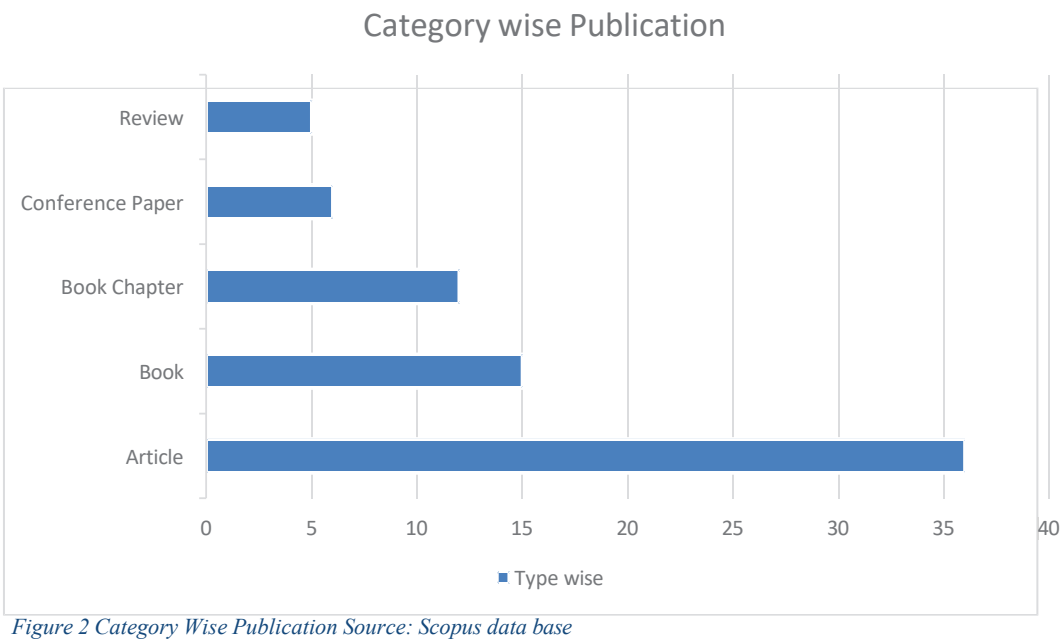

Figure 2 Category Wise Publication Source: Scopus data base

The horizontal bar chart titled "Category wise Publication" presents the distribution of publications across different categories. The x-axis represents the number of publications, while the y-axis lists the categories, which include Review, Conference Paper, Book Chapter, Book, and Article. Among these categories, Articles have the highest number of publications, significantly exceeding 35. Books and Book Chapters follow, with a moderate number of publications, while Conference Papers and Reviews have the least number of publications. The chart highlights that Articles are the most prominent type of publication, whereas Reviews and Conference Papers contribute the least to the total publications.

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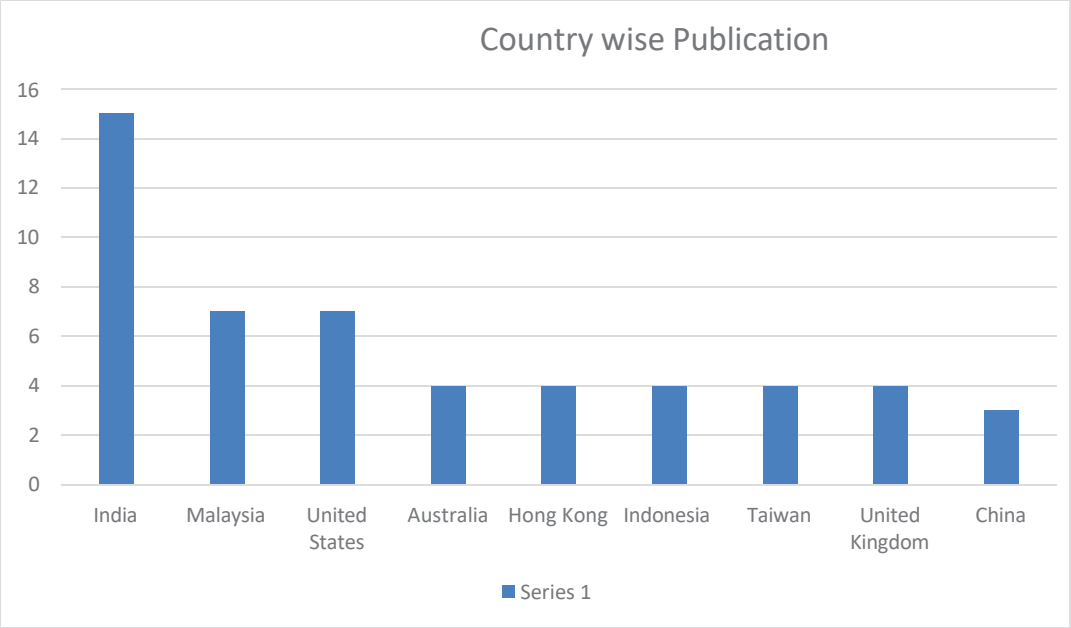

Figure 3 Country wise Publication Source: Scopus data base

The bar chart titled "Country wise Publication" displays the number of publications across different countries. The x-axis represents the countries, while the y-axis indicates the number of publications. India has the highest number of publications, exceeding 14, making it the leading contributor. Malaysia and the United States follow with an equal number of publications, both around 7. Australia, Hong Kong, Indonesia, Taiwan, and the United Kingdom each have a similar number of publications, approximately 4. China has the least number of publications, with a count slightly above 2. This chart highlights that India plays a dominant role in publications, whereas other countries contribute in varying but relatively lower proportions.

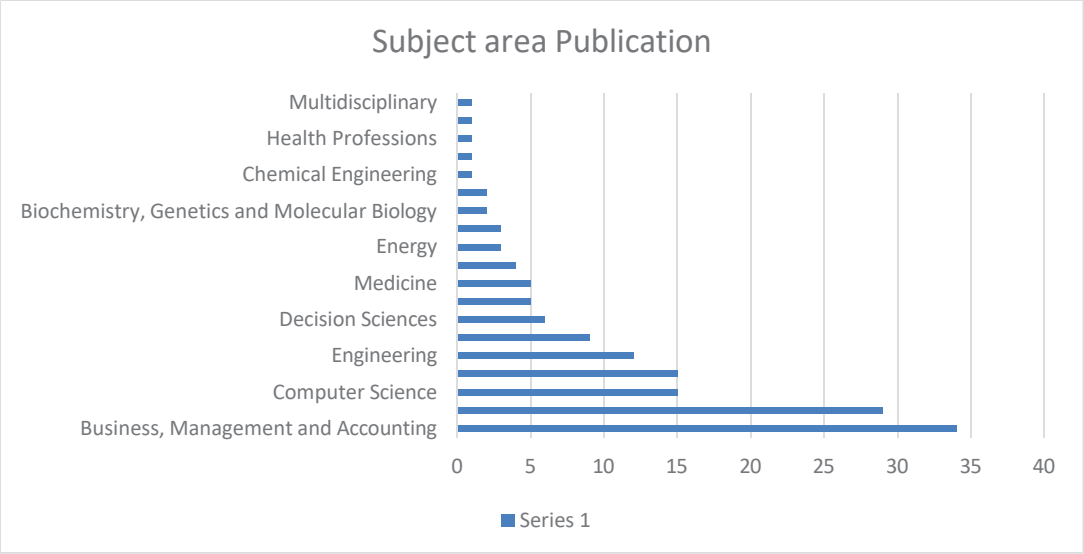

Figure 4 Subject area wise Publication Source: Scopus data base

The distribution of research publications by subject area highlights a strong emphasis on business, technology, and engineering fields. Business, Management, and Accounting have the highest number of publications, with around 35 papers, followed by Computer Science, which contributes approximately 20 papers. Engineering ranks third with around 15 publications. Moderate research activity is observed in Decision Sciences, Medicine, and Energy, each having a publication count ranging between 5 to 8. In contrast, subjects such as Biochemistry, Genetics, and Molecular Biology, Chemical Engineering, Health Professions, and Multidisciplinary studies have the lowest number of research papers. This distribution indicates a predominant focus on business, management, and technological advancements, while biological sciences and health-related fields receive comparatively less research attention.

4. Conclusion

The integration of smart technology in housekeeping has proven to be a significant step toward achieving sustainability in the hospitality industry. This review highlights how IoT-enabled devices, AI-driven housekeeping management, and automated energy and resource optimization contribute to eco-friendly practices. The adoption of smart technology helps reduce water and energy consumption, minimize waste, and improve operational efficiency while maintaining high service standards.

Despite its numerous benefits, implementing smart housekeeping solutions comes with challenges such as high initial investment costs, staff resistance, and cybersecurity concerns. However, with proper training, strategic planning, and technological advancements, these challenges can be mitigated. The findings suggest that adopting smart housekeeping technologies not only enhances sustainability efforts but also improves cost-effectiveness and guest satisfaction.

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As the hospitality industry continues to evolve, integrating smart technology into housekeeping operations will play a crucial role in achieving long-term environmental and economic sustainability. Future research should explore innovative solutions for overcoming implementation barriers and further optimizing resource management for greener hotel operations.

5. Findings & Suggestions:

The findings of the study highlight that the integration of smart technology in hotel housekeeping significantly contributes to sustainability by optimizing resource usage, reducing energy and water consumption, and minimizing waste. IoT-enabled devices, AI-driven housekeeping management, and automated energy optimization systems were found to improve operational efficiency while maintaining high service standards. The adoption of these technologies not only supports eco-friendly practices but also leads to long-term cost savings, with some hotels experiencing reductions of up to 30% in energy costs. However, the study also identifies challenges in implementation, including high initial investment costs, staff resistance to change, and cybersecurity concerns. Despite these barriers, the findings suggest that with proper staff training, strategic planning, and technological advancements, these challenges can be mitigated, allowing hotels to reap the environmental and economic benefits of smart technology. Overall, the study concludes that adopting smart housekeeping technologies is essential for achieving both sustainability and improved guest satisfaction in the evolving hospitality industry.

To enhance the review paper, it would be beneficial to narrow the focus to a few key smart technologies that have the most significant impact on eco-friendly housekeeping, such as IoT-enabled sensors and AI-powered scheduling. Including real-world case studies from various hotels would provide practical insights into the scalability and effectiveness of these technologies. Additionally, incorporating a detailed cost-benefit analysis, exploring staff training and overcoming resistance, and expanding on guest perceptions of these technologies would offer a more comprehensive view. Further, discussing the role of smart waste management, future innovations like AI-driven predictive maintenance, and how smart technology helps hotels achieve sustainability certifications would strengthen the paper's relevance and actionable value. Lastly, integrating more quantitative data on energy savings, water reduction, and cost savings would provide a solid foundation for the claimed benefits of smart housekeeping technologies.

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