Journal of Tourism, Hotels and Heritage (JTHH)
Journal Homepage: https://sjs.journals.ekb.eg
Print ISSN: 2682-4329
Online ISSN: 2735-3044

The Role of Internet of Things in Improving Hotel Operations in Hospitality and Tourism Services and Its Impact on Customers Loyalty

دور إنترنت الأشياء فى تحسين عمليات التشغيل بخدمات الضيافة والسياحة وأثره على ولاء العملاء

Ayda Fayez Saber[1] | Shams Hassan Helmy[2] | Mohamed Hussein Abd El-Gaber[3]

Article Info
Article Language: English
Vol. 10 No. 1, (2025) pp. 102-126 | https://doi.org/10.21608/sis.2025.383006.1193

معلومات المقالة
لغة المقالة: الإنجليزية

Abstract

This study explores the role of Internet of Things (IoT) in improving hotel operations and hospitality and tourism services, examining its impact on customers loyalty. The research investigates how IoT applications enhance operational efficiency, guest experiences, and personalized services, contributing to higher customer retention rates. Using qualitative and quantitative-approaches, the study provides insights into IoT adoption in the hospitality and tourism industry and offers recommendations for optimizing its benefits.

Findings reveal that IoT significantly automates processes such as check-in/out, energy management, and smart room controls, thereby enhancing guest comfort and convenience. IoT technologies also facilitate real-time guest interaction and personalized service delivery, boosting satisfaction and brand loyalty. Nevertheless, the study highlights challenges including high implementation costs, data security risks, and the need for continuous employee training. Statistical analysis confirms a strong positive correlation between IoT adoption and improvements in operational efficiency, customer satisfaction, and loyalty. Recommendations emphasize investing in smart infrastructure, staff training, data privacy policies, and integrating AI-based personalized services. Overall, IoT emerges as a vital tool in elevating competitive advantage and service quality in the hospitality and tourism sector.

Keywords: Internet of Things (IoT), Hospitality and Tourism Industry, Customers Loyalty and Experience, Operational Efficiency, Data Security

الملخص

تتناول هذه الدراسة دور إنترنت الأشياء (IoT) في تحسين عمليات الفنادق بصناعة الضيافة والسياحة، وتأثيرها على ولاء العملاء. يستعرض البحث كيف تسهم تطبيقات إنترنت الأشياء في رفع كفاءة العمليات التشغيلية، وتحسين تجارب الضيوف من خلال تقديم خدمات شخصية مخصصة، مما يؤدي إلى زيادة معدلات الاحتفاظ بالعملاء. استخدم البحث منهجًا مختلطًا يجمع بين الدراسات الكمية النوعية من خلال استبيانات ومقابلات مع خبراء ومدراء فنادق.

أظهرت النتائج أن إنترنت الأشياء يسهم بشكل كبير في أتمتة العمليات مثل تسجيل الدخول والخروج، إدارة الطاقة، وتحسين راحة الضيوف عبر التحكم الذكي بالغرف. كما ساعدت تقنيات IoT في تعزيز تجربة الضيف من خلال التفاعل اللحظي مع الطلبات وتوفير خدمات مخصصة وفقًا لتفضيلات العملاء. ومع ذلك، تواجه الفنادق تحديات تشمل تكلفة تطبيق التكنولوجيا، مخاطر أمن البيانات، والحاجة لتدريب الموظفين. تظهر الدراسة أن تبني IoT يؤثر إيجابيًا وقويًا على الكفاءة التشغيلية ورضا العملاء وولائهم للعلامة التجارية. تُوصي الدراسة بزيادة الاستثمار في بنية تحتية ذكية، وتوفير برامج تدريبية مستمرة، ووضع سياسات لحماية بيانات العملاء، إلى جانب تطوير خدمات شخصية تعتمد على الذكاء الاصطناعي. تلعب هذه التقنيات دورًا أساسيًا في تعزيز القدرة التنافسية للفنادق وتحسين جودة الخدمات في قطاع الضيافة والسياحة.

الكلمات الدالة: إنترنت الأشياء (IoT)، صناعة الضيافة والسياحة، ولاء العملاء وتجربة الضيوف، الكفاءة التشغيلية، أمن البيانات

[1]Lecturer, Hospitality Management Department, the Higher Institute for Tourism and Hotels, Badr City, Cairo, Egypt
[2] Lecturer, Tourism Studies Department, the Higher Institute for Tourism and Hotels, Badr City, Cairo, Egypt
[3] Lecturer, Hotel Management Department, the Higher Institute for Tourism and Hotels, Badr City, Cairo, Egypt

1. Introduction

1.1 Background:

The increasing adoption of IoT in hospitality and tourism sector has been a major driving force in the industry's digital transformation. IoT refers to the interconnection of smart devices, enabling seamless communication and automation in hotel operations. According to Gursoy et al. (2021), IoT-based solutions are being utilized to enhance service quality, streamline operations, and improve customer experiences. Hotels worldwide have started leveraging smart technology to provide automated check-in processes, smart room controls, and AI-powered concierge services (Tussyadiah, 2020). The integration of IoT helps in real-time data collection, which assists hotel management in making data-driven decisions to improve guest satisfaction (Buhalis & Leung, 2022).

IoT technology is particularly beneficial in energy management, security systems, and predictive maintenance. Studies show that smart hotels can significantly reduce operational costs by utilizing IoT-enabled thermostats, lighting control systems, and keyless entry (Morosan & DeFranco, 2019). Moreover, IoT enhances guest personalization, allowing hotels to tailor experiences based on guests' preferences and previous stays (Chourasia, 2025). Despite these advantages, IoT adoption comes with challenges such as high implementation costs, cyber security risks, and the need for employee training (Kim et al., 2021). This study aims to analyze the impact of IoT adoption on hotel efficiency and customer loyalty, providing practical recommendations for industry stakeholders.

1.2 Problem Statement:

The need to understand how IoT can optimize hotel operations and its impact on customer loyalty.

Despite the growing use of IoT in the hospitality and tourism sector, there is a need to understand how these technologies optimize hotel operations and their impact on customer loyalty. While IoT implementation enhances operational efficiency, its role in fostering long-term customer relationships and brand commitment remains underexplored (Brown & Green, 2023). This study aims to bridge this knowledge gap by investigating the connection between IoT-driven hotel services and customer loyalty outcomes.

1.3 Research Significance:

Addressing operational challenges, enhancing guest experiences, and fostering long-term loyalty through IoT.

This study addresses critical operational challenges in hospitality and tourism sector by exploring how IoT can streamline hotel operations, enhance guest experiences, and foster long-term customer loyalty. Understanding the impact of IoT will provide valuable insights for hotel managers and policymakers seeking to leverage technology for competitive advantage and improved service delivery.

The integration of IoT in hospitality and tourism industry has emerged as a transformative force, addressing key operational challenges while enhancing guest experiences and fostering customer loyalty (Bujari et al., 2021). The hospitality and tourism sector faces increasing demands for efficiency, personalized services, and sustainability, all of which IoT solutions can significantly impact (Ivanov et al., 2022).

Operational Challenges and IoT Solutions: Operational inefficiencies, such as energy management, room maintenance, and housekeeping scheduling, pose ongoing challenges for hotels. IoT-enabled smart sensors and automated systems optimize energy consumption, reducing operational costs and environmental impact (Ali et al., 2023). Predictive maintenance, enabled by IoT, minimizes downtime and enhances service efficiency by detecting issues before they escalate (Hu, 2025).

Enhancing Guest Experiences: IoT technology facilitates hyper-personalization, allowing hotels to tailor services to individual preferences. Smart rooms with voice-controlled assistants, automated climate control, and real-time service requests enhance guest comfort and satisfaction (Tussyadiah & Miller,

2022). IoT-driven mobile applications further improve convenience, enabling seamless check-ins, keyless room entry, and personalized recommendations based on guest behavior (Wang et al., 2023).

Fostering Long-Term Customer Loyalty: A superior guest experience, driven by IoT-enabled personalization and efficiency, directly contributes to long-term customer loyalty. Real-time data analytics allow hotels to anticipate guest needs and offer customized promotions, fostering repeat business and enhancing brand reputation (Buhalis & Leung, 2022). Additionally, IoT-driven feedback systems enable hotels to address guest concerns promptly, ensuring continuous service improvement and satisfaction (Law et al., 2021).

Understanding the impact of IoT on hotel operations and guest experiences provides valuable insights for hotel managers and policymakers. By leveraging IoT technologies, hotels can gain a competitive advantage, improve service delivery, and create a more sustainable and guest-centric hospitality and tourism experience (Sigala, 2022).

1.4 Research Aim and Objectives

The overall aim of this study is to examine the role of the IoT in enhancing hotel operations and hospitality and tourism services, with particular emphasis on its impact on customer loyalty. To achieve this aim, the study will focus on the following objectives:

1) To analyze the role of IoT in improving hotel operational efficiency.
2) To assess how IoT-driven personalization enhances guest experiences.
3) To evaluate the impact of IoT on customer satisfaction and loyalty.
4) To identify challenges and opportunities in implementing IoT in hospitality and tourism.

2. Literature Review

2.1 Internet of Things (IoT)

The Internet of Things (IoT) refers to a network of interconnected physical devices that communicate, collect, and analyze real-time data to automate operations (Atzori, Iera, & Morabito, 2010). The concept has rapidly evolved, significantly impacting various industries, including hospitality and tourism (Gubbi et al., 2013). IoT in hotels facilitates intelligent automation, improves operational efficiency, and enhances guest satisfaction by integrating smart devices such as sensors, automated check-ins, smart locks, and AI-driven customer service (Bujari et al., 2018).

IoT's role in hospitality and tourism aligns with General Systems Theory (GST), which emphasizes the interconnectivity of components within a system to achieve overall optimization (Cabrera & Cabrera, 2018). By implementing IoT in hotel management, properties can integrate various operational processes, such as energy management, housekeeping automation, and personalized guest experiences, creating an interconnected, responsive environment (Kamble et al., 2020). The integration of IoT also supports sustainability initiatives, reducing energy consumption and enhancing resource efficiency (Kasemsap, 2017).

In the context of this research, IoT serves as a core enabler for improving hotel services, which directly influences operational efficiency and customer satisfaction, forming the basis of the study's hypotheses. This research will examine how IoT adoption impacts hotel operations and its role in increasing guest loyalty through a data-driven, personalized approach.

2.2 Hospitality and Tourism Industry

The hospitality and tourism industry comprises a broad range of services, including lodging, food and beverage, recreation, and tourism (Bharwani & Jauhari, 2013). In recent years, digital transformation has played a vital role in reshaping the hospitality and tourism sector, particularly through the adoption of IoT (Tung & Law, 2017). Hotels increasingly rely on smart technologies to streamline operations, improve customer service, and enhance overall efficiency (Buhalis & Leung, 2018).

Customer Loyalty Theory (CLT) suggests that businesses, including hotels, must focus on service quality to drive repeat business and customer retention (Fatima et al., 2021). IoT-driven solutions,

such as AI-powered concierge services, real-time feedback mechanisms, and predictive maintenance, contribute to better guest experiences and increased brand loyalty (Morosan & DeFranco, 2016). Additionally, real-time data analytics allow hotels to anticipate customer needs, further strengthening guest satisfaction and loyalty (Tussyadiah, 2020).

2.3 Smart Hotels

Smart hotels leverage IoT technologies to offer enhanced guest experiences, improve operational efficiency, and reduce costs (Gretzel et al., 2015). Through automation and interconnected systems, guests can control room settings such as lighting, temperature, and entertainment via smartphones or voice-activated assistants (Zeng, Wu, & Kang, 2020). Smart hotels also incorporate robotics for housekeeping, AI-driven customer service, and automated inventory management to optimize efficiency (Buhalis & Leung, 2018).

The Technology Adoption Model (TAM) explains that technology adoption in the hotel industry depends on perceived usefulness and ease of use (Liu et al., 2022). Hotels that integrate smart technologies experience higher customer engagement and satisfaction, leading to increased occupancy rates and revenue (Kabadayi, Ali, & Choi, 2019).

The integration of smart technologies into hotel operations supports the study's hypothesis that IoT adoption leads to enhanced guest satisfaction and improved efficiency. This research will explore how smart hotels drive guest engagement, increase operational effectiveness, and contribute to sustainability through energy-efficient IoT applications.

2.4 Customer Loyalty

Customer loyalty refers to a guest's inclination to return to a hotel due to previous positive experiences (Fatima et al., 2021). A loyal customer base contributes to higher profitability, reduced marketing costs, and sustained business growth (Reichheld & Schefter, 2000). In the IoT-driven hospitality and tourism landscape, personalized guest experiences play a crucial role in fostering customer loyalty (Tussyadiah, 2020).

Customer Loyalty Theory (CLT) suggests that service quality and customer satisfaction are critical factors in building long-term loyalty (Fatima et al., 2021). IoT applications, such as smart room personalization, AI-driven recommendations, and real-time feedback systems, create unique and seamless guest experiences that encourage repeat visits (Morosan & DeFranco, 2016). Loyalty programs driven by IoT-generated customer data allow hotels to offer tailored rewards, further strengthening guest relationships (Bujari et al., 2018).

This study aims to assess the extent to which IoT-enabled services enhance customer loyalty, focusing on personalized offerings, seamless service delivery, and enhanced security. The hypothesis states that hotels leveraging IoT effectively will experience higher customer retention rates due to improved service satisfaction.

2.5 Guest Experience

Guest experience refers to the overall interaction between a customer and a hotel, spanning from the reservation process to post-stay engagement (Dianawati et al., 2024). In modern hospitality and tourism, guest experience plays a critical role in shaping customer perceptions, influencing satisfaction, and fostering long-term loyalty (Buhalis & Leung, 2018). The integration of IoT enhances this experience by enabling hyper-personalization, seamless automation, and real-time responsiveness (Gretzel et al., 2015). IoT-driven smart rooms, for example, allow guests to customize lighting, temperature, and entertainment preferences through mobile applications or voice assistants, significantly improving comfort and convenience (Chourasia, 2025). This aligns with the Customer Experience Theory (CET), which emphasizes that personalized and immersive experiences lead to higher guest satisfaction and engagement (Dianawati et al., 2024). Furthermore, IoT-enabled feedback systems enable real-time service recovery, enhancing overall customer perception of service

quality (Tussyadiah, 2020). Thus, IoT contributes to creating a competitive advantage for hotels by fostering superior guest experiences and increasing customer retention.

2.6 Operational Efficiency

Operational efficiency in the hospitality and tourism industry involves optimizing resource utilization, reducing operational costs, and improving service delivery with minimal effort (Lee, Phaal, & Lee, 2013). IoT plays a pivotal role in enhancing efficiency by automating routine hotel operations, improving energy management, and streamlining workflows (Marriott & Brown, 2018). For instance, IoT-integrated property management systems (PMS) automate check-ins and check-outs, reducing front desk workload and improving guest service speed (Ivanov et al., 2017). Additionally, smart HVAC (Heating, Ventilation, and Air Conditioning) systems, powered by IoT sensors, optimize energy consumption based on occupancy, leading to significant cost savings and sustainability improvements (Gretzel et al., 2015). This aligns with General Systems Theory (GST), which postulates that optimizing interconnected subsystems leads to overall operational improvements (Jadhav et al., 2023). Hotels that implement IoT-driven predictive maintenance can also reduce equipment downtime, ensuring uninterrupted service delivery (Tian, 2017). By enhancing automation and resource efficiency, IoT contributes to increased profitability and operational sustainability in hotels.

2.7 Data Security

With the proliferation of IoT in hospitality and tourism, data security has emerged as a critical concern, as hotels collect vast amounts of personal guest information, including payment details and preferences (Tian, 2017). Cybersecurity threats such as data breaches, identity theft, and unauthorized access pose significant risks to guest trust and business reputation (Alghoul, 2021). Secure IoT infrastructure, including encryption, multi-factor authentication, and blockchain-based security measures, helps mitigate these risks and ensures data integrity (Kapoor & Gunta, 2022). According to the Technology Adoption Model (TAM), trust in data security significantly impacts IoT adoption rates, as both guests and hotel operators prioritize privacy protection (Kim et al., 2017). Additionally, compliance with international data protection regulations, such as GDPR (General Data Protection Regulation), is crucial for maintaining legal and ethical standards in IoT implementation (Kshetri, 2021). Hotels that invest in robust cybersecurity frameworks can enhance customer confidence, leading to higher guest satisfaction and loyalty.

2.8 IoT Adoption

The adoption of IoT technologies in the hotel industry is influenced by perceived usefulness, ease of use, and trust in technology (Kim et al., 2017). As per the Technology Adoption Model (TAM), hotels are more likely to integrate IoT solutions if they perceive tangible benefits in operational efficiency and guest satisfaction (Sharma, 2020). Smart locks, automated lighting, and voice-controlled concierge services exemplify IoT applications that enhance both operational efficiency and customer convenience (Wang, Li, & Li, 2021). However, barriers to IoT adoption include high implementation costs, technical complexity, and cybersecurity concerns (Gretzel & Buhalis, 2021). Effective training programs and stakeholder engagement strategies can mitigate resistance and facilitate seamless IoT adoption (Marriott & Brown, 2018). By leveraging IoT's capabilities, hotels can differentiate themselves in a competitive market, offering innovative and technology-driven guest experiences.

2.9 Hotel Technology

Hotel technology encompasses various digital innovations, including Property Management Systems (PMS), cloud computing, artificial intelligence (AI), and IoT-enabled solutions (Law et al., 2014). These technologies streamline hotel operations, reduce manual workload, and enhance guest service delivery (Ivanov et al., 2017). For instance, AI-powered chatbots provide instant guest assistance, while IoT-integrated PMS facilitates real-time room availability updates (Gretzel et al., 2015). The adoption of such technologies aligns with General Systems Theory (GST), where interconnectivity among different hotel subsystems leads to improve efficiency and service quality (Jadhav et al.,

2023). Furthermore, big data analytics enables hotels to derive actionable insights from guest preferences, optimizing personalized marketing strategies and enhancing customer engagement (Tussyadiah, 2020). As hotel technology continues to evolve, IoT will play an increasingly vital role in shaping the future of hospitality and tourism operations.

2.10 Smart Tourism

Smart tourism refers to the application of advanced digital technologies, including IoT, AI, and big data, to create personalized and seamless travel experiences (Gretzel et al., 2015). In the hospitality and tourism sector, smart tourism enables real-time service customization, predictive analytics, and efficient resource management (Buhalis & Amaranggana, 2015). IoT-powered smart hotels offer connected environments where guests can interact with digital concierge services, automated room settings, and mobile-based service requests (Wang et al., 2021). This aligns with the Customer Experience Theory (CET), which emphasizes that customized and technology-enhanced experiences result in higher customer satisfaction and loyalty (Pine & Gilmore, 1999). Furthermore, IoT applications in smart tourism enhance sustainability through efficient energy management and waste reduction strategies (Sharma, 2020). The growing demand for smart tourism solutions underscores the need for continuous innovation in IoT implementation within the hospitality and tourism industry.

The integration of IoT in hotel operations significantly enhances guest experience, operational efficiency, data security, and customer loyalty. By aligning with key theoretical frameworks such as General Systems Theory (GST), Technology Adoption Model (TAM), Customer Experience Theory (CET), and Customer Loyalty Theory (CLT), this study underscores the strategic importance of IoT in modern hospitality and tourism. Future research should explore emerging IoT trends and their long-term impact on the hospitality and tourism industry's digital transformation.

The relationship between the two countries is looking for each other

This study explores the relationship between the implementation of Internet of Things (IoT) technologies in hotels and their impact on operational efficiency, guest satisfaction, and customer loyalty, while also considering the challenges associated with IoT adoption. Previous research and theoretical frameworks provide a solid foundation for understanding the interconnection of these variables:

1. **General Systems Theory (GST)**

   GST posits that a hotel operates as a system composed of interrelated subsystems (e.g., front office, housekeeping, security, guest services), where improvements in one part—such as the integration of IoT—can enhance the overall performance of the system (Skyttner, 2005).

   ⇨ **Relationship**: IoT → Improved operational efficiency through better coordination and responsiveness.

2. **Technology Acceptance Model (TAM)**

According to TAM, technology adoption depends on perceived usefulness and ease of use (Davis, 1989). In the hospitality context, successful IoT integration is contingent on staff and management perceiving these technologies as valuable and user-friendly (Morosan & DeFranco, 2016).

⇨ **Relationship**: IoT adoption → Enhanced operational efficiency and guest satisfaction.

3. **Customer Experience Theory (CET)**

   CET emphasizes the importance of delivering personalized and memorable experiences. IoT facilitates this by allowing hotels to offer tailored services, such as automated room settings and smart recommendations, enhancing guest engagement and comfort (Buhalis & Leung, 2018).

   ⇨ **Relationship**: IoT → Increased guest satisfaction through enhanced personalization.

4. **Customer Loyalty Theory (CLT)**

   This theory suggests that satisfaction leads to loyalty when the service is consistently high in quality and personalized (Oliver, 1999). The implementation of IoT contributes to loyalty by exceeding guest expectations and fostering a positive emotional connection with the brand (Kim et al., 2017).

   ⇨ **Relationship**: Guest satisfaction (via IoT) → Stronger customer loyalty.

5. **Challenges in IoT Adoption**

   Studies highlight barriers such as data privacy concerns, high implementation costs, and insufficient staff training as critical challenges that can hinder the adoption of IoT in the hospitality sector (Gretzel et al., 2015; Morosan & DeFranco, 2016).

   ⇨ **Relationship**: Operational and security challenges ↔ Slower or limited IoT adoption.

By integrating theoretical perspectives and prior studies, it becomes evident that IoT adoption in hotels is closely linked to improved operational performance, guest satisfaction, and customer loyalty. However, the presence of technological, organizational, and security-related challenges significantly influences the pace and success of this adoption. This interconnected framework strengthens the logic and coherence of the research hypotheses.

Unifying the Theories: Linking Variables

The integration of theories such as General Systems Theory (GST), Technology Acceptance Model (TAM), Customer Experience Theory (CET), and Customer Loyalty Theory (CLT) reveals a coherent framework connecting the study's core variables. The Internet of Things (IoT) acts as a pivotal enabler within this system, influencing operational processes, customer experiences, and long-term loyalty.

The synthesized relationships are as follows:

- **IoT Implementation → Operational Efficiency**

  Through the lens of GST and TAM, IoT systems streamline operations by enabling real-time communication, automation, and data-driven decision-making (Skyttner, 2005).

- **IoT-Based Personalization → Guest Satisfaction**

  CET emphasizes the emotional and experiential aspects of service. IoT enables hyper-personalized services (e.g., room settings, digital concierge), directly enhancing guest satisfaction (Buhalis & Leung, 2018).

- **Enhanced Satisfaction → Customer Loyalty**

  CLT supports the notion that satisfaction serves as a critical driver of guest retention and advocacy. IoT-facilitated satisfaction increases brand trust and loyalty (Kim et al., 2017).

- **Security and Usability → IoT Adoption Rates**

  As highlighted in TAM and supported by industry-specific literature, perceived ease of use and concerns over data privacy and technical barriers significantly influence the rate of IoT adoption in hospitality environments (Davis, 1989; Morosan & DeFranco, 2016; Gretzel et al., 2015).

This unified model underscores the systemic impact of IoT technologies on hospitality operations and provides a theoretical foundation for the study's hypotheses.

This section critically analyzes previous studies and theories relevant to the role of the Internet of Things (IoT) in enhancing hotel operations, improving hospitality services, and strengthening customer loyalty. Rather than repeating hypotheses, the focus is on how these variables interrelate through established theoretical lenses.

1) General Systems Theory (GST) GST explains how hotels function as integrated systems where IoT enhances interconnectivity between subsystems (e.g., front desk, housekeeping, security). IoT devices streamline operations, reduce waste, and promote efficiency across departments (Rajgor et al., 2023).
2) Technology Acceptance Model (TAM) TAM supports the idea that perceived usefulness and ease of use influence IoT adoption in hotels. Smart features like mobile room control and automated services improve user acceptance (Al-Fuqaha et al., 2015), linking IoT with operational efficiency and guest satisfaction.
3) Customer Experience Theory (CET) CET emphasizes the creation of personalized, memorable guest experiences. IoT enables smart customization—through AI-driven suggestions or room ambiance settings—which directly impacts customer satisfaction (Chourasia, 2025).
4) Customer Loyalty Theory (CLT) CLT connects customer satisfaction to loyalty. IoT contributes to this cycle by enhancing service quality, building trust, and enabling personalized loyalty programs that foster repeat visits (Kim et al., 2023).

Unifying the Theories: Linking Variables

The integrated role of IoT across these theories highlights a clear relationship between the study's key variables:

- IoT Implementation → Operational Efficiency (via GST and TAM)
- IoT-Based Personalization → Guest Satisfaction (via CET)
- Enhanced Satisfaction → Customer Loyalty (via CLT)
- Security and Usability → IoT Adoption Rates (via TAM & industry

3. Research Methodology

This study requires a robust methodological framework to examine the integration of IoT technologies in the hospitality and tourism industry and its impact on operational efficiency and customer loyalty. This section outlines the research approach, data collection methods, sampling techniques, and analytical strategies, aligning with the study's objectives, hypotheses, and theoretical foundations.

3.1 Research Approach: Mixed-Method (Qualitative and Quantitative)

This research employs a mixed-method approach to provide a comprehensive understanding of the role of the Internet of Things (IoT) in hotel operations, the hospitality sector, and tourism services. By combining quantitative data from surveys and qualitative insights from interviews and case studies, the study ensures a holistic evaluation of IoT's impact on operational efficiency, guest satisfaction, and customer loyalty.

The mixed-method approach allows for assessing measurable effects through quantitative analysis and exploring subjective experiences through qualitative insights. This approach aligns with General Systems Theory (GST) and the Technology Adoption Model (TAM), which help examine how IoT components interact within the broader hospitality and tourism ecosystem and identify factors influencing IoT adoption among stakeholders.

3.2 Data Collection Methods

To achieve the study's objectives, data will be collected through multiple sources, ensuring triangulation and credibility. Quantitative data will be gathered through surveys targeting hotel guests, including tourists and business travelers, to measure IoT's impact on guest experience, operational efficiency, and customer loyalty. The surveys will assess variables such as IoT implementation in the tourism, hospitality, and hospitality sectors, as well as customer satisfaction, loyalty, and operational efficiency. Hypothesis testing will be conducted to verify the relationships among these variables, including the impact of IoT on guest experience, operational efficiency, and loyalty.

Additionally, qualitative data will be collected through semi-structured interviews with industry experts, senior hotel managers, and IT professionals in the tourism and hospitality sectors. These interviews will explore expert insights on IoT adoption, implementation challenges, and future trends, with a focus on perceived benefits, adoption barriers, and security concerns. The thematic analysis of these interviews will help identify recurring patterns, aligning with Customer Experience Theory (CET) to examine how personalized services enhance guest satisfaction.

3.3 Sampling Techniques

To ensure representative and meaningful insights, two sampling techniques are employed in this research.

3.3.1 Stratified Random Sampling for the quantitative surveys. The target population includes hotel guests from various hotel categories (luxury, medium, and economy) known for integrating smart technologies. The sample size is determined using the Krejcie & Morgan's (1970) statistical formula, which ensures statistical generalization for large study populations. The final sample size consists of 384 participants. Stratification criteria include hotel type, location, and guest demographics such as gender, age, nationality, and the availability of IoT in the tourism, hospitality, and hospitality sectors. This technique ensures fair representation and avoids sampling bias, thereby strengthening the statistical validity of the quantitative findings. It aligns with the Technology Adoption Model (TAM), capturing expert perspectives on the perceived ease of use and usefulness of IoT.

The sample description is based on gender, age, nationality, and the availability of IoT in the tourism and hospitality sectors, which are key characteristics of the respondents' opinions. Frequency distribution is used to indicate the percentage of each characteristic, as shown in Table (1)

Table (1) Descriptive statistics of the participants (N=384)

Characteristics	Category	Frequency	Percent	Rank
Gender	Male	212	55.21%	1
	Female	172	44.79%	2
Age	Under 25 years	42	10.94%	4
	From 25 Up to 35 years	97	25.26%	2
	From 36 Up to 45 years	138	35.94%	1
	From 46 Up to 55 years	81	21.09%	3
	Above 55 years	26	6.77%	5
Nationality	Arab country	27	7.03%	4
	African country	42	10.94%	3
	European country	225	58.59%	1
	Asian country	68	17.71%	2
	American country	22	5.73%	5
Availability IoT In The Tourism And Hospitality Sectors	Robots	9	2.86%	9
	Chabot's AI	16	5.21%	7
	Smart phones	53	20.31%	2
	E-payment	31	10.94%	4
	Wi-Fi	70	23.71%	1
	E-gate	44	12.24%	3
	Virtual reality	7	2.34%	10
	Augmented reality	5	2.08%	11
	Sensor	11	4.17%	8
	Automated services	20	7.03%	6
	Self-cheek in	25	9.11%	5

The previous table shows that the largest percentage according to gender was in favor of the (male) category, with a percentage of (55.21%), followed by the (female) category, with a percentage of (44.79%), While it appears that the largest percentage according to age was in favor of the age group (From 36 Up to 45 years) with a percentage of (35.94%), followed by the age group (From 25 Up to 35 years) with a percentage of (25.26%), followed by the age group (From 46 Up to 55 years) with a percentage of (21.09%), followed by the age group (Under 25 years) with a percentage of (10.94%), followed in last place by the age group (Above 55 years) with a percentage of (6.77%), The table also shows that the largest percentage according to nationality was in favor of (European country) with a percentage of (58.59%), followed by the (Asian country) category with a percentage of (17.71%), followed by the (African country) category with a percentage of (10.94%), followed by the age group (Arab country) with a percentage of (7.03%), followed in last place by the (American country) category with a percentage of (5.73%), It also appears that the largest percentage according to Availability IoT In The Tourism And Hospitality Sectors was in favor of the (Wi-Fi___33) category with a percentage of (23.71%), followed by the (Smart phones) category with a percentage of (20.31%), followed by the (E-gate) category with a percentage of (12.24%), followed by the (E-payment) category with a percentage of (10.94%), followed by the (Self-cheek in) category with a percentage of (9.11%), followed by the (Automated services) category with a percentage of (7.03%), followed by the (Chabot's AI) category with a percentage of (5.21%), followed by the (Sensor) category with a percentage of (4.17%), followed by the (Robots) category with a percentage of (2.86%), followed by the (Virtual reality) category with a percentage of (2.34%), followed in last place by the (Augmented reality) category with a percentage of (2.08%), These results reflect that the sample is comprehensive in terms of gender, age, nationality, and the diversity of Internet of Things technologies in the tourism and hospitality sectors, which is reflected in the credibility of the study sample's responses due to their knowledge of multiple Internet of Things technologies and thus the validity of the results.

3.3.2 Purposive Sampling (For Qualitative Interviews & Case Studies): The purposive sampling technique is used for the qualitative interviews and case studies to gain in-depth insights from professionals with relevant expertise. The target audience includes hotel managers with direct experience in implementing the Internet of Things (IoT), along with experts specializing in hospitality, tourism, and the hospitality sector technologies. The sample size consists of 50 experts. Stratification criteria for selecting the experts include demographic data such as gender, age, and profession. The purpose of this sampling approach is to select information-rich cases that can provide a deeper understanding of IoT adoption and its implications in the tourism, hospitality, and hospitality sectors.

Table (2) Descriptive statistics for experts in the tourism and hotel sector (N=50)

Characteristics	Category	Frequency	Percent	Rank
Gender	Male	36	72.00%	1
	Female	14	28.00%	2
Age	Under 25 years	2	4.00%	5
	From 25 Up to 35 years	4	8.00%	4
	From 36 Up to 45 years	12	24.00%	3
	From 46 Up to 55 years	14	28.00%	2
	Above 55 years	18	36.00%	1
Profession	Senior hotel managers	28	56.00%	1
	IT specialists in the tourism and hospitality sectors	22	44.00%	2

The previous table shows that the largest percentage for Sample of experts in the tourism and hotel sector according to gender was in favor of the (male) category, with a percentage of (72.00%), followed by the (female) category, with a percentage of (28.00%), While it appears that the largest percentage according to age was in favor of the age group (Above 55 years) with a percentage of

(36.00%), followed by the age group (From 46 Up to 55 years) with a percentage of (28.00%), followed by the age group (From 36 Up to 45 years) with a percentage of (24.00%), followed by the age group (From 25 Up to 35 years) with a percentage of (8.00%), followed in last place by the age group (Under 25 years) with a percentage of (4.00%), While it seems that the largest percentage according to Profession was in favor of the category (Senior hotel managers) at (56.00%), followed by the category (IT specialists in the tourism and hospitality sectors) at (44.00%).

3.4. Research Instruments

3.4.1 Survey

The survey instrument was meticulously developed to evaluate the integration of Internet of Things (IoT) technologies within hospitality and tourism frameworks, with particular emphasis on measuring impacts across customer experience dimensions, operational efficiency metrics, and loyalty indicators. The theoretical underpinnings of the questionnaire are founded upon established scientific models including the Technology Acceptance Model (TAM) proposed by Liu et al. (2022), Customer Experience Theory (CET) introduced by Dianawati et al. (2024), and General Systems Theory (GST) conceptualized by Cabrera & Cabrera (2018).

The questionnaire construction process adhered to rigorous academic standards, drawing extensively from seminal hospitality technology literature, notably the frameworks established by Law, Buhalis, and Cobanoglu (2014) and Gretzel et al. (2015). Instrument validation followed a comprehensive multi-phase approach incorporating expert panel reviews, pilot testing protocols, and preliminary exploratory research to ensure construct validity and measurement reliability.

The instrument was systematically organized into six distinct thematic sections, each carefully aligned with the research objectives and hypothesized relationships. Section 1 collected demographic information including gender, age, nationality, and awareness of IoT availability in tourism contexts, primarily for segmentation analysis rather than theoretical testing. Section 2 assessed familiarity levels and interaction frequency with IoT implementations in Egyptian hospitality, aligning with Technology Acceptance Model frameworks for evaluating adoption patterns and technology diffusion.

Section 3 presented significant IoT implementation models facilitating service delivery in hospitality environments, examining utilization patterns and perceived utility according to TAM principles. Section 4 evaluated IoT impact vectors on guest experience parameters through the lens of Customer Experience Theory, analyzing how technology-enabled personalization enhances satisfaction metrics. Section 5 measured IoT influence on retention indicators and loyalty constructs using Customer Loyalty Theory to examine relationships between technological interventions and repeat patronage behavior. Section 6 identified adoption barriers and implementation constraints, analyzing perceived risks and resistance factors within the TAM framework.

Each section employed standardized measurement using a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) to ensure consistency in response quantification and facilitate statistical analysis. This methodological approach enabled robust quantitative assessment of respondent attitudes and perceptions regarding IoT implementation in hospitality contexts.

The questionnaire development process was grounded in comprehensive analysis of hospitality and tourism literature focusing on technological innovation adoption. Key reference sources included Law, Buhalis, and Cobanoglu (2014), whose work on hotel technology integration provided frameworks for measuring guest experience dimensions; Gretzel et al. (2015), whose research on smart tourism ecosystems informed questions regarding IoT-driven personalization; and Liu et al. (2022), whose Technology Acceptance Model provided the foundational structure for measuring adoption parameters.

The questionnaire underwent systematic validation through implementation of a modified Delphi technique. A panel comprised of subject matter experts from academic institutions (Higher Institutes of Tourism & Hotels, Faculties of Tourism & Hotels) and industry practitioners (Hotel Managers, Hospitality IT Specialists) evaluated the instrument across multiple dimensions including linguistic clarity, relevance to research objectives, and appropriateness of measurement scales and terminology.

Following multiple iterative refinement cycles, several modifications were implemented: simplification of technical terminology to enhance respondent comprehension; restructuring of question sequencing to optimize engagement and response quality; and integration of validation questions to assess response consistency and reliability. This systematic approach to questionnaire development ensured that the final instrument demonstrated robust validity, reliability, and alignment with established theoretical frameworks in hospitality technology research.

3.4.2 Personal interviews

To achieve the study objectives, a personal interview was prepared with a group of experts (senior hotel managers, IT specialists in the tourism and hotel sectors), where the respondents' answers were recorded (audio or written), This tool is one of the tools for collecting information and data in the scientific study. The form consisted of (7) open questions directed to experts. In this type of interview, the study sample members are allowed to answer freely and to elaborate on their opinion or the reason for their answer. The questions were as follows:

1- How can the IoT improve hotel and tourism services?
2- How easy is it to interact with IoT technologies?
3- How prepared are hotels and tourism organizations to adopt IoT-enabled technologies to attract visitors again?
4- How do personalized services through technology impact the customer experience?
5- How does technology adoption affect customer satisfaction and loyalty to a brand?
6- What are the factors that influence customers' adoption and use of new technologies in the hospitality and tourism sectors?
7- What are the challenges facing the implementation of the Internet of Things in hotels and tourism organizations?

3.5 Pilot Study, Reliability, and Validity Testing:

3.5.1 Pilot Study for Reliability and Validity Testing of the Questionnaire

A comprehensive pilot study was conducted prior to full-scale deployment of the research instrument to validate its efficacy and ensure methodological rigor. The pilot phase incorporated a strategic sample of 10 hospitality and tourism professionals (including hotel managers and IoT specialists) alongside 30 hotel guests with diverse travel profiles. This preliminary testing phase was methodically designed to assess questionnaire clarity and length, identify potential technical ambiguities, and validate the appropriateness of the Likert measurement scale.

The pilot study yielded several significant findings that informed instrument refinement. Specifically, respondents with limited technical backgrounds reported difficulty with IoT terminology, prompting simplification of technical language. Industry experts recommended enhanced coverage of cybersecurity concerns, resulting in the addition of relevant items. Additionally, response patterns indicated reluctance to complete open-ended questions, leading to their reclassification as optional to maximize response rates. These modifications significantly enhanced instrument accessibility and comprehensiveness.

The research instrument underwent rigorous validity testing through complementary methodological approaches. Construct validity was systematically assessed through factor analysis to confirm each item's alignment with intended theoretical constructs. Content validity was established through expert panel evaluation and comprehensive literature validation, ensuring complete coverage of relevant IoT implementation domains within hospitality contexts.

Internal consistency reliability was meticulously evaluated through statistical analysis of pilot data (n=30). Pearson correlation coefficients demonstrated statistically significant positive correlations ($p \leq 0.05$) between individual items and their respective dimensions. Specifically, the IoT Awareness dimension exhibited correlation coefficients ranging from 0.756 to 0.901 with an overall dimension correlation of 0.834. The Examples of IoT Applications Usage dimension demonstrated coefficients between 0.741 and 0.932 with an overall correlation of 0.829. The Perceived Benefits dimension showed coefficients from 0.710 to 0.854 with a dimensional correlation of 0.796. The Customer

Satisfaction and Loyalty dimension presented coefficients ranging from 0.769 to 0.924 with an overall correlation of 0.855. Finally, the Challenges in IoT Adoption dimension displayed coefficients between 0.774 and 0.921 with a dimensional correlation of 0.834.

Reliability analysis utilizing Cronbach's alpha methodology confirmed exceptional internal consistency across all instrument dimensions. Alpha coefficients ranged from 0.774 (good reliability) for the Customer Satisfaction and Loyalty dimension to 0.913 (excellent reliability) for the Challenges in IoT Adoption dimension. The composite instrument demonstrated a robust alpha coefficient of 0.876, substantially exceeding the conventional threshold of 0.70 required for research instruments. These comprehensive validity and reliability indicators collectively confirm the methodological soundness of the research instrument and its readiness for implementation in the main study.

3.5.1 Pilot Study for Reliability and Validity Testing of Personal Interview

The methodological validity and reliability of the expert interview instrument were rigorously evaluated through implementation of established scientific protocols. Test-retest reliability assessment was conducted with a one-week interval between administrations using a representative sample of 10 industry experts (comprising hotel managers and IoT technology specialists) distinct from the main study participants. Statistical evaluation employed Pearson's correlation coefficient to quantify the relationship between first and second administration responses.

The interview instrument demonstrated robust temporal stability with statistically significant positive correlations ($p \leq 0.05$) between first and second administrations across all question items. Correlation coefficients ranged from 0.744 to 0.869, indicating substantial consistency in expert responses between testing intervals. These values exceed conventional thresholds for acceptable reliability in qualitative research instruments within hospitality and tourism contexts.

Self-validity coefficients were calculated through established psychometric methodology (self-validity coefficient = square root of reliability coefficient). This analysis yielded excellent validity indicators ranging from 0.862 to 0.932 across all interview questions. These elevated validity metrics confirm the instrument's capacity to effectively measure the intended constructs related to IoT implementation in hospitality settings.

Detailed statistical analysis of response patterns revealed consistent mean scores between test administrations, with minimal standard deviation fluctuations. Specifically, first question reliability indicators ($r=0.801$, self-validity=0.894) demonstrated strong measurement consistency with mean scores of 3.24 (SD=0.423) and 3.27 (SD=0.348) for first and second administrations respectively. The highest reliability was observed in the sixth question ($r=0.869$, self-validity=0.932) with mean responses of 3.50 (SD=0.365) and 3.54 (SD=0.158) across administrations.

The comprehensive reliability and validity indicators collectively confirm the methodological rigor of the expert interview protocol, establishing its suitability for application in the primary research investigation. The instrument demonstrates appropriate psychometric properties for gathering expert perspectives on IoT implementation within hospitality and tourism contexts.

3.6 Application of questionnaire and personal interviews:

The questionnaire was applied electronically via email, hotel websites, and travel forums over a period of three months during the year 2025, which was directed to guests (tourist and business travelers) in several selected hotels that succeeded in applying Internet of Things technologies in them, for example, but not limited to (smart rooms, automatic check-in), and the number of them was (384) guests of different ages and nationalities, To survey their opinions about the impact of the Internet of Things on operational efficiency, customer experience, customer satisfaction and loyalty to the tourism brand. The total sample answered all questions included in the survey form correctly, and there is no error rate, and no form was excluded, Since the electronic questionnaire was set up so that all questions were “required”, meaning that it was necessary to answer all questions and not move to the next question unless the previous question was answered, thus the responses that were actually collected were (384) responses at a rate of (100%), Standardized personal interviews were also conducted with senior hotel managers as well as information technology specialists in the tourism

and hospitality sectors, numbering (50) individuals, in order to obtain answers to the questionnaire phrases as well as the open study questions directed to experts to collect the information necessary to conduct the statistical analysis.

3.7 Data Analysis Techniques:

The data for the study variables were processed using IBM SPSS Statistics ver.26; a significance level of 0.05 ≥α was chosen to ensure the significance of the statistical results. The statistical processing plan included the following methods:

1) Descriptive Statistics
   - Frequency distribution: Quantified categorical variable occurrences
   - Arithmetic means: Determined central tendency values
   - Standard deviation: Assessed response dispersion patterns
2) Inferential Statistics
   - Pearson's correlation coefficient: Measured strength and direction of relationships between IoT implementation and hospitality metrics (operational efficiency, guest satisfaction, brand loyalty)
   - Cronbach's alpha: Evaluated questionnaire reliability with 0.70 threshold
   - Linear regression analysis: Quantified impact of independent variables on dependent variables through R^2 values
   - Stepwise multiple regression: Assessed combined effects of multiple IoT implementation factors
3) Measurement Approach
   - Standardized five-point Likert scale
   - Systematic category length calculation for consistent interpretation
   - Facilitated comprehensive analysis of IoT implementation effects across hospitality performance indicators

Table (3) Estimating the importance degrees of the statements according to the five-point Likert scale to indicate the respondents' responses to the questionnaire statements

Response	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scores	1	2	3	4	5
Weighted Mean	1: 1.79	1.80: 2.59	2.60: 3.39	3.40: 4.19	4.20: 5

3.8 Analysis and discussion of the results of the field study:

3.8.1 Descriptive Analysis of Questionnaire Statements:

Table (4) Mean and standard deviation of Awareness of IoT Usage in Hospitality, Tourism in Egypt

	Variable	Mean	Std. Deviation	Rank
1	I am aware of the concept of the Internet of Things (IoT)	4.73	0.452	1
2	I have previously used IoT-based technologies in Hospitality and Tourism	4.61	0.468	2
3	Believe that the Internet of Things enhances the tourist experience.	4.57	0.524	3
4	I would like to experience hotels and Tourist areas that utilize IoT more extensively.	4.33	0.695	5
5	Using IoT saves you time and effort in searching for your tourism requirements	4.50	0.569	4
Total statistics of all variables		4.55	0.541	

The previous table shows that respondents demonstrated high awareness of IoT concepts (Mean=4.73, SD=0.452). Previous usage of IoT technologies in hospitality was widely reported (Mean=4.61, SD=0.468). Respondents strongly believed that IoT enhances tourism experiences (Mean=4.57, SD=0.524) and provides time and effort savings (Mean=4.50, SD=0.569). Although the desire for more extensive IoT implementation in hospitality was slightly lower (Mean=4.33, SD=0.695), the overall results were highly positive (Mean=4.55, SD=0.541).

The analysis reveals consistently high awareness and positive perceptions of IoT applications. The highest mean score was for the conceptual understanding of IoT, indicating strong awareness among respondents, with a relatively low standard deviation (0.452), suggesting considerable agreement on IoT knowledge. While all items received strongly positive responses, the slightly lower mean score for the desire for more IoT implementation (4.33) and its higher standard deviation (0.695) suggest some variability in respondents' interest in expanding IoT experiences. These findings align with contemporary research on IoT integration in tourism, which views IoT as an interconnected ecosystem of sensor-equipped devices that enhance tourism experiences through technologies like sensors, AI, data analytics, voice assistants, and virtual tours.

Table (5) Mean and standard deviation of Examples of IoT Applications Usage in Hospitality, Tourism in Egypt

	Variable	Mean	Std. Deviation	Rank
1	I can perform tourism and hotel services via Smartphone, such as booking airline tickets and hotel rooms	4.82	0.428	1
2	I can control room settings (lighting, air conditioning, curtains) via my Smartphone.	4.36	0.673	6
3	Smartphone check-in and check-out is easy and efficient	4.44	0.631	5
5	Service robots provide a more comfortable and seamless hospitality	4.27	0.685	7
6	Smart energy management systems make hotels and heritage sites more sustainable and efficient	4.13	0.825	9
7	Voice-controlled smart assistants in the room make it easier to request hotel services	4.18	0.767	8
8	AI-powered online booking systems provide accurate recommendations based on my preferences	4.77	0.468	2
9	IoT provides an integrated hotel and tourism experience that meets my expectations	4.60	0.563	3
10	I feel my personal data is secure when using smart technologies during tourist trips and when staying in a hotel	3.95	0.892	10
11	Use smart technology makes me want to repeat my tourist visit again to the host country	4.54	0.580	4
Total statistics of all variables		4.41	0.651	

The previous table shows that the phrases of the second dimension, "Examples of IoT Applications Usage in Hospitality and Tourism in Egypt," had arithmetic means ranging from 3.95 to 4.82 and standard deviations from 0.428 to 0.892, indicating variation in respondents' views. The phrase "I can perform tourism and hotel services via Smartphone, such as booking airline tickets and hotel rooms" ranked first with a mean of 4.82 and a standard deviation of 0.428, reflecting that smartphones are the most popular IoT technology used by tourists for booking tickets, checking in, and controlling room settings. The statement "I feel my personal data is secure when using smart technologies during tourist trips and when staying in a hotel" ranked last with a mean of 3.95 and a standard deviation of 0.892, reflecting concerns about data security and the risk of cyber-attacks.

These findings align with the 2025 study, which highlighted that IoT applications in hospitality and tourism enhance service quality and improve the tourist experience, increasing brand loyalty. However, they also pose a potential cyber security risk, as cybercriminals may use phishing tactics to steal personal information or launch malware attacks.

Table (6) Mean and standard deviation of Perceived Benefits of IoT in Enhancing Customer Experience

	Variable	Mean	Std. Deviation	Rank
1	The services provided by the IoT save time, effort and cost	4.34	0.602	4
2	IoT offers financial benefits by automatically saving energy in tourist and hotel facilities	4.26	0.655	5
3	IoT facilitates digital check-in and check-out processes at airports and hotels	4.47	0.592	3
4	IoT enhances the personal comfort of the tourist	4.55	0.576	2
5	Use IoT Applications Improves The Services Provided	4.64	0.536	1
Total statistics of all variables		4.45	0.592	

The previous table shows that the phrases of the third dimension, "Perceived Benefits of IoT in Enhancing Customer Experience," had arithmetic means ranging from 4.26 to 4.64 and standard deviations from 0.536 to 0.655, indicating variation in respondents' views. The phrase "Use of IoT applications improves the services provided" ranked first with a mean of 4.64 and a standard deviation of 0.536, reflecting IoT's ability to provide timely, cost-effective information while enhancing operational efficiency. The statement "IoT offers financial benefits by automatically saving energy in tourist and hotel facilities" ranked last with a mean of 4.26 and a standard deviation of 0.655, indicating that the financial benefits of IoT, such as energy-saving smart systems, were perceived as less significant.

These findings align with the 2025 study, which indicated that increased use of IoT technologies in the tourism and hotel sector enhances comfort, attracts tourists, and encourages repeat visits. The main advantages of IoT include providing tourists with essential information and personalized recommendations that align with their interests and financial capabilities, helping them better determine their travel destinations.

Table (7) Mean and standard deviation of Impact of IoT on Customer Satisfaction and Loyalty

	variable	Mean	Std. Deviation	Rank
1	Improving services using the IoT increases my level of satisfaction with the tourism and hotel services provided.	4.60	0.458	2
2	I highly recommend my friends and family to go to tourist areas and also stay in IoT based hotels when planning travel to tourist destinations	4.52	0.527	3
3	Experiencing the IoT in tourist areas and hotels makes me more loyal to the brand	4.77	0.348	1
4	I intend to replicate the tourism experience in the future for the country, which is constantly expanding its use of IoT technologies	4.40	0.566	4
5	The ease of completing tourism and hotel services using IoT makes me return to it in the future	4.22	0.687	6
6	IoT encourages me to repeat the process of visiting tourist destinations	4.33	0.660	5
Total statistics of all variables		4.47	0.541	

The previous table shows that the phrases of the fourth dimension, "Impact of IoT on Customer Satisfaction and Loyalty," had arithmetic means ranging from 4.22 to 4.77 and standard deviations from 0.348 to 0.687, indicating variation in respondents' views. The phrase "Experiencing the IoT in tourist areas and hotels makes me more loyal to the brand" ranked first with a mean of 4.77 and a standard deviation of 0.348, reflecting strong loyalty to tourism or hotel brands using IoT to improve services and increase customer satisfaction. The statement "The ease of completing tourism and hotel services using IoT makes me return to it in the future" ranked last with a mean of 4.22 and a standard deviation of 0.687, indicating that while IoT services impact future customer behavior, they are less influential in driving loyalty.

These findings align with the 2025 study, which highlighted that high customer satisfaction, driven by the use of advanced technological solutions in tourism and hospitality, leads to strong brand loyalty. When customer satisfaction is high, it reflects the brand's ability to meet customer needs and adapt, fostering repeat visits and continued loyalty.

Table (8) Mean and standard deviation of Challenges in Adopting IoT in tourism and hotel sectors

Variable		Mean	Std. Deviation	Rank
1	I am concerned about the security risks of data privatization when using the Internet of Things in the tourism and hotel sector	4.40	0.621	2
2	I believe that implementing IoT technologies is costly for tourism and hotel organizations	4.47	0.542	1
3	Technical malfunctions in IoT systems may reduce my comfort while staying at the hotel or performing a tourist service	4.31	0.657	3
4	Hackers' control of the network control system for all Internet of Things devices is causing significant damage to individuals and tourism establishments.	4.11	0.751	5
5	I find it difficult to use IoT technologies efficiently in some tourist areas and hotels	3.97	0.790	6
6	Weakness of qualified and trained human cadres in the tourism and hotel sector to deal with the complex control systems of the IoT	4.19	0.687	4
Total statistics of all variables		4.24	0.674	

The previous table shows that the phrases of the fifth dimension, "Challenges in Adopting IoT in Tourism and Hotel Sectors," had arithmetic means ranging from 3.97 to 4.47 and standard deviations from 0.542 to 0.790, indicating variation in respondents' views. The statement "I believe that implementing IoT technologies is costly for tourism and hotel organizations" ranked first with a mean of 4.47 and a standard deviation of 0.542, reflecting the high costs of acquiring and maintaining IoT technologies. The statement "I find it difficult to use IoT technologies efficiently in some tourist areas and hotels" ranked last with a mean of 3.97 and a standard deviation of 0.790, indicating that some tourist areas and hotels face challenges in effectively using IoT due to high costs.

These findings align with the 2025 study, which indicated that the main challenges for the tourism and hotel sectors in adopting IoT are the high costs of manufacturing IoT chips and the increasing global demand for these services, which requires more data support. Additionally, the lack of continuous updates to these technologies may lead to technical malfunctions that negatively affect service quality.

3.8.2 Verifying the validity of the study hypotheses:

The first hypothesis states that "there is a statistically significant relationship at a significance level of 0.05 $\geq\alpha$ between the use of the IoT and (operational efficiency, tourism customer experience, customer satisfaction and brand loyalty) in the tourism and hospitality sectors", To test the validity of this hypothesis, the correlation coefficients between the study variables were calculated using Pearson's correlation coefficient. The following table shows the correlation matrix between the use of the IoT as an independent variable and each of (operational efficiency, tourism customer experience, customer satisfaction and loyalty to the brand) as dependent variables in the tourism and hospitality sectors.

Table (9) Pearson's correlation coefficient between the use of the IoT and operational efficiency, tourism customer experience, customer satisfaction, and brand loyalty in the tourism and hospitality sectors.

Axis		Dependent variables			
		Operational efficiency	Tourism customer experience	Customer satisfaction and loyalty to the brand	Total correlation
(Internet Of Things) Independent variable	R	0.842*	0.815*	0.803*	0.928*
	Sig	0.000	0.000	0.000	
	N	384	384	384	

*Significant at 0.05 ≥α

The previous table shows that there is a statistically significant positive correlation at a significance level of 0.05 ≥α, between the use of the Internet of Things and (operational efficiency, tourism customer experience, customer satisfaction and loyalty to the brand) in the tourism and hospitality sectors, Whereas the calculated Pearson correlation coefficients "R" values reached respectively (0.824) (0.774) (0.862) at a significance level of (0.000) and this value is less than the significance level of 0.05 ≥α and therefore we accept the hypothesis, and the positive value of this correlation indicates the existence of a strong and high direct relationship between the study variables, These results reflect that the greater the use of IoT technologies in the tourism and hospitality sectors, the more it will improve operational efficiency, make the customer experience more unique and distinctive, and increase tourist satisfaction and brand loyalty

The second hypothesis states that "there is a statistically significant effect at a significance level of 0.05 ≥α between the IoT and (operational efficiency, tourism customer experience, customer satisfaction and brand loyalty) in the tourism and hospitality sectors", To test the validity of this hypothesis, statistical analysis was conducted using the stepwise multiple regression method to measure the impact of the IoT as independent variables on (operational efficiency, tourism customer experience, customer satisfaction and loyalty to the brand) as dependent variables according to the responses of the respondents under study.

Table (13) Results of a multiple linear regression analysis to demonstrate the impact of the IoT on operational efficiency, customer experience, customer satisfaction, and brand loyalty in the tourism and hospitality sectors

Dependent Variables	Coefficients[a]				
	Unstandardized Coefficients (B)	Standardized Coefficients (Beta)	R Square	T Test	Sig
Regression constant (α)	.585	--	--	6.495*	.000
Operational efficiency (Y)	.336	.389	.709	13.163*	.000
customer experience (Y)	.272	.323	.814	11.250*	.000
brand loyalty (Y)	.279	.336	.861	12.361*	.000
– R2 = 0.928 – Adjusted R2 = 0.861 – (F) Values = 781.560 – P. Value = 0.000 – Confidence (0.99%) – Error percentage of the model = 7.20% – **Independent variable (X) : Internet of Things (IoT)**					

The multiple linear regression analysis tables show the following:

There is a relationship between the impact of the IoT on operational efficiency, customer experience, satisfaction, and brand loyalty in the tourism and hospitality sectors, as the F value reached (781.560) at a significance level of (0.000) which is less than the level of (0.05 ≥α), which indicates the

significance of the multiple linear regression model for the relationship between the independent variable and the dependent variables in the study

The positive Beta Standardized Coefficients for the regression coefficient of the dependent variables (operational efficiency, customer experience, customer satisfaction, and brand loyalty) indicate a direct relationship between it and the independent variable (IoT), which indicates that the more the application of the Internet of Things expands in the tourism and hospitality sectors, the greater the improvement in operational efficiency, making the customer experience more distinctive and increasing tourists' satisfaction and loyalty to the brand.

Statistical evidence indicates that the independent variable (IoT) has a significant impact on improving operational efficiency by (70.90%), supporting the tourism customer experience by (81.40%), and increasing customer satisfaction and brand loyalty by (86.10%). The results also indicate that the total percentage explained by the independent variable in the changes occurring in the dependent variables reached (92.80%) according to what is indicated by the value of the coefficient of determination R^2.

The error rate in the model indicates that (7.20%) of the variance resulting from measuring the effect of the independent variable on the dependent variables is due to other random factors that were not mentioned in the model.

These findings align closely with prior research indicating that IoT integration enhances operational performance and guest satisfaction by enabling personalized services and efficient resource management (Gajić et al., 2024). Similarly, Dianawati et al. (2024) emphasize that smart hotel technologies, encompassing IoT applications, significantly increase guest satisfaction and loyalty by improving usability and perceived usefulness. Thus, both the present and previous studies consistently demonstrate that expanding IoT deployment fosters superior operational outcomes and stronger customer relationships in the hospitality industry.

3.8.3 Personal interview responses to the study questions directed to experts in the tourism and hotel sectors:

1) How can the IoT improve hotel and tourism services?

The Internet of Things (IoT) can enhance hotel and tourism services in several ways, such as by using sensors to monitor visitor movement in hotels and tourist sites, which helps improve transportation, accommodation, and activities. IoT enables smart control of energy systems like lighting, air conditioning, and curtains, improving comfort and reducing human effort. Interactive electronic displays can guide visitors around tourist areas, providing information on local history. Additionally, digital tourist guides can offer real-time information on attractions and local areas. IoT-powered smartphone apps provide details about accommodations, tourist sites, and activities, with features like smart check-in and device control systems. By analyzing large volumes of visitor data, IoT helps identify interests and assists in decision-making for tourism management. Overall, IoT enables tourism companies to automate operations, reduce labor costs, improve service delivery, and provide transparency in customer transactions, ultimately increasing visitor satisfaction and boosting revenue in the tourism and hotel sectors.

Prior studies have emphasized IoT's capacity to automate processes, optimize resource use, and personalize visitor experiences, leading to improved service quality and increased revenue (Car et al., 2019). These consistent results demonstrate that IoT technologies significantly contribute to advancing tourism management through enhanced comfort, operational transparency, and data-driven decision-making.

2) How easy is it to interact with IoT technologies?

The Internet of Things revolves primarily around connected devices integrated into our daily environment in tourism and hotel organizations, which means that users must interact with them. Therefore, Internet of Things interfaces must be simpler, easier to handle, and more integrated with each other. Examples of such applications are mobile phones and integrated touch screens to control various functions, however, interaction with these applications is still very simple due to their

continuous development and growth, which means that the interaction between humans and IoT devices is somewhat imperfect. Therefore, there is a need to implement types of technologies that allow interaction and can improve the IoT and make it more user-oriented.

3) How prepared are hotels and tourism organizations to adopt IoT-enabled technologies to attract visitors again?

When hotels and tourism organizations embrace the expanded use of the Internet of Things (IoT), it directly contributes to improving the tourism experience and thereby enhances long-term customer loyalty. Real-time customer data analytics enable IoT-based feedback systems to anticipate guest needs, provide personalized promotions, suggest nearby tourist attractions, and offer all necessary services. This directly influences future visitor behavioral intentions, transforming them into actual behaviors that support repeat visits, assuming tourists are satisfied with the services provided. It also strengthens customer loyalty to the reputation of the tourism brand. Furthermore, customer needs play a key role in developing new IoT-based technologies as an effective means to address future challenges.

4) How do personalized services through technology impact the customer experience?

Customer experience in the hospitality and tourism sectors refers to the overall interaction between customers and organizations, facilitated by modern technologies throughout the entire tourist journey, from booking to departure. The delivery of digital services plays a critical role in shaping customer perceptions, satisfaction, and long-term loyalty. Integrating the Internet of Things (IoT) enhances the automation of tourism services through immediate responses, such as streamlining check-ins with self-service kiosks and enabling smart rooms that allow guests to control lighting, temperature, and curtains via smartphones or voice assistants. IoT also improves hotel operations by automating tasks like baggage monitoring and cleaning services, thereby boosting operational efficiency.

In the tourism sector, IoT supports ticket bookings, biometric check-ins at airports, and instant communication with tourists via AI-powered chatbots. IoT technologies provide real-time information about accommodations, transportation, restaurants, and tourist attractions, making it easier for tourists to access essential services. They also utilize tourist data to offer personalized suggestions and enhance the experience through augmented and virtual reality technologies. By leveraging supporting technologies such as cloud computing, mobile communications, blockchain, big data, and AI, IoT improves the overall tourist experience, increases visitor numbers, and creates a competitive advantage for tourism destinations, ultimately leading to greater customer retention and improved satisfaction.

5) How does technology adoption affect customer satisfaction and loyalty to a brand?

In the IoT-driven hospitality and tourism sector, personalized customer experiences play a significant role in enhancing customer loyalty to a tourism brand. Customer loyalty refers to a customer's tendency to return to a hotel or tourist area as a result of previous positive experiences based on the quality of services provided, If the quality of services is exceptional, this increases customer satisfaction and loyalty, and the tourist experience remains a mental image in the tourist's memory for the long term, and vice versa.

IoT applications, such as AI-powered recommendations and instant feedback systems, contribute to unique and seamless experiences for tourists and encourage repeat visits. Loyalty programs powered

by customer data generated through the IoT enable personalized rewards, strengthening guest relationships and increasing overall satisfaction with the tourism experience and brand loyalty.

6)What are the factors that influence customers' adoption and use of new technologies in the hospitality and tourism sectors?

One of the key factors influencing customers' adoption and use of new technologies in the hospitality and tourism sectors includes perceived ease of use, which refers to how easy individuals believe using the IoT system is, with minimal effort required for comfort, trust, and satisfaction. Another important factor is technical compatibility, which measures how well the technology aligns with the customers' needs and expectations. Organizational readiness is also crucial, as it refers to the ability of tourism organizations to manage resources effectively, adjust work methods, allocate financial resources, and collaborate with other entities to adopt modern technologies.

Operational efficiency is a significant factor, as it involves optimizing resource utilization, reducing costs, and enhancing service delivery through IoT automation. Environmental impacts refer to the conditions within which the tourism organization operates and how it influences technology use. Perceived benefits are also important, as they reflect how users view the advantages of a system in improving their tasks and performance. Lastly, customer intent to use the Internet of Things is a factor that assesses an individual's willingness or planned behavior to adopt a specific technology.

These factors collectively influence the decision to adopt IoT in hospitality and tourism, driving improvements in efficiency, satisfaction, and overall performance.

The foreign results align with the previous study in highlighting key factors such as perceived ease of use, technical compatibility, and organizational readiness as crucial for adopting IoT technologies in the tourism and hospitality sectors, enhancing customer satisfaction and trust (Dianawati et al., 2024; Ahmed et al., 2022). Both emphasize operational efficiency through optimized resource use and automation as vital for improved performance (Gajić et al., 2024). Additionally, the findings stress the environmental dimension and the role of technology in supporting sustainable practices, reflecting a shift towards smart and sustainable tourism (Silber, 2025). The foreign study further highlights customer intent to use IoT, which aligns with the previous study's focus on cognitive and affective readiness influencing satisfaction and loyalty (Dianawati et al., 2024). Overall, the combined evidence supports IoT's role in advancing efficiency, customer satisfaction, and sustainability in the tourism industry.

7) What are the challenges facing the implementation of the Internet of Things in hotels and tourism organizations?

The implementation of the Internet of Things (IoT) in hotels and tourism organizations in Egypt faces several significant challenges. One major issue is the increased risk of cybercrime and hacking. The theft of confidential data from tourism organizations via the internet can lead to substantial financial losses, a decline in customer trust, and damage to the organization's reputation. This may also result in reduced website traffic, which negatively affects income and credibility. Therefore, securing, protecting, and managing customer data is essential.

Another challenge is the reduction of job opportunities due to advances in IoT technology within the hospitality and tourism sectors. As many services and products are marketed and sold online, there is a shift in labor demands, requiring the reassignment of surplus workers to other areas. Additionally, the high cost of IoT technologies poses a major barrier, especially for small and medium-sized tourism enterprises, which require sufficient financial resources to implement IoT effectively.

Moreover, there is a lack of experience among workers in the hospitality and tourism sectors in dealing with IoT technologies. This necessitates continuous training to keep up with technological updates. The rapid growth of IoT also presents a challenge, as it limits a proper understanding of its

scope and benefits. Consumers need to be educated about these changes to fully enjoy the advantages of IoT.

Finally, intermediaries connecting customers to different companies may cause website homogeneity and similarity, which can reduce profits since these intermediaries must be compensated for their services. Addressing these challenges is crucial for the successful adoption and integration of IoT in Egypt's tourism and hospitality sectors.

These findings align with Ahmed et al. (2022), who highlight security, cost, and infrastructure as major obstacles affecting customer satisfaction in Egyptian hospitality. Additionally, Gajić et al. (2024) emphasize the importance of data security and the economic impact of IoT integration in hotel management, while Vo Phu (2024) underscores the need for technical staff training to address rapid IoT development and complexity. Moreover, Dianawati et al. (2024) confirm that successful IoT adoption depends on user competency and readiness, which directly influences guest satisfaction and loyalty. Finally, the challenge of intermediaries reducing profits due to website similarity resonates with concerns about operational and economic inefficiencies noted in the literature. Thus, the critical issues identified in this study reflect a global consensus on the complexities of IoT adoption in hospitality, stressing cybersecurity, cost management, workforce adaptation, and consumer education as keys to success.

Conclusions:

This scientific theory-driven questionnaire ensures accurate measurement of IoT's role in hospitality and tourism. The following are the most important conclusions reached:

- The use of IoT applications improves services provided to tourists, such as booking airline tickets and hotel rooms, saving time, effort, and costs, enhancing the tourist's personal comfort and well-being.
- IoT adoption improves operational efficiency by automating processes such as check-in and check-out, room service, and energy management via smart phone.
- The IoT provides an integrated, personalized hotel and tourisms experience for tourists that meets their personal expectations, increases overall satisfaction with services provided, and makes them more loyal to the tourism brand
- Expanding the use of the IoT in tourism and hotel organizations works to transform the tourist's behavioral intention into an actual reality to repeat the visit to the host country again when planning future travel to tourist destinations.
- The use of the IoT in large tourism and hotel establishments gives them competitive advantages that attract tourists. These smart technologies also reduce operational costs in these establishments through automatic energy-saving systems, chatbots customer service support, and more.
- Challenges of adopting the IoT in the tourism and hotel sectors include (data security concerns, high costs, employee training requirements, reduced job opportunities, and sudden technical failures in IoT technology systems).
- Statistical evidence shows a strong and high positive relationship between the use of IoT and (operational efficiency, tourism customer experience, customer satisfaction and brand loyalty) in the tourism and hospitality sectors, These results reflect that the greater the use of IoT technologies in the tourism and hospitality sectors, the more it will improve operational efficiency, make the tourism customer experience unique and distinctive, and also increase tourist satisfaction and brand loyalty.
- Statistical evidence shows that the IoT has a significant impact on improving operational efficiency by (70.90%), supporting the tourism customer experience by (81.40%), and increasing customer satisfaction and loyalty to the brand by (86.10%).

Recommendations:

Based on the results reached, the study recommends the following:

- Hotels and tourism establishments invest in IoT infrastructure to enhance operational efficiency.

- Training programs be implemented for tourism and hospitality sector workers to enhance their skills in dealing with ongoing developments of IoT and ensure smooth implementation.
- Policies be adopted to address data privacy concerns through secure networks and compliance procedures.
- Efforts focus on developing personalized services by integrating artificial intelligence and IoT technologies into the tourism and hospitality sectors.
- Regular updates and maintenance of IoT devices ensure their reliability.
- Hotel and tourism facility managers and policymakers aiming to achieve a competitive advantage and provide high-quality services leverage modern advanced technologies, especially IoT.

References

Ahmed, M., Abdou, M. Y. K., & Elnagar, A. M. (2022). The Impact of Implementing the Internet of Things (IoT) on Customer Satisfaction: Evidence from Egypt. *Journal of Arabian Architecture and Urbanism and Tourism*, 22(2), 365–380.

Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of things: A survey on enabling technologies, protocols, and applications. *IEEE communications surveys & tutorials*, *17*(4), 2347-2376.

Ali, F., Nisar, T. M., & Lee, D. (2023). The impact of IoT on hotel operational efficiency: A case study approach. *Journal of Hospitality and Tourism Technology*, 14(2), 150-169.

Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. *Computer Networks*, 54(15), 2787-2805.

Bharwani, S., & Jauhari, V. (2013). An exploratory study of competencies required to co-create memorable customer experiences in the hospitality industry. *International Journal of Contemporary Hospitality Management*, 25(3), 275-292.

Buhalis, D., & Leung, D. (2022). Smart hospitality: IoT and AI applications in the hotel industry. *Journal of Hospitality & Tourism Technology*, 13(2), 145-160.

Buhalis, D., & Leung, R. (2018). Smart hospitality – Interconnectivity and interoperability towards an ecosystem. *International Journal of Hospitality Management*, 71, 41-50.

Buhalis, D., & Leung, R. (2022). Smart hospitality: The impact of IoT on customer experience and loyalty. *International Journal of Contemporary Hospitality Management*, 34(4), 789-812.

Bujari, A., Zaccagnini, F., & Girolami, M. (2021). IoT applications in the hotel industry: Enhancing operational efficiency. *Tourism Management Perspectives*, 40, 100878.

Cabrera, D. and Cabrera, L. (2018). *Systems thinking made simple: New hope for solving Wicked problems*. New York: Plectica Publishing.

Car, T., Pilepić Stifanich, L., & Šimunić, M. (2019). Internet of Things (IoT) in Tourism and Hospitality: Opportunities and Challenges. *Tourism in Southern and Eastern Europe*, 5, 163–175.

Chourasia, B. (2025). The Future of Smart Hotels and Digital Transformation in the Hospitality Industry. In *Transforming the Service Sector With New Technology* (pp. 533-540). IGI Global Scientific Publishing.

Dianawati, N., Saepudin, P., Misran, M., Sinaga, E. K., Putra, F. K. K., & Susanto, E. (2024). The impact of smart hotel technology on guest satisfaction and loyalty: A user competency perspective. *African Journal of Hospitality, Tourism and Leisure, 13*(1), 213-220.

Dianawati, N., Saepudin, P., Misran, M., Sinaga, E. K., Putra, F. K. K., & Susanto, E. (2024). The impact of smart hotel technology on guest satisfaction and loyalty: A user competency perspective. *African Journal of Hospitality, Tourism and Leisure*, 13(1), 213-220.

Dianawati, N., Saepudin, P., Misran, M., Sinaga, E. K., Putra, F. K. K., & Susanto, E. (2024). The impact of smart hotel technology on guest satisfaction and loyalty: A user competency perspective. *African Journal of Hospitality, Tourism and Leisure, 13*(1), 213–220.

Fatima, M., Hassan, F., & Huraira, A. (2021). Impact of trust, satisfaction and service quality on customer loyalty: A study of pakistan's hotel sector. *Journal for Business Education and Management*, *1*(1), 29–57.

Gajić, T., Petrović, M. D., Milanović Pešić, A., Conić, M., & Gligorijević, N. (2024). Innovative Approaches in Hotel Management: Integrating Artificial Intelligence (AI) and the Internet of Things (IoT) to Enhance Operational Efficiency and Sustainability. *Sustainability*, 16(7279).

Gretzel, U., Sigala, M., & Xiang, Z. (2021). Smart tourism and IoT: Transforming hospitality services. *Annals of Tourism Research*, 89, 103227.

Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2015). Smart tourism: Foundations and developments. *Electronic Markets*, 25(3), 179-188.

Gursoy, D., Chi, C. G., & Lu, L. (2021). Enhancing customer experience with IoT-based smart hotel services. *Tourism Management*, 84, 104239.

Hu, M. (2025). Internet of Things and big data in the hospitality industry: current state and future prospects. *Handbook on Big Data Marketing and Management in Tourism and Hospitality*, 194-212.

Ivanov, S., Webster, C., & Berezina, K. (2022). The role of IoT in the digital transformation of hotels. *Tourism Economics*, 28(5), 1203-1220.

Jadhav, B., Kulkarni, D., & Chaudhari, C. (2023). *Introduction to GST: Concepts, theory and practical problems*. Notion Press, India.

Kim, W. G., Lee, C., & Fairhurst, A. (2017). The impact of hotel service quality on guest loyalty: The mediating role of satisfaction. *Service Industries Journal*, 27(8), 1115–1129.

Kim, Y., Park, Y., & Choi, J. (2017). A study on the adoption of IoT smart home service: Using Value-based Adoption Model. *Total Quality Management & Business Excellence*. 28(9),1-17

Koo, C., Shin, S., Kim, K., & Chung, N. (2017). Internet of Things (IoT) technology advancements in hospitality industry. *Journal of Hospitality and Tourism Technology*, 8(2), 212-228.

Law, R., Buhalis, D., & Cobanoglu, C. (2014). Progress on information and communication technologies in hospitality and tourism. *International Journal of Contemporary Hospitality Management*, 26(5), 727-750.

Law, R., Buhalis, D., & Cobanoglu, C. (2021). Guest experiences enhancement through IoT: A systematic review. *Journal of Hospitality and Tourism Management*, 47, 128-140.

Lee, C., Phaal, R., & Lee, S. H. (2013). An integrated service-device-technology roadmap for smart hotel services. *Journal of Hospitality and Tourism Technology*, 4(2), 104-123.

Liu, Y., Henseler, J., & Liu, Y. (2022). What makes tourists adopt smart hospitality? An inquiry beyond the technology acceptance model. *Digital Business*, 2 (2)., 1-10.

Morosan, C., & DeFranco, A. (2016). Co-creating value in hotels using mobile devices: A conceptual model with empirical validation. *International Journal of Hospitality Management*, 52, 131-142.

Rajgor, H., Rakshit, P., & Sain, M. (2023). Impact of GST on the hospitality sector in Navi Mumbai. *International Journal of Advances in Engineering and Management (IJAEM)*, 516-524.

Sigala, M. (2022). Digital transformation in hospitality: The impact of IoT and artificial intelligence. *Journal of Service Management*, 33(3), 367-386.

Silber, H. (2025). New Business Models in Tourism – An Industry in Transformation. *Master's Thesis*, Johannes Kepler University Linz.

Skyttner, L. (2005). *General Systems Theory: Problems, Perspectives, Practice* (2nd ed.). World Scientific Publishing.

Tian, F. (2017). A supply chain traceability system for food safety based on HACCP, blockchain & internet of things. *Future Generation Computer Systems*, 76, 463-476.

Torres, E., Singh, D., & Robertson-Rose, M. (2019). IoT-driven customer experience: A framework for enhancing hospitality services. *Tourism Review*, 74(1), 36-50.

Tussyadiah, I. (2020). A review of research into automation in tourism: Launching the Annals of Tourism Research Curated Collection on Artificial Intelligence and Robotics in Tourism. *Annals of Tourism Research*, 81, 102883.

Tussyadiah, I. P. (2020). How IoT reshapes customer experiences in hospitality. *International Journal of Hospitality Management*, 91, 102630.

Tussyadiah, I., & Miller, G. (2022). Personalization and automation in smart hotels: The role of IoT. *International Journal of Hospitality Management*, 102, 103165.

Vo Phu, V. (2024). Internet of Things (IoT) in the hospitality industry: How does IoT benefit hotels? *SSRG International Journal of Electrical and Electronics Engineering*, 11(10), 1-9.

Wang, Y., Park, S., & Lee, H. (2023). Mobile IoT solutions for hotel guest services: A user-centered approach. *Computers in Human Behavior*, 139, 107531