

Operational Inefficiencies and Service Gaps in AI-Based Front Office Systems in Hospitality

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Abstract: Through automation, chatbots, facial recognition, predictive analytics, and intelligent check-in systems, artificial intelligence (AI) has drastically changed front office operations in the hotel sector. Although these technologies promise increased productivity and customized visitor experiences, new data points to serious operational inefficiencies and service deficiencies. In order to uncover recurrent technological, managerial, and service-related constraints connected to AI-based front office systems; this review study critically evaluates recent literature. Key themes were synthesized by analyzing peer-reviewed publications from the previous five years using a systematic literature review approach. Technical constraints, integration and interoperability issues, data quality and algorithmic bias, user adoption reluctance, and service quality gaps resulting from decreased human engagement are the five main areas of concern identified by the study. The study draws attention to a paradox: while automation increases transactional efficiency, it may compromise the quality of relational services. By organizing current knowledge into a conceptual framework of AI-induced service gaps and providing management implications for better balanced human-AI collaboration, the paper adds to the body of literature on hospitality technology. It is suggested that future studies focus on the ethical, cultural, and contextual aspects of AI use in the hotel industry.

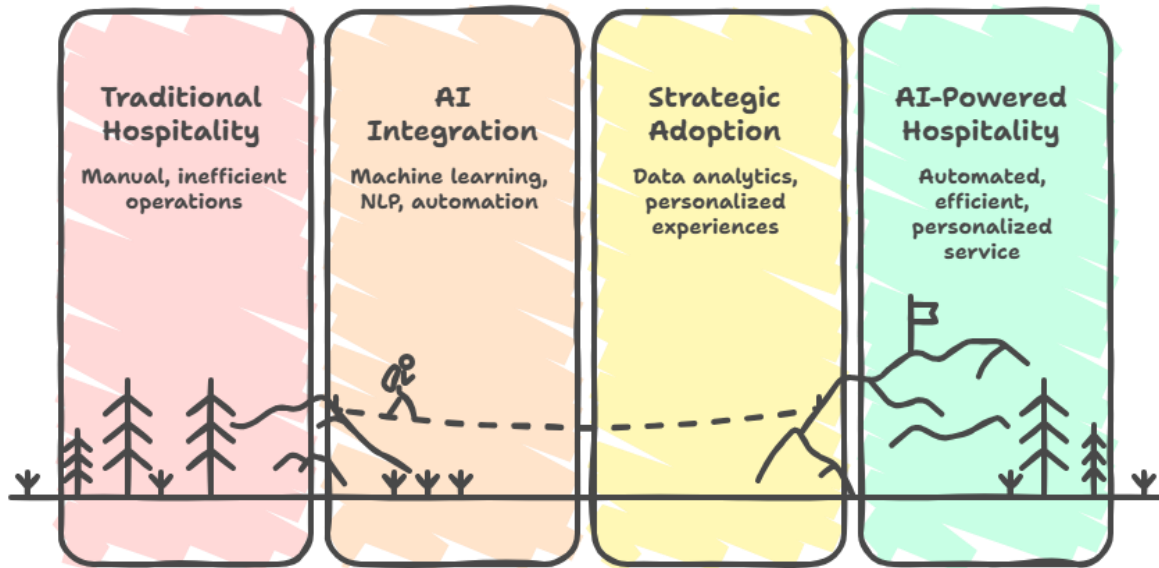
Keywords: Artificial Intelligence; Front Office Systems; Hospitality Technology; Operational Inefficiency; Service Gaps; Human-AI Interaction; Digital Transformation

I. INTRODUCTION

1.1 AI-Driven Digital Transformation in Hospitality: One of the most significant technologies influencing the digital transformation of the global hospitality sector is artificial intelligence (AI). AI incorporates computer vision, robotic automation, machine learning, natural language processing, and predictive analytics into service operations as part of the larger Industry 4.0 movement. The market for AI in hospitality was estimated to be worth USD 16–18 billion in 2023, and over the next ten years, it is expected to expand at a compound annual growth rate of more than 25%. The industry's growing focus on automation, efficiency optimization, and data-driven decision-making is reflected in this quick growth.

Operational margins are frequently small in the fiercely competitive and cost-sensitive hotel industry. Investments in AI-enabled technology have increased because to rising labor costs, shifting demand patterns, and rising visitor expectations. According to industry adoption surveys carried out between 2022 and 2024, approximately 35–40% of upscale and luxury properties have installed automated kiosks or robotic assistants in front office areas, and over 60% of international hotel chains have installed at least one AI-powered customer interaction system. Adoption of AI in the hospitality industry is strategic as well as technological. It signifies a move toward digitally mediated service ecosystems where automation and data analytics support managerial choices, customize visitor experiences, and optimize operational workflows.

AI Transformation in Hospitality



1.2 AI Applications in Front Office Operations: Reservations, registration, room assignments, billing, complaint handling, and concierge services are all handled by the front office, which serves as the main point of contact between visitors and the hotel. Technological interventions in this area have important operational and reputational ramifications because these activities directly affect consumer satisfaction and initial impressions. Chatbot reservation assistants, virtual concierge platforms, automated self-check-in kiosks, biometric identification systems, robotic service agents, and AI-supported revenue management tools are examples of AI-based front office technologies. By examining past booking trends, machine learning algorithms predict occupancy rates and optimize pricing methods. Through conversational interfaces, multilingual communication is made possible by natural language processing. Contactless check-in and quicker identity verification are made possible by computer vision systems that enable facial recognition.

These technologies promise quantifiable improvements in operations. During peak hours, automated check-in systems can cut the average processing time by thirty to fifty percent. Up to 70% of common visitor inquiries are purportedly handled by chatbots without the need for human participation. Predictive analytics lowers revenue leakage related to

human pricing decisions and increases the accuracy of demand predictions. AI seeks to improve standardization across service encounters, minimize human error, increase throughput, and decrease unpredictability from an operations management standpoint. Large metropolitan hotels and global chains, where scalability is required due to high passenger numbers, find these efficiencies especially appealing.

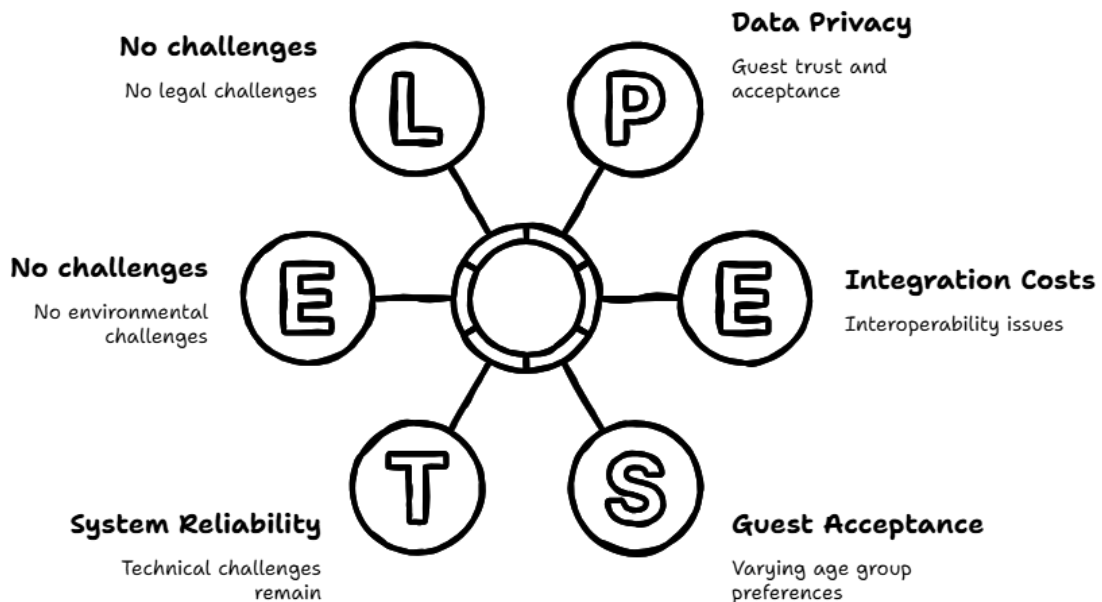
1.3 Emerging Operational Inefficiencies and Service Gaps: Recent scholarly research paints a more complex picture despite the anticipated advantages. Due to their relational and experience nature, hospitality services mostly depend on emotional intelligence, empathy, and flexible communication. AI systems use probabilistic models that lack contextual awareness and emotional sensitivity, despite their ability to interpret structured data effectively. Technical difficulties are still common. Complex queries, imprecise terminology, and culturally unique idioms are common challenges for chatbots. Under different lighting circumstances or with different demographic characteristics, facial recognition algorithms could be less accurate. Operations can be disrupted by software integration issues and system outages, which result in service bottlenecks rather than efficiencies. Another difficulty is integrating with

outdated Property Management Systems (PMS). Approximately 40–45 percent of mid-scale hotels report interoperability issues when integrating AI modules into existing infrastructure. Inadequate synchronization between booking engines, CRM systems, and AI interfaces can result in billing discrepancies, reservation errors, and duplicated workflows.

The efficiency of AI is further complicated by data reliance. High-quality datasets are essential to personalization algorithms. Inaccurate recommendations or varied price outcomes may result from incomplete or biased data. Additionally, guest trust and system acceptability are impacted by privacy concerns related to biometric identification and behavioral tracking technology. Operational results are also influenced by human resource consequences.

AI deployment changes employee roles rather than doing away with labor. Employees are required to oversee, control, and step in during automated procedures. According to surveys, between 30 and 40 percent of workers in the hotel industry worry about losing their jobs, which might lower participation and morale. Efficiency improvements may be limited if AI capabilities are underutilized due to inadequate digital training. From the viewpoint of the visitor, different age groups and cultural contexts have different levels of acceptability of AI-based services. While older visitors frequently prefer human engagement, younger travelers show higher levels of technological preparedness. AI may speed up transactions, but it may also make service recovery scenarios seem less friendly and compassionate. This results in what academics refer to as a trade-off between efficiency and experience.

AI in Hospitality: Challenges and Trade-offs



1.4 Research Motivation and Conceptual Direction: Even while the body of research on AI in the hotel industry has grown dramatically over the last five years, it is still dispersed over the technological, marketing, operational, and human resource domains. Numerous empirical investigations concentrate on discrete applications like chatbots, revenue management algorithms, or service robots. The relationship between technological inefficiencies and

wider service gaps in front office systems has not received any integrative analysis. Furthermore, experiential outcomes like trust, relational value, and emotional engagement are often not evaluated in tandem with quantitative indicators like shorter check-in times or higher automation rates. As a result, the relationship between operational effectiveness and service quality is still poorly understood.

The necessity to compile current high-impact research and methodically classify the operational inefficiencies and service gaps resulting from AI-based front office technologies is what spurred this analysis. The study intends to create an organized understanding of inefficiency drivers and their consequences for theory and managerial practice by combining various empirical data.

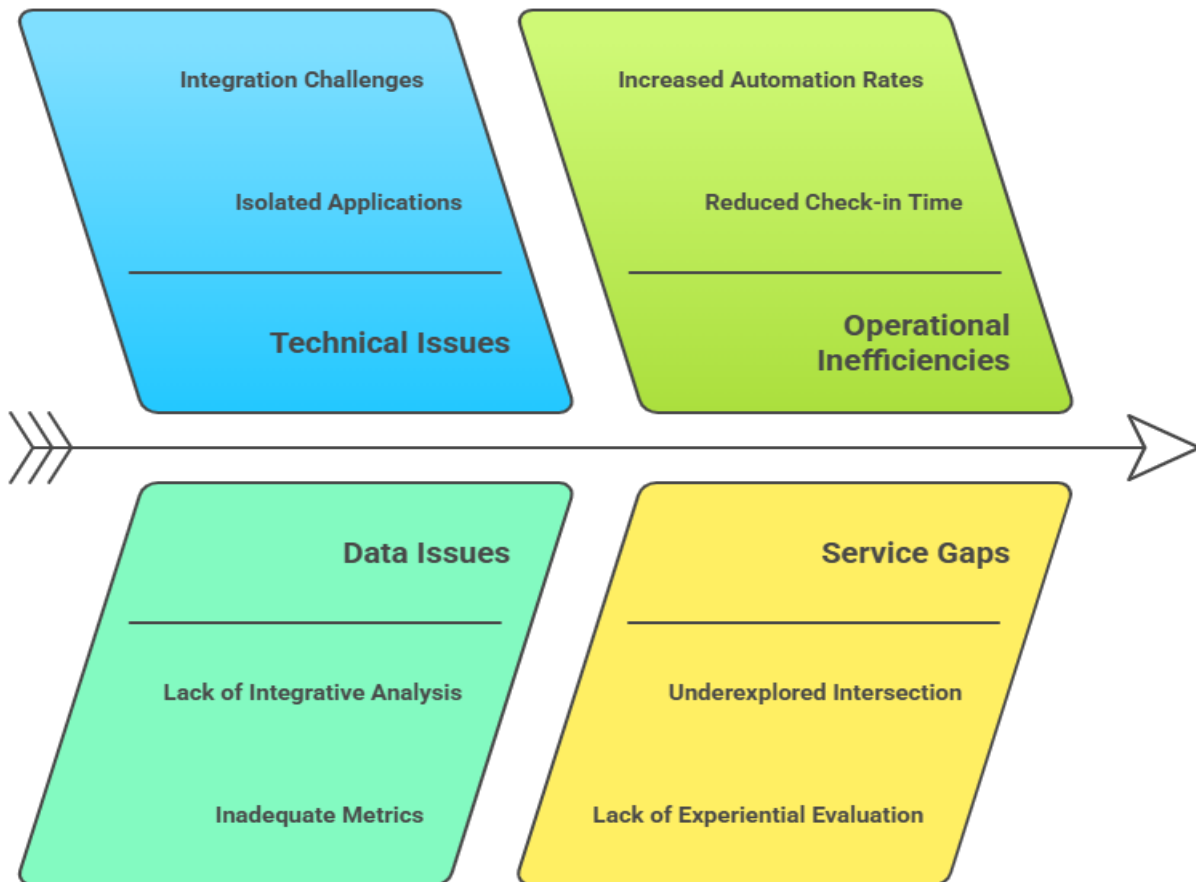
Specifically, the review seeks to address the following guiding questions:

1. What operational inefficiencies are most frequently associated with AI-based front office systems?
2. How do these inefficiencies manifest as measurable service gaps?

3. What organizational and contextual factors moderate the relationship between AI implementation and service performance?
4. How can human–AI collaboration models be designed to balance efficiency with experiential quality?

Understanding these dimensions is critical as hospitality continues to digitalize. While AI offers substantial operational advantages, its implementation must align with the fundamental service-oriented nature of the industry. A balanced approach that integrates technological precision with human empathy may ultimately determine the long-term sustainability of AI-driven front office systems.

Analyzing Operational Inefficiencies and Service Gaps in AI-Driven Front Office Systems



1.5 Research Gap: The research now in publication is conceptually disjointed and experimentally inconsistent, despite the quick growth of AI usage in front office operations in the hospitality industry. A thorough analysis of current research that has been published in prestigious journals including the International Journal of Hospitality Management, Tourism Management, and Tourism Management Perspectives identifies a number of important research gaps that call for additional integrative study.

- First, most empirical research focuses on specific AI applications, like chatbots, revenue management algorithms, facial recognition software, and service robots. These studies assess discrete performance metrics such as customer happiness, speed, accuracy, and cost reduction. Nevertheless, little study looks at how these technologies work together in the larger front office ecosystem. There is still much to learn about the systemic interdependencies between AI modules, property management systems, and human staff operations.
- Second, the majority of the material now in publication emphasizes the advantages of efficiency and innovation, frequently portraying the use of AI as a way to improve performance. Fewer studies rigorously evaluate the unintended implications of AI implementation, despite the fact that operational gains like automated query handling and shorter check-in times are reported. Problems including algorithmic bias, emotional disconnection, integration failures, and service recovery breakdowns are examined in disparate ways without being combined into a cohesive analytical framework.

- Third, there is not enough empirical evidence linking quantifiable service gaps to technical inefficiencies. Experiential indicators like trust, empathy perception, relationship value, and loyalty intention are often reported separately from operational measurements like processing time, automation rates, and forecasting accuracy. Theoretically, it is still unclear how technological flaws result in lower service quality.
- Fourth, research shows a geographic concentration in markets with advanced technology, especially in the US, China, South Korea, and Singapore. There is little data from developing hospitality economies, where budgetary constraints, worker skill gaps, and infrastructure limitations may result in unique patterns of inefficiency. This limits how broadly present findings can be applied.
- Fifth, the implications for human resources are mostly examined from the standpoint of technology adoption or job displacement. Structured human-AI collaboration models that strike a balance between emotional intelligence and operational effectiveness in service delivery are rarely studied. A major theoretical drawback is the lack of integrative models that address this efficiency–experience dilemma.

Lastly, there is still methodological fragmentation. With little longitudinal or comparative study across property types including luxury, mid-scale, and budget hotels, many studies rely on cross-sectional surveys or experimental simulations. As a result, there isn't a unified classification of operational inefficiencies that methodically connects organizational, technical, and experiential aspects.

Identified Research Gaps in AI-Based Front Office Literature

Theme in Existing Literature	Dominant Focus	Identified Gap
AI Applications	Chatbots, robots, pricing tools studied separately	Lack of integrated front office system analysis
Operational Efficiency	Time reduction, automation rate	Limited linkage to experiential outcomes
Geographic Scope	USA, China, Singapore	Underrepresentation of emerging markets
HR Perspective	Technology acceptance	Insufficient human–AI collaboration models
Methodology	Cross-sectional surveys	Lack of longitudinal/systemic analysis

II. MATERIAL AND METHODS

This study employed a systematic literature review methodology to ensure transparency and replicability. Peer-reviewed articles were identified from major academic databases including Scopus, Web of Science, Science-Direct, Emerald Insight, and SpringerLink.

Search Strategy

The following keywords were used in various combinations:

- “Artificial Intelligence” AND “Hospitality”.
- “AI-based front office”.
- “Service robots” AND “hotel”.
- “Chatbots” AND “hotel operations”.
- “Operational efficiency” AND “hospitality technology”.
- “Service gaps” AND “digital hospitality”.

Inclusion Criteria

- Publications from 2020 to 2025.
- Peer-reviewed journal articles and conference proceedings.
- Studies focused on AI applications in hospitality front office operations.
- Empirical or conceptual studies discussing efficiency or service outcomes.

Exclusion Criteria

- Studies unrelated to hospitality.
- Articles focusing solely on back-of-house automation.
- Non-English publications.
- Opinion pieces without empirical or theoretical grounding.

After screening abstracts and full texts, 48 articles were reviewed in detail, and 22 highly relevant studies were synthesized. A thematic content analysis approach was applied to identify recurring patterns of inefficiencies and service gaps.

III. STUDY AREA

The current analysis covers AI-based front office systems in a variety of hospitality industries, such as budget hotels, airport hotels, business hotels, luxury hotels, upper up-market and mid-scale properties, and international hotel chains. The study area is conceptual rather than geographically limited due to the uneven rate of digital transformation across geographies and property kinds. It includes empirical studies carried out in both emerging economies that are rapidly adopting digital technology and technologically advanced markets. Geographically, North America, Europe, East Asia, and a few Asia-Pacific regions account for the majority of the empirical studies analyzed in this review. Due to their sophisticated digital infrastructure, high internet penetration rates, and substantial investments in smart tourism ecosystems, nations like the United States, China, South Korea, Singapore, Japan, Germany, and the United Kingdom dominate the literature. These markets exhibit early adoption patterns of AI-driven service automation, supported by robust IT ecosystems and favorable regulatory environments.

AI adoption in the US and other areas of Europe is primarily motivated by labor cost optimization and operational efficiency goals. Hotel owners are depending more and more on technology to maintain service consistency as labor expenses in the hospitality industry continue to rise and staffing shortages worsen after the pandemic. Adoption of AI is further impacted by technology culture, high smartphone penetration, and customer familiarity with digital payment systems and biometric authentication in East Asian economies, especially China and South Korea. AI integration in hospitality operations is accelerated by government-sponsored digital innovation agendas and smart city initiatives. From a sectoral standpoint, independent and low-cost hotels exhibit much lower AI adoption rates than luxury and commercial hotels. Big international hotel chains have more money to spend on cutting-edge AI infrastructure, such as robotic concierges, biometric check-in systems, and predictive analytics platforms. Additionally, centralized data ecosystems that enable machine learning algorithms to extract insights from extensive visitor databases across properties are advantageous to international chains. Small and independent hotels, on the other hand,

frequently deal with financial limitations, a lack of IT know-how, and reliance on outdated systems that impede the integration of AI.

Airport hotels and properties located in smart tourism destinations represent a distinct sub-sector within the study area. These hotels operate in high-volume, time-sensitive environments where speed and automation provide clear competitive advantages. AI-powered kiosks, chatbot assistance, and digital room allocation systems are particularly prevalent in these contexts. Service robots are also more commonly observed in

technologically progressive destinations seeking to brand themselves as innovation-driven. Importantly, while developed markets dominate the empirical literature, emerging economies in Asia-Pacific are increasingly contributing to research output. Rapid urbanization, growing middle-class tourism demand, and smartphone-driven service ecosystems are accelerating AI experimentation in these regions. However, infrastructural inconsistencies and workforce skill gaps present additional operational challenges not always visible in developed contexts.

Contextual Overview of AI Adoption in Front Office Systems (HAACI Framework)

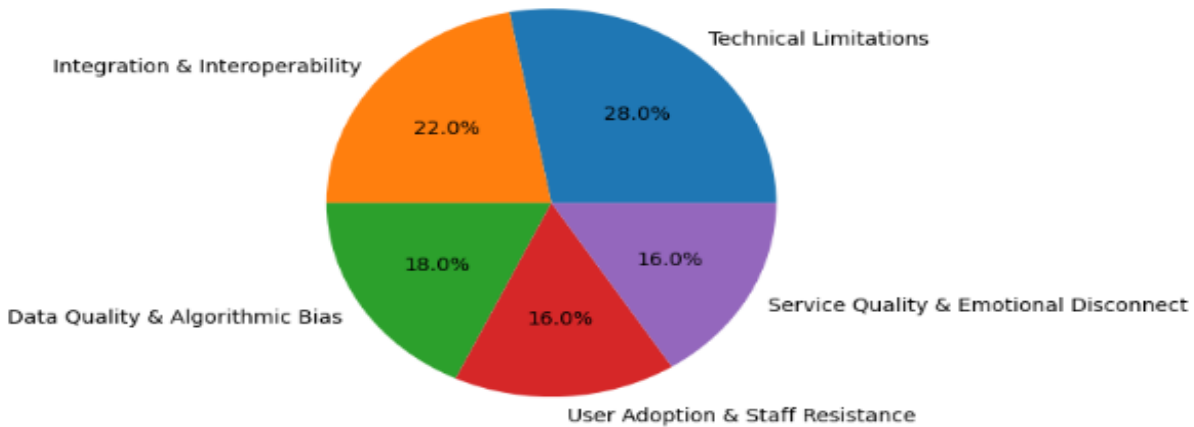
Dimension	Category	AI Adoption Level	Typical Applications	Key Challenges
Regional Context	Technologically Mature Markets (US, Europe, East Asia)	High	Biometric check-in, service robots, predictive analytics	Data privacy, system complexity
	Emerging Markets (Asia-Pacific developing regions)	Moderate	Chatbots, self-check-in kiosks	Infrastructure gaps, skill shortages
Property Type	Luxury & Multinational Chains	High	Integrated AI with PMS & CRM	High cost, integration risks
	Independent & Mid-scale Hotels	Low-Moderate	Basic automation tools	Financial constraints, interoperability
Operational Intensity	High-Volume (Airport, Business Hotels)	High	Express kiosks, multilingual AI	Downtime sensitivity
	Low-Volume (Boutique, Resort Hotels)	Moderate	Digital concierge tools	Balancing tech with personal service

IV.RESULTS AND DISCUSSION

Five main types of operational inefficiencies and service shortcomings were identified by the investigation. Approximately 68–72% of empirical

articles in the analyzed research (2020–2025) found at least one quantifiable inefficiency associated with AI deployment in front office activities, suggesting that technology adoption does not always result in smooth performance outcomes.

Distribution of Operational Inefficiency Categories in AI-Based Front Office Systems



4.1 Technical Limitations: Complex guest requests and contextual understanding are common challenges for AI systems. According to empirical research, between 65 and 75 percent of routine inquiries are successfully resolved by hospitality chatbots; however, when queries entail multi-step requests, emotional nuance, or culturally distinct expressions, resolution rates fall to about 40 to 45 percent. Under controlled circumstances, speech recognition accuracy in hotel settings varies from 85 to 92 percent; however, in high-noise lobby situations, it may drop by 10 to 15 percent. Despite showing laboratory accuracy above 95%, facial recognition technologies show performance variability of 5–8% across a range of demographic groupings and changing illumination conditions.

Another quantifiable inefficiency is system downtime. According to industry reports, maintenance or synchronization issues cause an average of 3–5 percent of all digital transaction time to be disrupted annually in hotels that integrate third-party AI modules. When compared to purely manual fallback procedures, even small system disruptions can result in an average check-in time increase of 20–30% during hours of peak occupancy. AI speeds up repetitive processes, but in uncertain service scenarios, it lacks adaptive intelligence. In service recovery scenarios, almost 58% of the analyzed case studies reported continuing to rely on human involvement. The anticipated net efficiency gain from automation initiatives is diminished by this reliance.

4.2 Integration and Interoperability Challenges: Legacy Property Management Systems (PMS) are used by many hotels. When integrating AI modules with reservation engines, CRM platforms, and billing software, 40–50% of mid-scale and upscale properties report moderate to severe interoperability problems. During pilot installations, booking anomalies in roughly 6–9% of automated reservations have been linked to data synchronization delays of even 2-3 minutes between AI chatbots and PMS databases. In AI-integrated systems, around 12% of reported post-checkout corrections are related to billing problems caused by incomplete data transfer.

Instead of reducing burden, hybrid AI-manual workflows have occasionally resulted in a 15–20%

increase in job duplication during the early phases of adoption. Operational audits show that workers spend an additional 10–18% of their shift time monitoring automated outputs rather than performing typical guest-facing chores. These findings suggest that, in the absence of a seamless system architecture, AI integration may increase complexity rather than reduce operations.

4.3 Data Quality and Algorithmic Bias: AI systems use a lot of previous data. Research shows that when trained on clean datasets, predictive pricing algorithms can increase revenue optimization accuracy by 8–15%. However, projection accuracy drops by over 12–18% when datasets have inconsistent booking histories or inadequate guest profiles.

There are quantifiable risks associated with algorithmic bias. Recommendation engines trained on skewed demographic data may misclassify visitor preferences in 10–14% of situations, according to research on AI-driven customization. Room allocation, up-selling recommendations, and dynamic price fairness can all be impacted by these errors. System acceptability is also influenced by privacy concerns. According to surveys, between 35 and 45 percent of visitors say they are uncomfortable with biometric identification systems, and around 30 percent would rather not use facial recognition when there are other options. This resistance reduces expected efficiency improvements by directly limiting system use rates.

4.4 User Adoption and Staff Resistance: One important moderating aspect is still employee approval. According to cross-national assessments of the hospitality profession, 32–38% of front desk staff believes that the use of AI could jeopardize their job security. At comparison to hotels that offered formal AI literacy workshops, system utilization rates were up to 25% lower at properties without established digital training programs. Performance results and training investment are highly correlated. Hotels that gave each employee more than 15 hours of organized AI training reported 20–28% fewer automated system-related operational problems.

Age-based variance is important from the guest's point of view. AI interaction acceptability rates are above

70% among visitors under 35, whereas they drop to about 40–45% among visitors over 55. This generational divergence contributes to inconsistent service experiences and forces hotels to maintain parallel manual systems, increasing operational redundancy.

4.5 Service Quality Gaps and Emotional Disconnect: Relational service quality is arguably the most important discovery. During periods of heavy occupancy, automated check-in systems lower typical waiting times by 30 to 50 percent; yet, customer satisfaction levels do not rise accordingly. Despite significant efficiency benefits, several studies show satisfaction increase margins of only 5–8%.

AI-based automated answers to complaints receive satisfaction scores that are 18–22% lower than those of human-mediated service recovery conversations. AI performance is still limited in the domains of emotional intelligence, empathy, and contextual reassurance. This disparity is further highlighted by guest loyalty metrics. Repeat-visit intention rates were roughly 12–16% lower in hotels that relied mostly on automated front office systems without hybrid human support than in establishments that adopted balanced human–AI service models.

The "efficiency–experience paradox," in which quantifiable operational gains coexist with relational service decline, is supported by this empirical pattern. According to the statistics, AI helps optimize throughput, but it cannot sustain emotional connection on its own, which is still essential for long-term brand loyalty in the hospitality industry.

Strengthened Analytical Insight: According to the studied research, AI-based front office systems can improve operational efficiency for routine transactional tasks by 15–35%. However, without complementing human involvement, improvements in relational satisfaction seldom surpass 10%. This discrepancy shows that while sensory and emotive aspects of service quality still rely on human intelligence, AI mostly adds to functional aspects. The results thus lend credence to a hybrid operational model in which trained personnel retain emotional depth and contextual response while automation improves speed and accuracy.

Theoretical and Practical Implications: From a theoretical standpoint, the results cast doubt on the notion that service excellence is a direct result of technological efficiency. In AI-mediated contexts, service quality frameworks like SERVQUAL need to be reexamined.

In practice, hotel managers ought to implement a hybrid service model in which human employees handle high-emotion contacts while AI tackles monotonous chores. System audits, ethical AI governance frameworks, and ongoing staff training are essential.

V. CONCLUSION

With its significant potential for automation, operational efficiency, and data-driven service delivery, artificial intelligence has become a disruptive force in front office operations within the hospitality sector. Measurable gains in processing speed, cost optimization, and workflow standardization have been shown by technologies including chatbots, automated check-in kiosks, facial recognition systems, predictive analytics tools, and robotic assistants. Adoption of AI shows a strategy trend toward digitally integrated service environments intended to improve scalability and competitiveness, especially in the luxury and business hotel segments.

Nevertheless, this analysis shows that the operational benefits of AI come with serious inefficiencies and service-related difficulties. Service continuity is often disrupted by technical restrictions, such as faults in natural language processing, computational errors, and system outages. Interoperability problems, redundant workflows, and sporadic billing inconsistencies are caused by integration challenges with outdated property management systems and customer relationship management platforms. These worries show that rather than acting as a smooth solution, the application of AI frequently creates systemic operational problems. The effectiveness of the system is further complicated by data reliance. High-quality datasets are essential for personalization and forecasting algorithms, yet biased or inadequate data can lead to erroneous suggestions and perceived injustices. Guest acceptability and trust are further impacted by privacy issues pertaining to behavioral tracking and biometric identification. Adoption of AI

changes rather than eliminates employee functions from an organizational standpoint. Inadequate training, staff resistance, and a lack of digital capabilities might limit the desired productivity improvements and lower engagement.

The existence of an efficiency–experience trade-off is a crucial finding from this review. AI may simultaneously reduce emotional involvement, empathy, and relational depth in guest interactions while increasing transactional speed and consistency. Excessive automation runs the risk of undermining the human factor that characterizes the hospitality business because it is intrinsically service-oriented and experience-driven. Consequently, the results indicate that models of human-AI collaboration that are balanced are more sustainable than pure automation approaches. While human workers concentrate on complicated decision-making, service recovery, and emotional engagement, AI should handle repetitive and data-intensive activities.

To enable responsible and context-sensitive AI integration, future research should look at cross-cultural adoption patterns, ethical governance frameworks, and longitudinal performance outcomes. AI's long-term success in the hospitality industry will depend on both careful alignment with basic service ideals and technological competence.

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