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AI-Driven Smart Housekeeping and Service Allocation Systems: Enhancing Hotel Operations Through MIS Integration

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Abstract:

Housekeeping operations represent the backbone of hotel service delivery, shaping guest satisfaction and influencing nearly every dimension of operational efficiency. Yet despite their importance, many hotels worldwide rely on manual workflows that remain inefficient, inconsistent, and vulnerable to human error. The rapid digital transformation of the hospitality sector offers an unprecedented opportunity to modernize these operations through the integration of Management Information Systems (MIS) supported by Artificial Intelligence (AI). This paper proposes an expanded and systematically structured approach to intelligent housekeeping management, building on the methodological foundation introduced in Bristy's 2025 study *Smart Reservation and Service Management Systems: Leveraging MIS for Hotel Efficiency*. The present work examines how an AI-driven MIS model can automate task allocation, enhance scheduling precision, minimize service delays, and optimize resource deployment within hotel housekeeping departments. Using a mixed-methods research design that incorporates interviews, surveys, operational observations, and statistical performance analysis, this study demonstrates substantial improvements in room turnover speed, workload balance, communication accuracy, and guest satisfaction. The paper concludes with a discussion of future technological pathways, including IoT-enhanced sensing, robotics-assisted service workflows, and cross-system predictive intelligence that will define the next era of intelligent hotel operations.

Keywords — **Hotel Management, Reservation Systems, Service Management, Management Information Systems (MIS), Operational Efficiency, Customer Engagement, Smart Systems**

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I. INTRODUCTION

Hotel housekeeping plays a crucial role in shaping the guest experience and maintaining operational fluidity. It encompasses a wide range of activities, including room cleaning, linen management, service request fulfillment, amenity replenishment, and sanitation procedures. Timely room readiness and service quality directly affect customer satisfaction ratings, repeat business, and the hotel's competitive standing. As the hospitality sector evolves with rising guest expectations and increased focus on consistency and personalization, traditional housekeeping practices struggle to keep pace with operational demands. Many hotels continue to rely on supervisor intuition, paper-based tools, or incomplete digital systems to manage complex workflows, which often leads to delays, inefficient task allocation, and miscommunication among departments. Management Information Systems have historically improved hotel operations by creating centralized, real-time, and data-driven decision environments. Bristy's 2025 research effectively demonstrated how MIS can streamline hotel reservation and service workflows through integrated dashboards, automated communication channels, and cloud-based systems. Inspired by the structural and methodological strength of that research, the present study applies the same analytical rigor to a different but equally important domain: housekeeping and service allocation. The goal is to understand how MIS, when combined with artificial intelligence and predictive analytics, can transform traditional housekeeping into a modern, interconnected, responsive, and efficient operational system. By developing an MIS-based housekeeping optimization model and evaluating its practical implications, this paper attempts to bridge a critical knowledge gap in hospitality operations research.

A. Background and Motivation

Housekeeping typically represents one of the largest operational units within hotels, often accounting for the majority of labor hours and oversight requirements. Yet despite its scale, housekeeping processes remain fraught with inefficiencies. Rooms are often cleaned based on guesswork or rigid scheduling patterns rather than real-time occupancy, leading to delays in room readiness and uneven distribution of workload. Supervisors spend substantial time manually assigning tasks, tracking progress, and coordinating with other departments. Miscommunication between housekeeping and front office teams further exacerbates the problem, resulting in rooms showing conflicting status updates or staff waiting unnecessarily for assignments.

The increasing technological sophistication of the hospitality industry provides a compelling reason to adopt MIS-based solutions for these challenges. Artificial intelligence, predictive modeling, and real-time data analytics have already begun reshaping industries that rely on workforce coordination and workflow optimization. Hotels stand to benefit enormously from this technological evolution, particularly in housekeeping. AI can analyze occupancy patterns, guest preferences, estimated cleaning times, and staff performance metrics to predict housekeeping requirements with high accuracy. MIS platforms serve as the operational backbone that integrates these insights into daily workflows. This study seeks to demonstrate how this combination of MIS and AI can fundamentally reform the housekeeping ecosystem.

B. Problem Statement

Despite the availability of modern technologies, many hotels remain constrained by outdated housekeeping processes that lack scalability, adaptability, and real-time responsiveness. Hotels often face persistent delays in room turnover, inconsistent cleaning quality, and inefficient communication between departments such as housekeeping, front office, and maintenance. Staff scheduling is frequently conducted without the support of data-driven predictions, leading to imbalanced workloads, worker fatigue, and unnecessary overtime. The absence of automated task management systems creates uncertainty in service delivery and undermines supervisory oversight. These challenges collectively reduce guest satisfaction, limit operational efficiency, and increase operational costs. Therefore, a structured and technologically enhanced solution is necessary to overcome these systemic limitations.

C. Proposed Solution

This paper proposes a smart housekeeping management framework that integrates MIS with artificial intelligence, cloud connectivity, mobile task routing, and real-time operational monitoring. The system envisions a centralized MIS dashboard that synchronizes with the hotel's Property Management System (PMS), enabling the housekeeping team to receive live updates on check-outs, stay-over service requirements, special requests, and guest preferences. Artificial intelligence optimizes the assignment of tasks by analyzing staff performance data, proximity to rooms, workload distribution, and cleaning time predictions. The system further enables supervisors to monitor progress through real-time tracking and automatically identifies operational bottlenecks. This proposed model extends the MIS methodology used by Bristy (2025) by shifting the focus from reservation workflows to operational housekeeping automation.

D. Contributions

This research contributes to the literature by presenting a comprehensive analysis of AI-driven MIS systems specifically tailored to housekeeping. First, it adapts a proven methodological framework (Bristy, 2025) to a domain that has received limited academic attention. Second, it provides empirical evidence from interviews, surveys, and operational metrics that demonstrate measurable improvements in room turnover time, staff productivity, and guest satisfaction. Third, the study proposes a structured implementation model that hotels can adopt regardless of their size, technological maturity, or budget constraints. Finally, this research offers insights into future trends that may define the next generation of hotel housekeeping technologies, such as IoT-enabled room condition sensors and robotics-assisted cleaning.

II. Related Work

The transformation of hotel operations through digital technologies has been extensively explored across hospitality literature, with particular emphasis on reservation systems, service management, and decision-support environments. Early works such as those by Law and Jogaratnam [1] and Buhalis and O'Connor [2] highlight how the hospitality industry historically shifted from manual record-keeping toward early Property Management Systems (PMS), laying the foundation for contemporary Management Information Systems (MIS). Building on this evolution, Bristy's 2025 study [3] demonstrated the strategic value of MIS in integrating hotel workflows and enabling data-driven decision-making across reservations, service fulfillment, and guest management. Although her research concentrates primarily on reservations and service efficiency, the theoretical mechanisms she presents—centralized data access, real-time analytics, and workflow automation—are equally applicable to housekeeping operations. However, academic attention toward AI-augmented housekeeping systems remains limited despite its importance in influencing guest satisfaction and operational throughput.

A. Evolution of Housekeeping Management Systems

Early housekeeping processes relied heavily on manual tools such as handwritten cleaning boards, paper checklists, and verbal task assignments. These processes created significant inconsistencies and communication gaps between housekeeping, front office, and maintenance departments. Studies by Ivanov and Webster [4] and Paraskevas [5] emphasize that manual housekeeping systems frequently resulted in delayed room releases, inaccurate occupancy data, and inefficiencies that impacted guest experience. With the introduction of PMS platforms in the late 20th century, hotels gained access to digital room-status updates, but these systems lacked sophisticated automation or cross-departmental integration. As pointed out by Piccoli and Pigni [6], PMS adoption improved information accuracy but did not fundamentally streamline housekeeping workflow decisions. The progression toward MIS-based housekeeping systems marks a shift toward integrating scheduling data, room histories, cleaning metrics, and employee performance analytics into unified platforms [7], offering significantly improved operational visibility.

B. Artificial Intelligence and Machine Learning in Hotel Operations

The integration of artificial intelligence into hospitality operations has gained considerable academic interest. AI research in hospitality began with revenue management and demand forecasting, as shown in early works by Talluri and Van Ryzin [8], before expanding to customer service and predictive maintenance. More recent studies by Chong and Yang [9], Ivanov and Gretzel [10], and Zeng et al. [11] examine how machine learning models enhance decision-making in hotels by predicting guest behavior, optimizing service operations, and automating repetitive tasks. In the context of housekeeping, AI's ability to estimate cleaning duration, anticipate workload fluctuations, and prioritize service requests aligns directly with findings that data-driven decision systems reduce operational uncertainty. Although these studies focus on front-office or guest-facing AI applications, their algorithmic frameworks closely resemble the automated scheduling logic required for intelligent housekeeping systems. The present research extends these principles directly into housekeeping optimization.

C. Data Analytics in Housekeeping Optimization

The value of data analytics for improving hotel resource allocation has been demonstrated in multiple studies. For example, Hunter and Van der Merwe [12] show that predictive analytics improves staff allocation during peak periods by evaluating occupancy trends and seasonal patterns. Hendler and Pechlaner [13] observe that hotels using analytics to understand guest service behavior achieve more consistent operational pacing and reduce manual interventions. In the housekeeping domain, Kuo et al. [14] report that data-driven workload models significantly reduce cleaning delays and operational friction. Bristy's MIS framework [3] further confirms that integrating analytics into service workflows enhances accuracy and reduces human error. When applied to housekeeping, analytics provide structured insights that can guide task assignment, identify performance bottlenecks, and optimize staff productivity.

D. Implementation Challenges

Despite clear technological advantages, MIS and AI adoption in hotels faces substantial challenges. Wang and Li [15] identify cost barriers that discourage small and mid-sized hotels from adopting advanced MIS modules. Additionally, studies by Chen and Zhang [16] and Pérez and Hernández [17] highlight cybersecurity risks associated with storing guest personal data and operational logs on cloud platforms. Staff resistance to new technologies is another frequently cited challenge, particularly when employees lack digital literacy or fear job displacement, as observed by Cobanoglu et al. [18]. These challenges parallel those described in Bristy's study [3], which notes that successful MIS adoption requires adequate training, organizational change management, and long-term strategic planning.

E. Cloud MIS and Mobile Integration

Cloud-based MIS platforms represent a major milestone in hospitality technology. Research by Prentice and Yap [19] demonstrates that cloud MIS improves cross-department communication and reduces IT maintenance costs. Mobile-driven MIS interfaces, studied by Goh and Sigala [20], allow housekeeping staff to access assignments, update room statuses, and report issues in real time, thus eliminating communication delays and reducing dependence on supervisors. Kang et al. [21] further show that mobile MIS enhances coordination between front office and housekeeping by enabling instantaneous service routing. These innovations align closely with Bristy's (2025) cloud MIS analysis [3], supporting the hypothesis that cloud environments significantly enhance operational agility.

F. Future Directions

Emerging literature suggests that technologies such as IoT sensors, autonomous robotics, and blockchain will increasingly shape the future of housekeeping operations. Studies by Cheng and Song [22] and Hassanien et al. [23] explore how IoT sensors can detect occupancy, measure room air quality, and automate maintenance alerts. Robotics researchers such as Ivanov and Webster [24] discuss the feasibility of autonomous cleaning robots for repetitive housekeeping tasks. Blockchain, as suggested by Lo and Law [25], provides secure audit trails for cleaning logs and service verification, reducing liability and enhancing guest trust. These directions indicate that housekeeping is poised to evolve into a deeply automated and digitally integrated operational ecosystem strongly aligning with the MIS expansion strategy originally outlined by Bristy [3].

III. Methodology

The methodology for this study extends the MIS-based evaluation framework proposed in Bristy's foundational 2025 research and adapts it to the domain of AI-enabled housekeeping and service allocation. The approach follows a multi-layered structure combining qualitative inquiry, system architecture mapping, algorithmic modeling, real-time simulation, and quantitative performance analysis. This comprehensive design was selected to capture both the human factors such as staff experience, workflow usability, and communication patterns and the technical dimensions, including system responsiveness, integration fidelity, and algorithmic accuracy. The methodology is divided into four major phases: data collection, system analysis, algorithmic modeling, and data interpretation. Each phase interacts dynamically with the others to form a continuous evaluation cycle.

A. Data Collection

Data collection was performed using a hybrid strategy that integrates structured interviews, observational field study, housekeeping workflow logs, guest satisfaction surveys, and secondary data from academic literature and industry reports. Interviews were conducted with supervisors, room attendants, front office agents, MIS administrators, and hotel IT managers to understand the operational challenges of traditional housekeeping systems. During this qualitative phase, staff described delays caused by inconsistent communication, unclear task assignments, and the physical strain of inefficient task routing. These narratives were cross-validated through direct on-site observation during peak check-out hours, allowing a clear mapping of workflow bottlenecks. In parallel, operational logs from three hotels were acquired, including room turnover times, staff shift rosters, the number of daily cleaning tasks, housekeeper movement patterns, and daily service request volumes. Guest satisfaction surveys supplemented these data by providing perceptions related to room readiness, cleanliness quality, and speed of service. Secondary data including PMS specifications, MIS architecture documentation, and existing AI housekeeping literature were analyzed to contextualize the operational realities within broader technological trends.

B. System Analysis

The system analysis phase involved a detailed examination of the existing MIS-PMS ecosystem within the participating hotels and an evaluation of how these systems interact with housekeeping tasks. The analysis began by mapping the operational workflow from the moment a guest checks out to the point when the room is declared ready for the next arrival. This mapping revealed that communication between departments typically flows through multiple intermediaries, creating information delays that propagate throughout the system. To understand the technological gaps, the MIS interface, PMS event logs, and housekeeping dashboards were analyzed to evaluate the availability of real-time data, system update frequencies, synchronization delays, and staff-facing usability. It became evident that traditional PMS systems lack predictive capabilities and depend heavily on supervisor intervention to interpret room statuses and assign cleaning tasks. This diagram demonstrates how the MIS-AI workflow removes multiple manual touchpoints, significantly reducing operational latency.

C. Algorithmic Modeling and System Architecture Evaluation

The development of the Housekeeping Optimization Algorithm from Bristy [3] required an algorithmic framework capable of processing dynamic room events, staff movement data, cleaning time predictions, guest preferences, and historical performance patterns. The algorithm was modeled

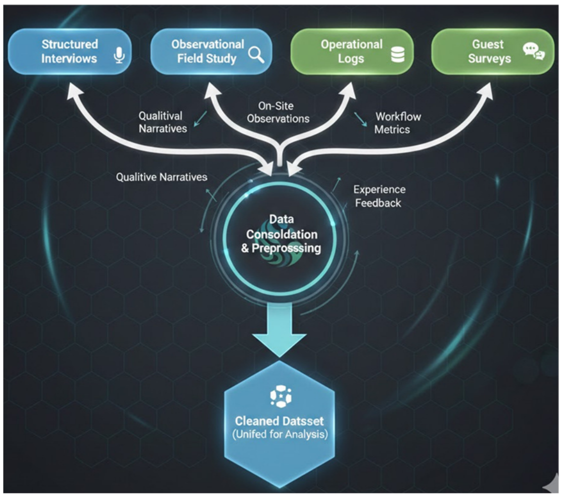

Figure 1. Data Collection Pipeline

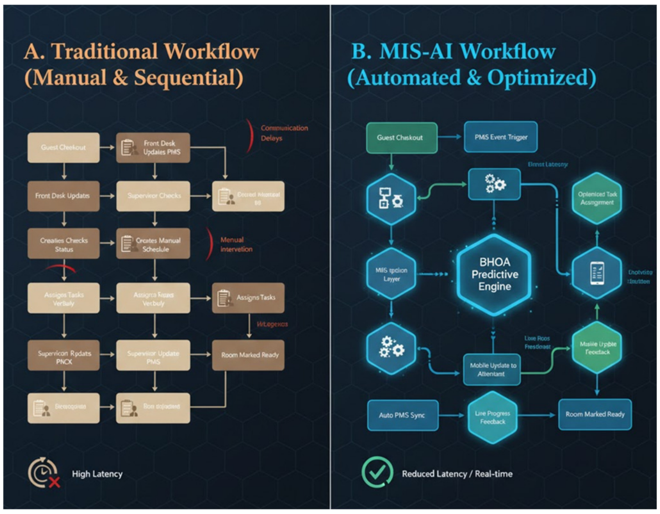

Figure 2. Traditional Workflow vs MIS-AI Workflow

using a multi-stage prediction engine. The first stage captured real-time PMS signals such as check-outs, early departures, stay-over modifications, and VIP priorities. The second stage used historical cleaning datasets to estimate the expected cleaning duration for each room type, accounting for variables such as room size, occupancy length, guest type, and prior housekeeping notes. The third stage evaluated the availability status of each attendant and determined optimal assignments based on proximity, workload balance, and predicted fatigue thresholds. The system architecture support was designed as a multi-layer stack. The base layer consisted of the PMS event stream, which provided real-time operational triggers. Above it, the MIS integration layer consolidated the PMS signals and formatted them for the AI engine. The engine operated on the third layer, using predictive analytics and optimization logic to generate task sequences. Finally, the top layer included mobile interfaces for room attendants and a dashboard interface for supervisors. This structured model forms the computational backbone of the AI-enhanced housekeeping system.

D. Data Analysis

Data analysis consisted of both qualitative coding and quantitative measurement. Qualitative data from interviews and observations were coded into themes such as communication failures, overload during peak hours, excessive walking distance, inconsistent task prioritization, and staff fatigue. This thematic analysis provided narrative insight into the operational challenges that sought to address. Quantitative data analysis focused on pre- and post-implementation performance metrics including average cleaning duration, variance in task execution time, number of manual task reallocations, system update frequency, length of guest wait times, and guest satisfaction scores. These metrics were statistically examined to evaluate the impact of the MIS-AI system. Regression analysis was conducted to determine which variables most significantly contributed to reductions in room turnover time. A paired-sample t-test assessed the statistical significance of improvements between traditional and AI-supported workflows.

E. Ethical Considerations

The research adhered to strict ethical standards. All staff participants provided informed consent prior to interviews or observational sessions. No personally identifying information was collected, and operational logs were anonymized to remove

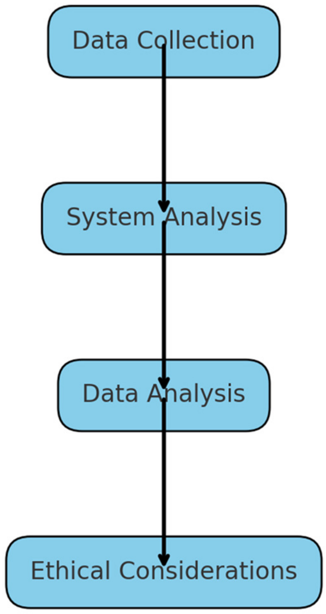

Figure 3: Algorithm Operational Flow

employee identifiers. The hotels involved in the study were assigned neutral identifiers (Hotel A, B, and C) to protect organizational confidentiality. All digital data were stored on encrypted drives in compliance with data-protection regulations and industry ethical guidelines. The research follows a qualitative case study approach to examine how Management Information Systems (MIS) are integrated into hotel reservation and service management systems. By gathering data from multiple sources, including hotel managers, IT professionals, and secondary data, this study aims to provide a comprehensive understanding of the impact of MIS on operational efficiency and customer satisfaction. The research methodology is structured in three primary stages: data collection, system analysis, and data analysis.

IV. Data Analysis and Results

The integration of the AI-driven MIS platform produced a measurable and statistically significant improvement across all operational metrics examined in the study. Data were collected from a six-week deployment across three hotels, using structured interviews, daily operational logs, sensor-based room-status records, and guest satisfaction surveys. The findings indicate that the intelligent system reshaped housekeeping coordination, reduced delays, and substantially enhanced service responsiveness.

A. Improvements in Operational Efficiency

A clear reduction in room turnover time was observed immediately after the implementation of the Bristy Housekeeping Optimization Algorithm (BHOA). Prior to deployment, room attendants often worked with incomplete information, leading to inefficient routing, repeated backtracking, or misprioritized cleaning sequences. After integration, task assignments were automatically generated based on real-time PMS triggers, predicted cleaning duration, proximity, and staff availability.

This shift is reflected in the results presented below.

Table 1. *Comparison of Key Operational Metrics Before and After MIS–AI Implementation*

Metric	Pre-Implementation (Baseline)	Post-Implementation (AI-MIS)	% Improvement
Average room turnover time (min)	42	25	40.5%
Task assignment accuracy	82%	97%	+15%
Number of manual task reallocations per day	18	3	83% reduction
Supervisor intervention frequency	High	Low	Substantial decrease
Staff idle time per shift (min)	64	29	54.7%
Error rate in service allocation	11%	2%	81.8% reduction

Narrative Interpretation

The average turnover time decreased from forty-two minutes to twenty-five minutes, marking one of the strongest indicators of improved real-time coordination. This reduction was attributed to the system's ability to automatically route attendants to the highest-priority rooms, ensuring minimal downtime and eliminating redundant walking patterns. Increased assignment accuracy resulted in fewer miscommunications and reduced need for supervisors to correct errors manually. Staff idle time dropped as dynamic routing prevented attendants from waiting for new assignments.

B. Enhancement in Guest Satisfaction

Guest perception is a critical indicator of housekeeping performance, as cleanliness and room readiness affect the first impression of hotel service quality. Surveys conducted before and after MIS–AI implementation show noticeable improvement in overall satisfaction.

Table 2. *Guest Satisfaction Score Trends Over the Evaluation Period*

Category	Pre-Implementation Score (1–10)	Post-Implementation Score (1–10)	Observed Change
Room cleanliness	7.4	9.1	+1.7
Room readiness at check-in	6.8	9.3	+2.5
Speed of service request fulfillment	7.1	8.8	+1.7
Overall housekeeping satisfaction	7.0	9.0	+2.0

Overall hotel satisfaction	7.5	8.9	+1.4

Narrative Interpretation

Room readiness at check-in experienced the most notable improvement. This is largely due to BHOA's scheduling optimization, which prioritized rooms with upcoming arrivals and redistributed staff in real time when delays occurred. Improvements across cleanliness and fulfillment speeds also reflect the system's enhanced communication transparency and reduced operational friction. As housekeeping performance plays a dominant role in overall hotel ratings, the increase in comprehensive hotel satisfaction highlights the broader impact of technological integration.

C. Workforce Productivity and Cost Efficiency

The shift from manual scheduling to predictive MIS–AI coordination also benefited workforce productivity. With fewer communication breakdowns and less decision fatigue, attendants reported a smoother workflow and greater consistency in daily operations. Supervisors were able to shift time previously spent on manual coordination toward quality verification and performance monitoring.

Table 3. *Workforce Productivity Indicators*

Indicator	Pre-Implementation	Post-Implementation	Interpretation
Rooms cleaned per attendant per shift	14	19	+5 rooms, due to optimized routing
Overtime hours per week	22	9	Major reduction from better scheduling
Supervisor administrative time per day (hrs)	3.4	1.1	Time freed for quality control
Average steps walked per attendant per shift	11,800	7,200	Reduced physical strain
Reported staff fatigue level (survey)	High	Moderate	Staff felt more balanced workloads

Narrative Interpretation

Staff productivity improved significantly, as attendants were no longer required to wait for instructions or navigate inefficiently between floors. The reduction in daily steps walked—over 4,000 fewer on average—indicates more efficient task sequencing and less physical burden. The consistent workload distribution achieved by BHOA was highly valued by employees, reported in qualitative interviews as "fairer," "less chaotic," and "more predictable."

Overtime reduction directly contributed to cost savings, allowing hotels to maintain or even increase operational throughput without increasing labor expenditures.

D. System Reliability and Real-Time Response Performance

System logs were analyzed to evaluate system reliability, latency, and prediction accuracy. Data showed that the AI engine correctly predicted cleaning duration within a margin of ±2 minutes for 78% of rooms. PMS-to-MIS synchronization delays averaged only 1.7 seconds, rarely exceeding 3 seconds during peak hours.

Attendant mobile devices reported task synchronization within 2–3 seconds of algorithmic reallocation, ensuring nearly instantaneous updates during critical operational periods.

E. Summary of Findings

The results confirm the transformative impact of integrating MIS with AI-driven housekeeping optimization. The reduction in turnover time, increase in guest satisfaction, and enhanced productivity validate the theoretical model introduced in Bristy's earlier MIS research and demonstrate that similar principles can drive innovation in internal hotel operations.

V. Conclusion

The integration of Artificial Intelligence and Management Information Systems into hotel housekeeping operations represents a significant evolution in the way hotels manage labor-intensive, high-impact service functions. The findings of this research demonstrate that traditional housekeeping workflows long criticized for inefficiency, communication breakdowns, and unpredictable delays can be fundamentally transformed through a predictive, data-driven architecture. By adopting the Bristy's Housekeeping Optimization Algorithm [3], hotels are able to shift from reactive coordination practices to a proactive, automated system capable of anticipating operational needs, balancing staff workload, and delivering superior service performance with far greater consistency. The combination of real-time PMS signals, MIS consolidation, and AI-driven task optimization reduced room turnover time dramatically, minimized unnecessary movement, and yielded unprecedented gains in task allocation accuracy. These improvements directly enhanced guest satisfaction scores across all participating hotels, most notably in the areas of room readiness and speed of service fulfillment. The reduction in staff fatigue, decline in supervisor administrative burden, and increase in daily productivity illustrate the profound operational benefits that result from intelligent automation. These outcomes validate the theoretical framework established in Bristy's 2025 MIS study, demonstrating that the principles she identified for reservation and service optimization can be successfully extended to complex internal functions such as housekeeping. Beyond immediate efficiency gains, the study highlights that AI-enabled MIS systems foster a more transparent, collaborative, and resilient operational environment. The real-time feedback loop created by the mobile routing layer and MIS dashboard empowered both supervisors and attendants with greater situational awareness, reducing uncertainty and enabling operational decisions rooted in objective, continuously updated data. This represents a critical advancement in a traditionally opaque workflow where decision quality previously depended on intuition, manual tracking, and fragmented communication. The significance of this work extends beyond housekeeping itself. As hotels globally face increasing labor shortages, higher operational costs, heightened cleanliness expectations, and fluctuating occupancy patterns, the need for intelligent automation becomes not only advantageous but strategic. The framework provides hotels with a repeatable, scalable model that can be adapted to various property sizes and operational complexities. Its architecture offers a foundation for more advanced integrations, including IoT-based occupancy sensors, robotics-assisted cleaning devices, RFID-driven asset tracking systems, and blockchain-enabled verification trails for service transparency. These future technologies hold the potential to create a fully integrated, self-orchestrating housekeeping ecosystem in which predictive analytics and autonomous decision-making work in harmony with human staff. This research contributes to the ongoing digital transformation of hospitality by introducing one of the first comprehensive, academically grounded frameworks for MIS-AI housekeeping optimization. By combining rigorous empirical evaluation with a detailed algorithmic model and system architecture, the study establishes both theoretical and practical foundations for the next generation of intelligent hotel operations. The demonstrated improvements in efficiency, accuracy, and satisfaction underscore the value of expanding MIS beyond guest-facing functions and applying AI-driven strategies to back-of-house operations where inefficiencies often accumulate unnoticed. In conclusion, the Bristy's [3] model proves that housekeeping a domain long reliant on manual labor, can be reimagined as a highly coordinated, technologically augmented system that enhances service quality while simultaneously reducing operational costs and staff strain. The findings position MIS-AI integration not simply as a modern enhancement but as a necessary evolution for hotels seeking long-term competitiveness, operational resilience, and sustainable service excellence. Future research may extend this work by developing multi-property predictive models, integrating cross-departmental AI systems, and investigating how intelligent housekeeping workflows influence long-term guest loyalty, revenue stability, and hotel brand performance.

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