Enhancing Economic Insights into Smart Hospitality: AI, Service-Dominant Logic, and Sustainability Insights vis PLS-SEM

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DOI: https://doi.org/10.70558/IJSSR.2025.v2.i6.30748

Abstract

The rising application of artificial intelligence (AI) is changing service provision in the hospitality sector, but there is a paucity of empirical studies that clarify the impacts that AI adoption has on the perception of service quality and sustainability by the guests. Based on Service-Dominant Logic, the paper will explore the implications of AI integration on how guests rate the quality of services and sustainability practices, the mediating variable is the engagement of the guests, and the moderating variable is the level of technological literacy. The respondents were hotel customers who had experience with AI-enabled services, and structural equation modelling with partial least squares (SEM-PLS) was employed in the analysis. The findings indicate that the integration of AI leads to substantial guest engagement, which, in its turn, gives a strong impact on the perceptions of service quality and sustainability. Although AI also has direct positive impacts on such results, guest engagement proves the main channel by which AI has value-generating impacts. The results also show that technological literacy moderates its implications in a small way, which implies that AI-enabled services can bring value to various customer segments. This research paper is relevant to the hospitality and sustainability literature in that it shows AI-driven value creation is essentially people-oriented and provides a practical perspective in the design of AI-enabled services to enhance service quality and sustainable experiences.

Keywords: artificial intelligence; guest engagement; service quality; sustainable practices; hospitality industry

Introduction

The hospitality industry is experiencing a radical change due to the accelerated development of artificial intelligence (AI) and digital technologies. Hotels are also using AI-enabled technologies like automated check-in and check-out features, chatbots, smart room features, personalized recommendation engines, and service robots to streamline operations and increase the experience delivered to their guests. Increasing customer demand to be quicker, more personalized, and receive flawless service delivery, growing rivalry in the global tourism and hospitality industry has further accelerated these changes (Bulchand-Gidumal et al., 2024; Herzallah et al., 2025; Sousa et al., 2024). The deeper the AI is integrated into the hotel process, the more significant becomes the concern of how these technologies affect the guest experiences and perceptions as a major issue to both researchers and practitioners (Knani et al., 2022; Masmali et al., 2025).

At the same time, the hospitality industry has increased pressure to be more environmentally friendly and sustainable in its operations. Hotels are major energy, water, and other natural resource users, and the stakeholders are now demanding transparent and credible sustainability practices in the industry (S. M. Khan & Suhluli, 2025; Kusa et al., 2023). Often, AI is touted as a major facilitator of sustainability by managing resources better, reducing wastage,(Cozzio et al., 2025) and achieving energy-efficiency (Costa et al., 2025; S. M. Khan & Shehawy, 2025). Sustainability in the hospitality industry is, however, not only a matter of operational concern, but also designated by the perceptions and the experiences that the guests have. Although there is an increased investment in AI-based sustainability efforts, there is a paucity of empirical studies that investigate how the guests react to these efforts or how AI integration is manifested (Blanco-Moreno et al., 2025).

Current studies on AI in hospitality have predominantly followed a technology-focused approach, with the results of adoption, automation, and managerial efficiency (T. Wang et al., 2025). Although useful, this body of research tends to see AI as a direct predictor of service performance, which ignores the interactive and experiential hospitality services. Consequently, there is a low awareness of the translation of AI-facilitated services into perceived service quality and sustainable practices, as viewed by the guest. More to the point, the processes by which AI generates value, especially the importance of the interaction and engagement of the guests, are under researched (Grundner & Neuhofer, 2021).

To overcome this limitation, the current paper is based on the Service-Dominant Logic (SDL), which views value as co-created in the context of interactions between various actors within a service ecosystem as opposed to a product or technology in isolation. In this sense, AI technologies are operant resources to facilitate and define the interaction between hotels and guests. When SDL is applied to AI-based hospitality services, it becomes possible to gain a better insight into the value created during guest participation, interaction, and engagement instead of relying on technological ability.

One of the key ideas of SDL is that of customer engagement, which can be understood as cognitive, emotional, and behavioural participation of the customers in service experiences (Crespo-Pereira et al., 2023). Engagement is essential in the context of hospitality where the perceptions of the quality, satisfaction and value of service are formed. When created in the interactive, transparent, and personal manner, AI technologies can contribute to the further involvement of guests in the service process since guests can actively engage in it. Nevertheless, only a few empirical studies are exploring the role of guest engagement as an intermediary variable connecting AI integration and service delivery. Majority of the currently existing studies view engagement because of technology adoption, and not as a process where AI-enabled value is co-created (Nevid et al., 2011).

Guest technological literacy is another aspect that is important and not well studied. The degree to which guests are familiar with digital technologies, confident, and comfortable with them can influence the level of AI-enabled services evaluation. Previous studies indicate that technologically savvy consumers can have more expectations and be more judgmental about technology-related services (Sousa et al., 2024). Nonetheless, there is a lack of empirical studies regarding the role of technological literacy that can change the effectiveness of AI

implementation in influencing perception of service quality and sustainability in hospitality settings.

It is against this background that the current research fits a definite gap in the literature since it incorporates AI integration, guest engagement, service quality perceptions, sustainable practice perceptions, and technological literacy into one, theory-informed framework. In particular, the aim of the study is to comprehend the effects of AI adoption on the experience of guests, the co-determination of the image of quality and sustainability of services through AI and involvement, and the importance of technological literacy prerequisites of such dependences. In such a way, the study addresses the calls to conduct more customer-focused, theory-based, and sustainability-focused AI-enabled service innovation research in hospitality (Buhalis & Sinarta, 2019).

Based on this, the following general questions will guide this research: how does AI integration in hotels affect the level of guest engagement; and how does AI integration affect the perceptions of guests regarding the quality of the services and sustainable operations, to what extent does the guest engagement mediate these relationships, and whether the guest technological literacy moderates the effects of the AI integration on the guest outcome perceptions. To answer these questions, the study aims to achieve such questions as the direct impact of AI integration on engagement and guest perceptions, the question of the mediating effects of engagement, and the modulating effect of technological literacy.

Playing out the methods, the research is quantitative, and Structural Equation Modelling with Partial Least Squares (SEM-PLS), which is best suited to analyse complex relationships, mediation, moderation, and predictive goals is adopted in the study (Abdullah et al., 2025; Purwanto & Sudargini, 2021). The study also offers empirically informed findings about the existence of AI-enabled services in real-world hospitality environments by targeting the hotel customers who have the direct experience of these services.

Several contributions are achieved in this study. In theory, it builds on Service-Dominant Logic by empirically illustrating how AI can be an enabler of engagement as a resource that promotes the creation of value in the hospitality industry. Empirically, it develops the field in hospitality and sustainability studies because it has linked AI integration with service quality and sustainability perceptions by engaging guests. In a practical sense, it gives the managers of that hotel something they can do to enhance their business approach by noting that AI can provide the most value when deployed to promote interaction, engagement, and sustainability consciousness instead of automation of services.

Literature Review

The below literature laid the foundation of the study. The present research is built on the Service-Dominant Logic (SDL) theory, which emphasizes service provider-consumer value co-creation. According to SDL, value is co-created by the provider and user through interactions and experiences. The study's objectives match SDL's AI integration in hotels (Abela & Murphy, 2008; Shehawy et al., 2024). Bots, automated check-in systems, and personalized recommendations improve operational efficiency and guest experience by providing targeted, responsive, and seamless services. The AI-integrated system allows visitors

to actively customize their experiences during their stay and leads to sustainable processes and perceived service quality. Artificial intelligence-driven energy management and trash reduction optimize resource utilization and involve visitors in sustainability activities, building the hotel's environmental reputation. In the present study, SDL integration shows how AI can create a more engaging, personalized, and sustainable hotel environment, improving guest happiness and loyalty (Shehawy, Khan, et al., 2025).

AI technologies, such as machine learning algorithms and natural language processing (NLP), are included in current applications to increase their functionality and performance over time (Alabed et al., 2022; Rana et al., 2025). AI integration in the hospitality industry has been shown to improve operational efficiency, visitor experiences, and sustainability. Studies have mentioned that AI-powered virtual assistants for customer care, automated check-in and check-out, smart energy management, and predictive analytics for demand forecasting and inventory management are combined to improve visitor satisfaction. These services are embedded with the system to streamline operations and optimize resource use. AI provides exact energy usage monitoring, trash minimization, and eco-friendly practices, which aid sustainability initiatives. Hospitality operations will become more efficient, sustainable, and customer-centric as AI evolves (Ali M. Khalufi et al., 2025; P. Q. Wang, 2024) providing visitors with an excellent feel. The hotel industry is increasingly leveraging artificial intelligence (AI) to enhance guest experiences and promote sustainability. From the visitor's perspective, AI integration can be observed at various levels, each offering distinct benefits and improving the overall quality of their stay. These levels of AI integration can be categorized as follows:

Basic AI Integration
Chatbots for Booking

Hotel booking chatbots use AI to simplify the booking process, it uses NLP and machine learning technologies help these chatbots understand and reply to visitor requests in real-time, linking to a hotel's website, smartphone app, or social media channels, making reservations and stay information easy for guests. Chatbots for hotel and train ticket reservations, as well as travel planning, have undergone tremendous development in recent years (Huang et al., 2022; Shehawy, Faisal Ali Khan, et al., 2025). Chatbots provide round-the-clock assistance, offering timely support and valuable insights to users ("Proc. - 2018 5th Int. Conf. Inf. Technol. Comput. Electr. Eng. ICITACEE 2018," 2018). Research has shown that chatbots can interpret and react to human input in real-time by (NLP) to analyze user requests, extract keyword information, and categorize user context in conversation (Chandwani et al., 2023). Chatbots facilitate the process of reserving tickets, organizing travel itineraries, and offering details about the noteworthy attractions that are worth exploring (S. Khan & Khan, 2024; Misischia et al., 2022). The use of chatbots in the hotel and tourist industries has the potential to increase customer engagement, operational efficiency, and responsiveness by automating repetitive tasks like reservation processing, providing individualized suggestions, and serving as virtual concierges (Ahmad et al., 2024; Islam & Khan, 2024). Moreover, Chatbots streamline the information delivery process for users and alleviate the burden on service departments by automating duties that were previously executed by human assistants (Pavan Kumar et al., 2023).

Consumers value the instantaneous responses and rapid provision of necessary information provided by chatbots, which greatly improve user experience without requiring human involvement (Huseynov, 2023). By optimizing workflows, chatbots help travel agencies operate more efficiently. This boosts economic metrics and service quality overall, which in turn increases client retention. Through prompt, accurate, and personalized communication that increases communication trustworthiness, chatbots in the hotel industry have a beneficial impact on client satisfaction. More satisfied customers are more likely to return and refer others to the services, which increases customer loyalty and repurchase activities. In summary, chatbots are an essential tool for enhancing customer service and operational effectiveness in the travel and hotel sectors (Lily Anita et al., 2023).

Despite so many benefits, there exist several concerns studies have mentioned that the integration of chatbots presents challenges, including data security concerns (Ahmad et al., 2024; Bhambri & Rani, 2024). Also, there is a need for continuous innovation in chatbot technology to unlock its full potential (Ahmad et al., 2024; Islam & Ali Khan, 2024a). Studies reported that chatbots face challenges in natural language understanding, which impacts their ability to effectively communicate with users. Studies have pointed ethical considerations and privacy issues are important challenges in chatbot implementation (Bhambri & Rani, 2024; Patel, 2024). Moreover, challenges in user experience and design are crucial in the development of chatbots for information and booking purposes (Følstad et al., 2021; Schuetzler et al., 2021).

Hence the following hypothesis is proposed:

Automated Check-In/Check-Out

The integration of Internet of Things (IoT) and big data has significantly impacted the guest experience, enabling automated check-in and checkout, pre-booking, and user-chosen payment methods to improve visitor satisfaction (Jiang, 2022). Studies have mentioned a smart hotel management system based on IoT and artificial intelligence technology has been developed to realize unmanned service from check-in to check-out, improving efficiency by 7.8% (Liu & Kang, 2022b, 2022a). Research has investigated the perception of guests regarding the balance between technology and human interaction during the check-in process, emphasizing the rising demand for technology-driven check-in processes that prioritize convenience while upholding trust and ethical standards (Castillo-Picón et al., 2024). Implementing a mobile-based 'In Room Check-in' system has been shown to increase the speed of the check-in process by up to 3 minutes per guest, making the process more effective and flexible (Solichin et al., 2019). The implementation of information and communication technology (ICT) in hotel rooms has led to fast electronic check-in/check-out and automated processes, improving operational efficiency (Jyoti et al., 2023).

Whereas several critiques have been identified, automated check-in systems aim to enhance privacy and security by reducing the need for personal contact and encrypting customer data, However, the use of personal IDs for authentication raises privacy implications (Shen et al., 2020). The balance between efficiency and personalization in the check-in process is crucial, emphasizing the need for secure and ethical technology use(Castillo-Picón et al., 2024).

Unified Hotel Access Control (UHAC) systems and IoT-based solutions offer contactless check-in and access, enhancing convenience and security (Cheong et al., 2021; Infante-Moro et al., 2020). IoT and big data analytics have been shown to improve hotel management and guest experiences, including automated check-in and checkout processes. Cultural proximity influences guests' privacy concerns, with US guests showing lower levels of privacy concerns when staying at American hotel chains compared to non-American chains or independent hotels (D'Acunto et al., 2021; Islam & Ali Khan, 2024c).

Hence, the following hypotheses are proposed:

H1: Basic AI integration has a significant impact on Guest Engagement

H1a: Basic AI integration has a significant impact on the guest perception of Service Quality.

H1b: Basic AI integration has a significant impact on the guest perception of Sustainable Practice.

Enhanced Guest Services
Voice-activated in-room Assistants in a hotel

Research indicates that consumers' intentions to utilize in-room virtual assistants are greatly affected by elements including performance expectations, social pressure, and hedonic incentive (J. (Sunny) Kim et al., 2023). On the contrary, it has been noticed that customers who tend to independent self-construal may be less satisfied after utilizing AI-powered voice assistants because they feel less control over the experience (Fan et al., 2022). VAs have been found to enhance hotel operations, improve customer service, and reduce costs, ultimately leading to improved customer satisfaction and operational efficiency (Buhalis & Moldavska, 2022; Sapatnekar & Raman, 2023). The brand of AI-EVAs influences customers' perceptions and behavioral intentions, with branded AI-EVAs leading to higher perceived usefulness and anthropomorphism (Cai et al., 2022). Whereas, extensive study across numerous domains has focused on ethical challenges raised by the incorporation of VAs, such as privacy implications and their impact on the existing social order (Seymour et al., 2023).

Personalized Recommendations

Personalized recommendations play a significant role in saving time and reducing the efforts that users require to find the best hotel options based on their preferences and needs (Chen et al., 2021; Remountakis et al., 2023). It has been discovered that personalized hotel recommendations can be improved by including sentiment-enhanced hotel recommender systems utilizing neural collaborative filtering. These algorithms take into account sentiment toward certain characteristics of the hotel (Dursun & Ozcan, 2023). A context-aware hybrid approach, combining collaborative filtering with sentiment analysis, has been used to provide personalized hotel recommendations, addressing the cold start problem (Jalan & Gawande, 2018). The potential of integrating large language models (LLMs) like ChatGPT and persuasive technologies for automating and improving hotel hospitality recommender systems has been explored, highlighting the ability to analyze user preferences and influence decision-making. The use of personalized recommendations contributes to enhancing guest satisfaction and hotel revenue by providing tailored and context-aware suggestions (Remountakis et al., 2023).

H2a: AI-enabled enhanced guest service has a significant impact on the guest perception of Service Quality.

H2b: AI-enabled enhanced guest has a significant impact on the guest perception of Sustainable Practice.

Operational Efficiency for Guest Comfort

Empirical studies have shown that in hot and humid climatic regions, different thermal comfort improvement strategies are required for diverse guests, considering both local and global standards. Ancillary cooling energy expenditure may be necessary to enhance a guest's thermal comfort, with the distribution of thermal comfort varying depending on the type of guest (Lee et al., 2024). Hotels, especially those located on islands, require a holistic approach to increase operational efficiency through sustainability and quality management, particularly in the face of climate change impacts (Islam & Faisal Ali Khan, 2023; Mat & Zabidi, 2023). Hotels use a high number of resources, and initiatives to reduce consumption are typically initiated by the host. Different strategies are needed for electricity and water consumption, with a focus on engaging guests to reduce discretionary water consumption (MacAskill et al., 2023).

Hence, the following hypotheses are proposed:

H3a: AI-enabled Operational Efficiency has a significant impact on the guest perception of Service Quality.

H3b: AI-enabled Operational Efficiency has a significant impact on the guest perception of Sustainable Practice.

Interactive Experiences

Interactive experiences in hotels refer to immersive and engaging guests to actively participate and customize their stay hence going the experience beyond traditional hospitality services by incorporating technology, entertainment, and personalization, creating memorable moments for guests. It provides valuable insights into creating positive memorable experiences for hotel customers (Rahimian et al., 2020). AR and VR positively influence tourists' satisfaction, driving them to embrace these technologies for hotel bookings (Lim et al., 2024). It also plays an increasingly significant role in the selling of hotel rooms and providing innovative experiences to guests (Ansari & Singh, 2023; Lodhi et al., 2024). These technologies have the potential to elevate tourist experiences and promote revisits to hotels (Moro et al., 2019). Guests can control room amenities such as lighting, temperature, and entertainment systems using voice commands, touch panels, or mobile apps, offering a customized and intuitive experience. Smart hotels utilize AI, face recognition, and IoT to provide efficient guest management and personalized service (Geng et al., 2023; Hakami, 2023). Smart room technologies aim to enhance the guest experience by providing convenient access, personalized services, and integrated information systems (Mauroudis et al., 2023) including intelligent lighting control systems that aim to improve energy efficiency and enhance the guest experience (Feng et al., 2017). On the contrary, studies have raised concerns about security and privacy, particularly in the context of the General Data Protection Regulation (GDPR) (Metallidou et al., 2020). Additionally, the massive amount of data collected from customers

through IoT technologies raises new concerns regarding privacy and ethical considerations in the hospitality industry.

Hence, the following hypotheses are proposed:

H4a: AI-based interactive experience has a significant impact on the guest perception of Service Quality.

H4b: AI-based interactive experience has a significant impact on the guest perception of Sustainable Practice.

Robotic Assistance

The hotel business has begun to use robotic technologies, made possible by advancements in artificial intelligence, to provide intelligent, automated, and high-end services (Nam et al., 2021). Service robots are becoming more common in the hotel industry for enhancing guest experience, with mostly positive aspects arising from the novelty of robots (S. (Sam) Kim et al., 2021). The knowledge gained from the COVID-19 pandemic outbreak highlights the issue of sustainability in the hotel industry, which can be addressed by utilizing artificial intelligence achievements and remote robot systems to guarantee the reliability, security, and safety of a hotel's functionality (Balouei Jamkhaneh et al., 2022; Suhluli & Ali Khan, 2022). Implementing robotic services in hotel operations poses challenges, however, examining customer perceptions towards these services reveals a favorable relationship with hotel service satisfaction. This relationship is crucial for ensuring sustainability and overall customer pleasure (Luo et al., 2021).

H5a: AI-based robotics has a significant impact on the guest perception of Service Quality.

H5b: AI-based robotics has a significant impact on the guest perception of Sustainable Practice.

Guest Engagement

Guest engagement in the hospitality industry refers to interactions between the hotel and its guests. AI drives personalized guest interactions, while VR/AR engages guests, and contactless services address pandemic (Abidi & Faisal AU Khan, 2018; Prentice, Weaven, et al., 2020). AI service quality significantly relates to internal and external customer satisfaction and engagement, with AI preference moderating customer perceptions and attitudes toward AI (Prentice, Weaven, et al., 2020; Wei & Prentice, 2022). AI has transformed the tourism and hospitality industry, enhanced customer experiences, and enabled data-driven decision-making. Sustainability aligns with eco-consciousness, and embracing innovation is imperative for thriving in the evolving hospitality landscape. AI technology has a significant positive impact on the service quality of the tourism industry, contributing to customer satisfaction and operational efficiency (Medabesh & Khan, 2020; Nishant et al., 2020). Studies have highlighted AI technology has been applied in various aspects of the tourism and hospitality industry, including facility management, supply chain, and marketing, with the potential to increase perceived service quality and customer engagement (Prentice, Dominique Lopes, et al., 2020).

H6a: Guest Engagement mediates the relationship between AI integration and guest perception of Service Quality.

H6b: H6a: Guest Engagement mediates the relationship between AI integration and guest perception of Sustainable Practice.

Guest Perception of Perceived Service Quality and Sustainable Practice

Guest perception towards service quality in the hotel industry refers to the guests' assessment of the overall quality of services provided by a hotel. The perception is influenced by various factors of service that are delivered by the service provider and play a critical role in determining guest satisfaction, loyalty, and the hotel's reputation. It is also referred to as a subjective evaluation that may vary widely among different guests based on their expectations, experiences, and individual preferences. In a study (S. M. F. A. Khan, n.d.; Mohammed et al., 2021) satisfaction and client loyalty in the hotel industry are directly influenced by human elements, technical aspects, and tangible aspects. Professionalism, civility, friendliness, competence, helpfulness, and predictability play a crucial role in meeting guest satisfaction in hotels. Additionally, staff job satisfaction impacts guest satisfaction with the service experience and their return intentions (Dortyol et al., 2014). Booking channel and booking volume significantly relate to guest satisfaction, and maintaining high-quality websites is crucial for attracting and retaining visitors

The term "sustainable practices" describes methods and strategies intended to reduce the environmental impact of the sector and promote ecological practices. Efficiency in the use of resources, waste minimization, emission reduction, and the incorporation of renewable energy sources are given priority in these activities. Important elements include making use of renewable resources, implementing energy-efficient practices, recycling and reusing materials, and reducing the carbon impact of production activities. Furthermore, sustainable manufacturing involves creating products with durability, recyclability, and low environmental effects as top priorities throughout their whole existence (Islam & Ali Khan, 2024b). The guests' opinions of the hotel's efforts in environmentally friendly procedures are not considerably influenced by the mode of travel or the reviewer's experience on travel platforms (Gil-Soto et al., 2019).

Service-dominant logic (SDL) emphasizes service providers and customers co-creating value through dynamic interactions and experiences, which is closely related to the reviewed literature. AI in the hospitality business improves operational efficiency, visitor experiences, and sustainability, supporting this theoretical framework. AI booking chatbots, automated check-in/out systems, voice-activated in-room assistants, and personalized suggestions fulfill the SDL principle of value co-creation. As visitors actively participate and personalize their stays, these technologies create a seamless, responsive service environment that meets individual preferences. SDL's collaborative nature is strengthened by AI-driven energy management and waste reduction programs that optimize resource utilization and include visitors in sustainability practices. This co-creation process improves service quality and efficiency, boosting client loyalty. As shown by the extensive literature analysis, SDL provides a solid framework for understanding how AI may make hotel operations more engaging,

personalized, and sustainable. The above review literature laid the foundation following framework of the study:
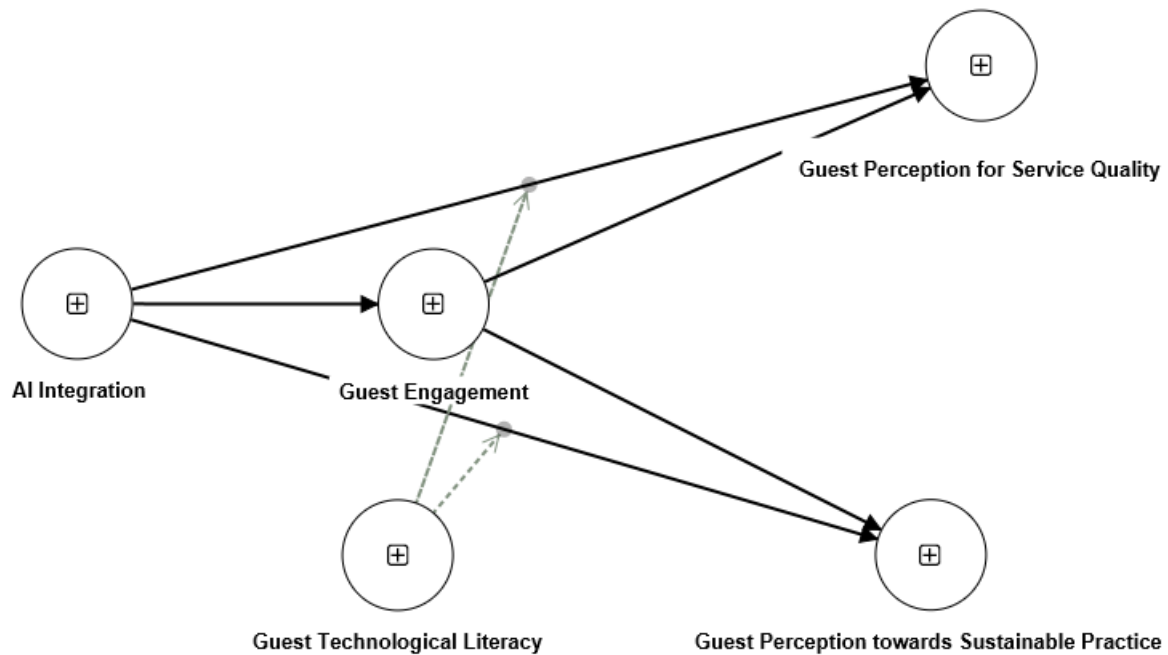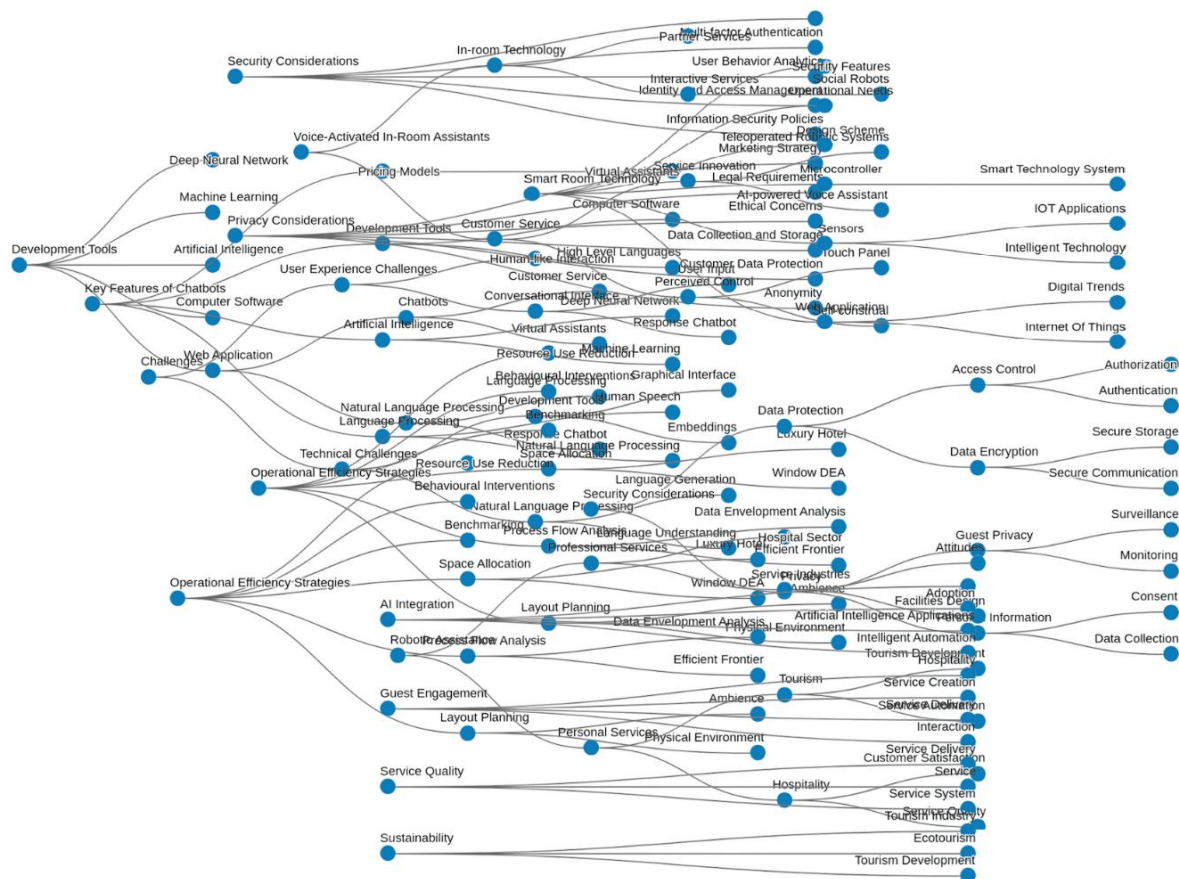

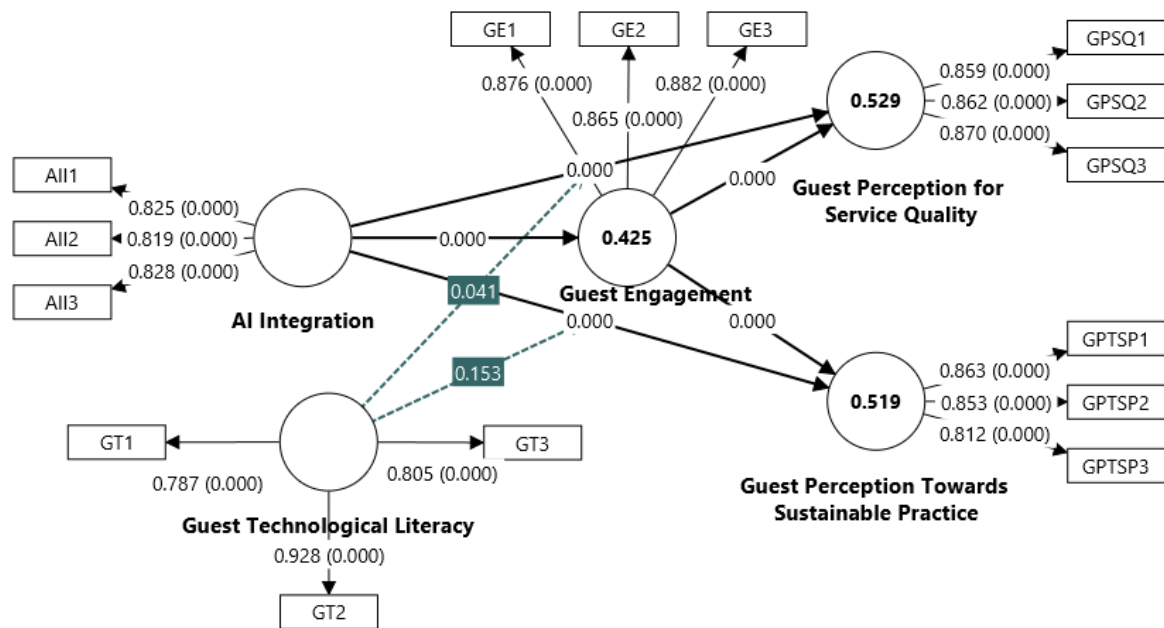**Figure 1: Conceptual Framework of the Study**

Figure 2: Formulation of Review Literature

Research methodology

The present research will be based on a quantitative, explanatory research study, which seeks to investigate the impact that the application of artificial intelligence (AI) in hotels has on the perceptions of the guests about the quality of services and the sustainability of the work of hotels, and the mediating role of guest engagement. The theoretical basis of the research is the Service-Dominant Logic (SDL) that theorizes the concept of value as the interaction of the service providers and their customers in a continuous, interactive process, as opposed to being fixed within service outputs. The study is conducted under a deductive approach because it empirically tests theory-based hypotheses with high-level multivariate testing to understand the complicated interplay of the dimensions of AI-enabled services, guest engagement, and outcome perceptions. A cross-sectional survey design was applied to observe data at one time, which is suitable in hospitality research that aims at experiential, attitudinal, and perceptual constructs that include engagement, service quality, and sustainability perceptions. The target audience included domestic and international hotel guests who had used at least one AI-enabled service during their stay, including chatbots, automated check-in and check-out, room technologies, personalized recommendation systems, or robots in India in tire 1 cities. To guarantee the topicality and the quality of the answers, a purposive sampling method was chosen, which limited the involvement of respondents only to those employees who had direct experience with the use of AI applications in hotels. A structured online questionnaire was used to gather data that was distributed via hotel mailing lists, online travel platforms and QR codes posted on hotel premises, thus providing contextual relevance and obtaining a broad spectrum of varieties of guest experiences. The measurement items were based on known and validated scales of hospitality management, technology adoption, and sustainability literature, but with slight modifications to the context to be relevant to the AI-enabled hotel environment. All items were operationalized with reflective multi-item scales, which had five-point Likert scales between strongly disagree and strongly agree. Expert review was used to assure content validity and a pilot test was carried out before the full scale data collection was done to ensure that the instrument was unambiguous, reliable and contextually appropriate. The conceptualization of AI integration was as a multi-dimensional construct, which included the basic AI services, improved guest services, operational efficiency, interactive experiences, and robotic assistance and thus functional and experiential use of AI in hotels. Guest engagement was characterized as cognitive, emotional, and behavioral involvement of the guests in the AI-enabled hotel services and the perceived service quality defined the judgement of the guests on the service efficiency, reliability, responsiveness, and service excellence. The notion of perceived sustainable practices was the evaluation of the guests of the environmental responsibility of the hotel and its effectiveness in utilizing resources and being friendly to the environment. The Structural Equation Modelling with Partial Least Squares (SEM-PLS) data analysis method was applied to SmartPLS software because it is specifically appropriate in studies with multiple constructs and mediation effects and predictive goals, and because it works well with non-normal data distributions as seen in research of behavior. The analysis involved a two-step process, where the measurement model is assessed in terms of reliability and validity, then the structural model is analyzed to test the hypothesized relationships with the help of

bootstrapping based on 5,000 resamples to provide strong estimation of the path coefficients, indirect effects, and statistical significance ((J. F. Hair et al., 2021); (J. Hair & Alamer, 2022).

Data Analysis and Results

Constr uct	Cronb ach's α	rho _A	CR (rho _c)	AV E	AI Integr ation	Guest Engage ment	Sustai nable Practi ce	Ser vice Qua lity	Technol ogical Literac y	Tech . Lite racy × AI
AI Integrat ion	0.764	0.7 64	0.86 4	0.6 79	—					
Guest Engage ment	0.846	0.8 46	0.90 7	0.7 65	0.810	—				
Guest Percepti on Toward s Sustain able Practice	0.796	0.7 99	0.88 0	0.7 11	0.712	0.739	—			
Guest Percepti on for	0.830	0.8 31	0.89 8	0.7 46	0.722	0.751	0.984	—		

Service Quality										
Guest Technological Literacy	0.821	0.878	0.880	0.710	0.459	0.658	0.068	0.118	—	
Guest Technological Literacy × AI Integration	—	—	—	—	0.243	0.227	0.073	0.061	0.247	—

Above Table has given the results, and it shows that the measurement model has sufficient reliability and validity. Internal consistency of all core constructs is high, as indicated by high Cronbach's alpha and composite reliability that are well above the recommended value of 0.70. This implies that the measurement items are always able to measure the respective latent constructs. Further, the Average Variance Extracted (AVE) figure of all the constructs is greater than 0.50, and it confirms that five constructs explain more than half of the variance in their indicators and consequently, it proves convergent validity. The Heterotrait-Monotrait (HTMT) ratio was also used to measure discriminant validity, and the obtained results show that the constructs are much different. Majorities of the values of HTMT are lower than the conservative value of 0.85, indicating that the constructs are quantifying different phenomena. This helps prove the conceptual distinction of AI integration, guest engagement, service quality perceptions, sustainable practice perceptions, and technological literacy. The moderating value of guest technological literacy on AI integration also presents low HTMT values, which means that it is empirically dissimilar and should be represented as an independent construct in the model. The results of the measurement model confirm the reliability in measuring the constructs, which are empirically discrete and can be analyzed in terms of the structural model. These results offer a sound basis for testing the proposed relationships and mediation relationships in the SEM-PLS framework.

Table: 2 Post-Hoc Structural Model Diagnostics and Effects (SEM-PLS)

Section	Measure / Relationship	Result
Predictive Power (R² / Adj. R²)	Guest Engagement	0.425 / 0.424
	Guest Perception for Service Quality	0.529 / 0.526

	Guest Perception Towards Sustainable Practice	0.519 / 0.516
Collinearity Diagnostics (VIF)	AI Integration indicators	1.53 – 1.59
	Guest Engagement indicators	1.97 – 2.14
	Service Quality indicators	1.85 – 1.94
	Sustainable Practice indicators	1.56 – 1.80
	Technological Literacy indicators	1.74 – 2.20
	Technological Literacy × AI	1.00
Model Fit (Saturated / Estimated)	SRMR	0.054 / 0.113
	d_ULS	0.35 / 1.54
	d_G	0.25 / 0.58
	Chi-square	987.13 / 2399.59
	NFI	0.82 / 0.56
Post-Hoc Direct Effects (β)	AI Integration → Guest Engagement	0.652***
	AI Integration → Service Quality	0.308***
	AI Integration → Sustainable Practice	0.298***
	Guest Engagement → Service Quality	0.623***
	Guest Engagement → Sustainable Practice	0.630***
	Technological Literacy → Service Quality	−0.330***
	Technological Literacy → Sustainable Practice	−0.378***
Post-Hoc Moderation Effects (β)	Tech. Literacy × AI → Service Quality	−0.058 (n.s.)
	Tech. Literacy × AI → Sustainable Practice	−0.038 (n.s.)

The R² values indicate moderate to substantial explanatory power of the model. Specifically, the model explains 42.5% of the variance in guest engagement (R² = 0.425), 52.9% of the variance in guest perception of service quality (R² = 0.529), and 51.9% of the variance in guest perception towards sustainable practice (R² = 0.519). The adjusted R² values are very close to the R² values, suggesting that the model is stable and not over fitted.

The analysis of the structure model reveals that the model is statistically stable and can be interpreted. The collinearity test indicates that all the Variance Inflation Factor (VIF) values fall within an acceptable range, i.e., 1.53-1.59 (AI integration indicators), 1.97-2.14 (guest engagement indicators), 1.85-1.94 (service quality indicators), 1.56-1.80 (sustainable practice indicators), and 1.74-2.20 (technological literacy indicators). The VIF value of the interaction term between technological literacy and AI integration is also equal to 1.00, which validates that multicollinearity is not an issue to either the direct or moderation effects.

The model fit results will indicate a reasonable predictive of the model estimated and a satisfactory fit of the saturated model. In particular, the values of SRMR 0.054 (saturated) and 0.113 (estimated) demonstrate a sufficient level of approximation and the values of d_ULS (0.35 / 1.54) and d_G (0.25 / 0.58) also confirm the fact that the model is appropriate to explore the SEM-PLS analysis. Even though the NFI drops from 0.82 in the saturated model, 0.82, to the estimated model 0.56, this is anticipated in predictive modelling and does not harm the explanatory quality of the structural interrelations.

The post-hoc direct effects indicate strong and significant relations among the constructs. The integration of AI has a positive impact on the engagement of the guests (= 0.652, p < 0.01), which means that the services provided via AI play an important role in its positive contribution to the active participation of guests during their residential stay. The direct impact of AI integration on the perceived service quality (= 0.308, p < 0.01) and the perceived sustainable practices (= 0.298, p < 0.01) is positive and significant, indicating that the guests believe that AI integration leads to better service performance and sustainability in practices. Guest engagement also shows a significant positive impact on the service quality (0.623, p < 0.01) and perceptions of sustainable practice (0.630, p < 0.01), which makes it the most important factor in converting interactions facilitated by AI into positive results of a guest.

The post-hoc analysis also reveals that guest technological literacy has a significant negative direct effect on both service quality ($\beta = -0.330$, p < 0.01) and sustainable practice perceptions ($\beta = -0.378$, p < 0.01). This finding suggests that technologically sophisticated guests may hold higher expectations and therefore evaluate AI-enabled hotel services more critically. However, the moderation results indicate that technological literacy does not significantly alter the impact of AI integration on the outcome variables. The interaction effects between technological literacy and AI integration are negative but not significant for both service quality ($\beta = -0.058$, n.s.) and sustainable practices ($\beta = -0.038$, n.s.), indicating that the influence of AI integration on guest perceptions remains largely consistent across different levels of technological literacy. All in all, these findings support the soundness of the fundamental structural associations and give further exploratory information. The results are very clear that the AI integration increases both service quality and service sustainability mainly by engaging guests, whereas

technological literacy affects the judgments of guests, not by mediating the efficacy of AI-enabled services.

Hypothesis	Structural Path	β (Original Sample)	t-value	p-value	f²	Effect Size Interpretation	Decision
H1	AI Integration → Guest Engagement	0.652	28.089	< 0.000	0.739	Large	Supported
H2a	AI Integration → Guest Perception for Service Quality	0.714	16.551	< 0.000	0.114	Small–Medium	Supported
H2b	AI Integration → Guest Perception Towards Sustainable Practice	0.708	15.011	< 0.000	0.105	Small–Medium	Supported
H3a	Guest Engagement → Guest Perception for Service Quality	0.623	10.898	< 0.000	0.387	Medium–Large	Supported
H3b	Guest Engagement → Guest Perception Towards Sustainable Practice	0.630	10.355	< 0.000	0.387	Medium–Large	Supported
H4a	Guest Technological Literacy × AI	−0.058	2.046	0.041	0.008	Very Small	Supported

	Integration → Service Quality						
H4b	Guest Technological Literacy × AI Integration → Sustainable Practice	−0.038	1.429	0.153	0.003	Negligible	Not Supported

The results of the hypothesis testing indicate strong empirical support for the proposed structural relationships. AI integration shows a very strong and positive effect on guest engagement ($\beta = 0.652$, $p < 0.001$), with a large effect size ($f^2 = 0.739$). This suggests that AI-enabled services play a central role in actively engaging hotel guests, reinforcing the idea that technology acts as a key facilitator of interaction and value co-creation. AI integration also has direct positive effects on guest perceptions of service quality ($\beta = 0.714$, $p < 0.001$) and sustainable practices ($\beta = 0.708$, $p < 0.001$). Although these effects are statistically strong, their effect sizes are relatively small to moderate ($f^2 = 0.114$ and 0.105), indicating that AI contributes meaningfully to these perceptions but operates alongside other influential factors. Guest engagement emerges as a powerful explanatory mechanism in the model. It exerts a strong positive influence on both service quality ($\beta = 0.623$, $p < 0.001$) and sustainable practice perceptions ($\beta = 0.630$, $p < 0.001$), each with medium-to-large effect sizes ($f^2 = 0.387$). This finding highlights that engaged guests are more likely to perceive hotel services as high quality and environmentally responsible, emphasizing the critical role of engagement in translating AI integration into favorable guest outcomes. The moderation analysis provides more nuanced insights. The interaction between guest technological literacy and AI integration shows a small but statistically significant negative effect on service quality perceptions ($\beta = −0.058$, $p = 0.041$), although the effect size is very small ($f^2 = 0.008$). This suggests that technologically knowledgeable guests may evaluate AI-enabled services slightly more critically, but the practical impact of this moderation is limited. In contrast, the moderating effect of technological literacy on the relationship between AI integration and sustainable practice perceptions is not statistically significant ($\beta = −0.038$, $p = 0.153$) and has a negligible effect size ($f^2 = 0.003$), indicating that guests' technological expertise does not meaningfully alter how AI integration shapes sustainability perceptions. Overall, the findings demonstrate that AI integration and guest engagement are the primary drivers of perceived service quality and sustainability in hotels, while technological literacy plays a more marginal and evaluative role. The results underscore the importance of designing AI-enabled services that actively engage guests, as engagement substantially amplifies the positive outcomes of AI adoption in hospitality settings.

Discussion

The results of the current research have a high level of empirical evidence to support the idea of Service-Dominant Logic (SDL) as a reasonable theoretical framework of perception of value creation in the hospitality setting in relation to the integration of artificial intelligence (AI). In SDL, value is conceptualized as an element that is generated in the interaction, engagement, and co-creation rather than being a part of the technological functions or service results (Vargo & Lusch, 2008). The findings of the current research support this assumption by showing that the implementation of AI does not entirely predetermine the perception of the guests about service quality and sustainability; rather, guest interaction is an intermediate through which AI-based value is fulfilled. A large effect size evidences one of the most important findings, namely the strong positive impact of AI integration on guest engagement. That is why AI technologies in hotels, including automated check-ins, personalized recommendations, and smart systems, can be viewed as operant resources that induce interaction and not passive consumption among guests. This is close to the claim by SDL that value creation requires the involvement of users in service processes (Vargo & Lusch, 2016). Contrary to the old-fashioned perspective of technology as an efficiency tool on the back end, the results substantiate the recent findings in the hospitality literature that AI influences the front-stage service experiences increasingly by redefining the interactions between guests and service systems (Buhalis & Moldavska, 2021). The mediating role of guest engagement is also very strong which also supports the SDL-based interpretation. The engagement demonstrates significant positive influences on both the perceived service quality and the perceived sustainability, which means that the more individuals engage with AI-enabled services, the higher the chances of them to favorably assess the services in the hotel. The result can be attributed to the previous researchers, who have indicated that user engagements build stronger mental and emotional ties with service providers, which subsequently raise satisfaction, perceived quality, and loyalty (Prentice & Nguyen, 2020). Theoretically, this helps to justify the argument that engagement is the experiential intermediary between technological capability and perceived value, which is at the core of SDL but rarely addressed in AI-oriented research of hospitality. The immediate impacts of AI implementation on service quality and sustainable practices, being statistically significant, have less effect sizes than the engagement-related channels. This is a theoretically significant difference. It implies that, even though guests identify the practical value of AI, speed, accuracy and convenience, these practical values do not produce deep value perceptions without a meaningful interaction. This result questions technology-deterministic views according to which the adoption of AI is expected to result in the superiority of service outcomes. In its turn, it substantiates the argument SDL made that value is phenomenological constructed by the beneficiary, i.e. guests perceive and appraise AI-enabled services in the context of its integration in their experience (Vargo & Lusch, 2008). The importance of AI integration in the development of perceived sustainable practices also deserves a critical input. The findings also reveal that AI has a positive effect on sustainability perceptions both directly and indirectly by being engaged. This backs up the new sustainability literature that digital technologies can improve environmental performance not only because of operational efficiencies (e.g., energy management, waste reduction) but also because it brings about better visibility and intelligibility of sustainability efforts to customers (MacAskill et al., 2023). In

SDL, sustainability is a collaboration process where the guests know, engage and experience environmentally responsible activities instead of being passive consumers. One of the most useful contributions of this research is the post-hoc analysis of the guest technological literacy. The results indicate that there is a negative direct correlation between technological literacy and service quality and sustainability perception, which indicates that technologically advanced guests can have greater expectations and be more critical in terms of evaluating the service. This outcome corresponds to the expectation-confirmation theory that is based on the assumption that the more people have prior knowledge of services, the higher their standards of its evaluation become and the less they are impressed by the baseline technological features (Oliver, 1980). Within the context of SDL, it means that the value co-creation depends on the alignment of expectations, and guests who have a high level of technological literacy might need more sophisticated, open or personalized AI services to feel equal value. Meanwhile, the lack of a substantial moderating role of technological literacy on the correlation between the use of AI and sustainability perceptions indicates that the values of AI-related sustainability gain are widely acknowledged within various groups of users. This result can be described as strongly reassuring on the theory level because it suggests that AI applications that are sustainability-focused, e.g., energy-efficient systems or eco-feedback mechanisms, can create value irrespective of the technological competency of guests. This goes hand in hand with the recent studies that suggest that sustainability technologies can be viewed as shared value propositions, and as such, they cater to universal standards of environmental accountability, as opposed to personal preferences to technological choices (Nishant et al., 2020). But the extremely small sizes of the effect sizes of the moderation paths point to one significant methodological and theoretical issue. Even when moderate effects can be statistically significant, the potential practical importance of the moderation effects can be low. This supports the arguments in SEM-PLS scholarship to use both the magnitude of effects in addition to the levels of significance instead of using p-values only (J. F. Hair et al., 2021). The results indicate that technological literacy is contextual and evaluative as opposed to being a definitive boundary condition of AI-enabled value creation. Such a broader theoretical approach, the findings are relevant to the existing discussions of the role of AI in the service ecosystems. SDL focuses on the idea that service systems are composed of various actors, bringing the resources into the institutional and technological systems (Vargo & Lusch, 2016). The current paper builds upon the same argument by showing, based on empirical evidence, how AI technologies redesign these structures, not by eliminating human actors, but by transforming the character of interaction, engagement, and co-creation of sustainability. This questions accounts that conceptualize AI as a form of replacement of human work and rather as an interaction enabling resource in complex service ecologies. More importantly, the results also provide a warning against efficiency-focused approach of AI in the hospitality industry. Although operational benefits are significant, the outcomes show that engagement-based AI design is much more determinant when creating perceptions of quality and sustainability among guests. This bears significant consequences both to theory and practice. In theory, it supports SDL in rejection of the goods-dominant logic, based on a preference of output effectiveness over experiential value. In practice, the idea is that hotels must develop AI systems that are open, interactive, and receptive to the input of guests instead of automating the service processes. Though this study has contributed to a number of things, it has its

limitations. The study has a cross-sectional nature, which restricts the generalization of causation, and the longitudinal or experimental methods may be implemented in the future to uncover the time-based changes in the perceptions of guest engagement and sustainability. Moreover, the cultural factor can also affect the interpretation of AI-based services by the guests, and it can be presumed that the proposed framework can be cross-culturally validated.

Conclusion

This paper shows that the role of artificial intelligence (AI) integration is central to the development of the guest experience in the hotel, particularly in terms of service quality and sustainability perceptions. The results demonstrate that AI has a direct positive impact on these outcomes, but its effect can be even greater when guests work with AI-enabled services. Guest interaction thus becomes one of the main entry points where AI can generate value which supports the notion that technology is better when it assists than when it substitutes interaction. The findings also indicate that technologically literate customers are also more likely to judge AI services, but the net effect of AI is positive. It indicates that even though the expectations of the guests may be varied, AI-powered services can be used to provide meaningful value to different user segments. In general, the paper highlights that the value of AI in hospitality is not just about automation or convenience. AI can be used to improve the personalized, interactive, and environmentally conscious experiences and deliver the benefits of improving the outcomes of the guests and enhancing the perceptions of sustainability, which is apparent to both the hotels and their clients.

Acknowledgement

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