Research article

The evolution of smart hotels: A bibliometric review of the past, present and future trends

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ABSTRACT

This study provides a bibliometric analysis of smart hotel research, drawing from 613 publications in the Web of Science (WoS) database to examine scholarly trends and developments in this dynamic field. Smart hotels, characterized by integrating advanced technologies such as AI, IoT, cloud computing, and big data, aim to redefine customer experiences and operational efficiency. Utilizing co-citation and co-word analysis techniques, the research delves into the depth of literature from past to future trends. In co-citation analysis, clusters including "Sustainable Hotel and Green Hotel", "Theories Integration in Smart Hotel Research", and "Consumers' Decisions about Green Hotels" underscore the pivotal areas of past and current research. Co-word analysis further reveals emergent trend clusters: "The New Era of Sustainable Tourism", "Elevating Standards and Guest Loyalty", and "Hotels' New Sustainable Blueprint in Modern Travel". These clusters reflect the industry's evolving focus on sustainability and technology-enhanced guest experiences. Theoretically, this research bridges gaps in smart hotel literature, proposing new frameworks for understanding customer decisions amid technological advancements and environmental responsibilities. Practically, it offers valuable insights for hotel managers, guiding technology integration strategies for enhanced efficiency and customer loyalty while underscoring the critical role of green strategies and sustainability.

1. Introduction

A smart hotel is characterised by its utilization of advanced technologies to offer customers unique and technology-driven experiences [1]. The idea of a "smart hotel" first surfaced in 2008 and has gained popularity recently (Kim & Han, 2020). According to Ref. [2], smart hotels use a variety of modern Information and Communication Technologies (ICTs), including artificial intelligence (AI) and service ideas, to provide guests with a novel sense of intelligence. Smart hotels actively control and integrate their technical

systems and technological operations over international computer networks [3]. In order to provide the customer with better service and far greater degrees of personalization, these incorporate modern IT, such as the IoT, cloud computing, mobile internet, smart devices, and big data [4–6].

The most apparent benefit of a smart hotel from the standpoint of a hotel operator is financial benefits via higher productivity and labour cost reductions [7]. Innovative technologies aspire to attain ultimate efficiency through service automation. The advancements in the Internet of Things (IoT) and Internet of Everything (IoE) have resulted in a shift towards using intelligent systems within the hotel industry, enhancing operational efficiency and service delivery [8–10]. This research uses an expanded definition of "smart hotel" that considers not just ICT practises but also environmental technology and industry-wide regulations (Apostolakis et al., 2020). This expanded definition cannot be regarded as arbitrary because (a) it encompasses additional technological advancements that contribute to the "smart" concept in addition to ICT, and (b) it also enhances the development of green or ecological applications in the hospitality industry (for instance, the temperature or lighting settings in a smart hotel room are built upon or combined with broader ICT technology).

Globally, smart hotels are proliferating and essential to the hospitality sector [1,5]. According to Refs. [6,8], the introduction of artificial intelligence (AI) in the hospitality industry has resulted in a significant shift in consumers' buying intentions and hotel operations. The rapid integration of new technology in the hospitality industry has led to a growing interest among practitioners and marketers to explore consumer perceptions of smart technologies in the context of hotels and the level of intention customers have in booking smart hotels [7].

Bibliometric analysis is used to evaluate the amount of research output and track the trends and patterns of scholarly publications to carry out a comprehensive study of smart hotels [11,12]. Researchers may get insight into the history and expansion of a discipline by examining the publishing rate and growth over time. To assess the significance and visibility of smart hotel research, bibliometric metrics may be utilized, including citation counts, h-indexes, and journal impact factors. This study helps academics and policymakers locate important studies, reputable publications, and developing research areas. Bibliometric analysis generally offers a quantitative framework for comprehending the state of the research on smart hotels today, detecting research trends and gaps, assessing the effect of research, and developing evidence-based decision-making in the industry. It helps academics and professionals stay up to date on the most current developments, make wise judgements, and expand their understanding of smart hotels.

1.1. Present study

The objective of our study is to explore the depth of scholarly articles related to smart hotels using a bibliometric technique. Our methodology focuses on bridging informational voids about smart hotels by closely examining all pertinent literature associated with smart hotels. This encompasses research from past, current, and future trends. We employed two bibliometric approaches. The two research objectives are derived from these thorough bibliometric evaluations:

1. Deploying co-citation analysis, we aim to spotlight past research and current trends within the smart hotel sector.
2. Through co-word analysis, we aspire to highlight and anticipate future trends in smart hotels.

1.2. Literature review

The Smart Hotel incorporates an intelligent system that utilises internet-based information technology, digitalization, and other technical methods to provide information services [3,5,13]. This system aims to achieve cost savings in hotel operations, enhance the customer experience, and improve employee productivity [8]. The construction of smart hotels plays a crucial role in adjusting and upgrading of the industrial structure within the hotel industry. To achieve this, it is necessary to shift existing concepts, prioritise sustainable development as both the starting point and ultimate goal, foster innovation, and develop new hotel operational management models [9]. Additionally, there is a need to reconstruct hotel business procedures. Smart hotels have demonstrated the importance of conserving resources and protecting the environment through low-carbon practises [8,10]. In addition to these environmental benefits, smart hotels have also managed to reduce operational costs, enhance the economic advantages of the hotel, and contribute to the overall advancement of economic, social, ecological, and cultural values. Consequently, adopting smart technologies is deemed essential for the sustainable development of the hotel industry [14].

The use of environmentally friendly technology in the construction of buildings plays a significant role in the realisation of the "smart hotel" idea [1,7,9]. This approach is characterised by innovative green technology with information and communication technologies (ICT). The notion of smart hotels is a recent development that may be regarded as a pioneering solution within the tourist industry [4,13]. Integrating various information technologies inside a smart hotel facilitates a sophisticated and convenient holiday experience for guests, enhancing the overall quality and prestige of their stay. This feature gives visitors a comprehensive understanding of not just the hotel itself but also the surrounding city and nation [13,15]. Additionally, it can potentially enhance visitor loyalty and improve repurchase rates. Therefore, implementing a smart hotel is of utmost importance in the practical context of the hospitality business [3]. When considering the concept of a smart hotel, it is noteworthy that its use is more prevalent among industry managers than academic researchers.

The concept of a smart hotel is often discussed in academic literature and is often mentioned from the perspectives of experts in the hospitality sector [8]. Consequently, the notion of smart hotels represent more than just a theoretical concept that emerges from the advancement of scientific thinking and elucidates the operational mechanisms of a hotel organisation. However, this is mostly a pragmatic approach to doing business, whereby new advancements in information and communication technology are incorporated

within the context of the hospitality industry. According to Ref. [9], the competitiveness of a hotel is contingent upon its ability to enhance operational efficiency via technology solutions. Smart technology in the context of hotels offers a wide range of possibilities that serve the dual purpose of impressing visitors and enhancing operational efficiency inside the property [16]. The prevalence of smartphones and tablets among travellers, accounting for more than 85% of the population, indicates a growing integration of mobile experiences into the daily lives of potential visitors [3]. It is logical for hotels to align with this trend and cater to guests' needs in a more personalized and mobile setting, allowing them to individually improve their overall hotel experience. When the potential advantages of implementing innovative smart technologies or adopting new norms are significant, as may be observed during a period of swift environmental transformation, the intentions to engage in experiential sharing undergo evolution and swiftly gain prominence within the hospitality industry [2,14].

2. Methods

In this study, we integrated bibliometric techniques to explore the expansive understanding of smart hotels literature. These methods, through visual representations, clarify the interconnectedness of different bibliometric parameters in a defined research area. This study adopts a holistic approach, covering all available studies on smart hotels from the Web of Science (WoS) database. We selected WoS for its outstanding quality and broad spectrum of content [17]. The WoS databases stand as reputable sources for academic publishing and citation records, granting vast access to globally acclaimed research [18,19]. Our evaluation strategy was thorough, focusing on the steps to detect, gather, and fine-tune information. Such a detailed method guaranteed the authenticity and preparation of the final dataset for the ensuing analytical phase.

2.1. Searching and retrieving data

On August 26th, 2023, we conducted an exhaustive exploration of the Web of Science (WoS) database to collate publications related to smart hotels literature, covering the period from its beginning to August 26th, 2023. We focused our search on the title and abstract sections using keywords such as: "Intelligent hotel*" OR "High-tech hotel*" OR "Digital hotel*" OR "Automated hotel*" OR "Connected hotel*" OR "Smart hotel*" OR "Eco-friendly hotel*" OR "Green hotel*" OR "Eco-hotel*" OR "Environmentally-conscious hotel*" OR "Eco-resort*" OR "Sustainable hotel*". To ensure consistency in language, our search was limited to articles written solely in English. This search approach produced an initial set of 613 articles.

2.2. Data analysis

Before conducting the analysis, we obtained a dataset from the WoS database consisting of 613 publications. We then converted the dataset into a plain text format in preparation for further examination. We utilized VOSviewer to visualize knowledge and conduct network analysis. We employed two different bibliometric analyses to fulfill our research objectives. Co-citation analysis quantifies the frequency of joint citations between two articles in a document collection [20] Highly cited papers frequently represent significant theories or methodologies in their respective fields. Therefore, this method allows us to identify important influences from past studies, highlight significant contributions, and identify current trends in smart hotels research. Co-word analysis examines the frequency and patterns of keyword co-occurrence in a text corpus [21]. Researchers can identify commonly linked concepts and evolving thematic patterns by analyzing keyword co-occurrence patterns. Frequent occurrences of certain words within a specific domain may indicate
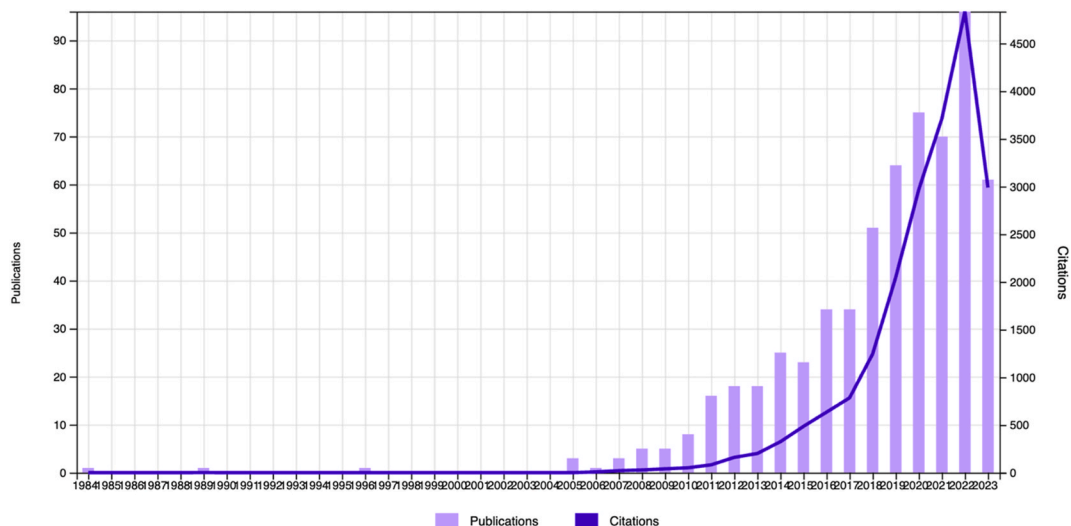

Fig. 1. Publication and citation patterns from 1984 to August 26th, 2023.

prominent themes and emerging research areas [22,23]. Co-word analysis is a valuable tool for understanding current research priorities and predicting future directions in smart hotels.

3. Findings and discussion

3.1. Trends in publication and citation

The Web of Science database yielded 20,610 references for the selected papers (N = 613), of which 16,689 were without self-citations. With an H-index of 74, the average citation count per article was 33.62. Fig. 1 presents a graphical representation of the fluctuations in publications and citation counts from 1984 to August 26th, 2023. Although research on this topic commenced in 1984, it was not until 2007 that substantial findings emerged, highlighting a twenty-year gap. Since then, the number of relevant publications has increased. Research in the smart hotel domain is anticipated to strengthen over the next five years.

3.2. The past and present trends of smart hotels literature

Co-citation analysis examined the fundamental concepts underlying past and present trends in smart hotels literature. The analysis utilized a citation threshold of 32, resulting in 58 cited references. Fig. 2 illustrates the network analysis conducted using the aforementioned references. Table 1 presents the top twenty most commonly cited sources, as determined by their total link strength [24]. received the highest number of citations with 192, followed by Ref. [25] with 160, and [26] with 139.

The co-citation analysis revealed the presence of three distinct clusters, each of which is linked to a particular theme. According to Ref. [44], the clusters denote collections of interconnected publications that exhibit thematic similarities. Publications exhibiting analogous content are organized into clusters. Nodes of the same color represent each cluster. Every cluster is described and assigned a label.

- Cluster 1 (Red) comprises 22 publications titled "**Sustainable hotel and green hotel**". These publications indicate that environment-friendly initiatives have received increasing attention in hospitality research [45]. According to Ref. [41], organizations may enhance the efficiency and effectiveness of their green programs by gaining a more profound comprehension of consumers' preferences for and engagement in environmentally friendly activities [46]. indicate a growing trend in the hotel industry where more companies are adopting proactive environmental management practices in response to the increasing recognition of consumer preferences for environmentally responsible products and services. This shift is seen as a means to enhance
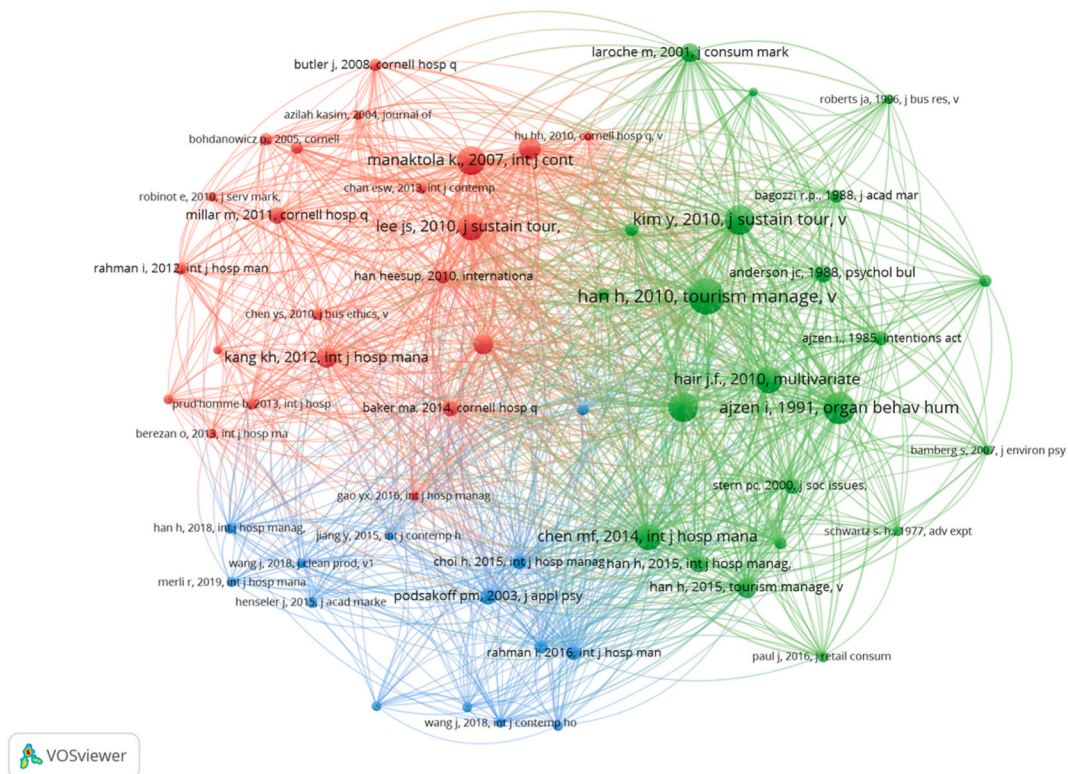

Fig. 2. Co-citation analysis (VOSviewer visualization).

Table 1
Ranking of the top 20 papers according to citation and total link strength from 1984 to August 26th, 2023.

No.	Documents	Citation	Total link strength
1	[24]. Application of the theory of planned behavior to green hotel choice: Testing the effect of environmental friendly activities. *Tourism management, 31*(3), 325–334.	192	1907
2	[25]. The theory of planned behavior. *Organizational behavior and human decision processes, 50*(2), 179–211.	160	1681
3	[26]. Exploring consumer attitude and behaviour towards green practices in the lodging industry in India. *International journal of contemporary hospitality management, 19*(5), 364–377.	139	1484
4	[27]. Developing an extended theory of planned behavior model to predict consumers' intention to visit green hotels. *International journal of hospitality management, 36*, 221–230.	127	1473
5	[28]. Intention to pay conventional-hotel prices at a green hotel–a modification of the theory of planned behavior. *Journal of Sustainable Tourism, 18*(8), 997–1014.	149	1466
6	[29]. Understanding how consumers view green hotels: how a hotel's green image can influence behavioural intentions. *Journal of sustainable tourism, 18*(7), 901–914.	128	1341
7	[30]. Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research, 18*(1), 39–50.	148	1285
8	[31]. *Multivariate Data Analysis*. Pearson, New York.	126	1189
9	[32]. Empirical investigation of the roles of attitudes toward green behaviors, overall image, gender, and age in hotel customers' eco-friendly decision-making process. *International journal of hospitality management, 28*(4), 519–528.	101	1108
10	[33]. Travelers' pro-environmental behavior in a green lodging context: Converging value-belief-norm theory and the theory of planned behavior. *Tourism Management, 47*, 164–177.	86	1050
11	[34]. Are lodging customers ready to go green? An examination of attitudes, demographics, and eco-friendly intentions. *International journal of hospitality management, 30*(2), 345–355.	86	965
12	[35]. Consumers' willingness to pay for green initiatives of the hotel industry. *International journal of hospitality management, 31*(2), 564–572.	96	940
13	[36]. Targeting consumers who are willing to pay more for environmentally friendly products. *Journal of consumer marketing, 18*(6), 503–520.	82	854
14	[37]. New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of social issues, 56*(3), 407–424.	65	763
15	[38]. Hotel customers' environmentally responsible behavioral intention: Impact of key constructs on decision in green consumerism. *International Journal of Hospitality Management, 45*, 22–33.	70	760
16	[39]. Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin, 103*(3), 411.	73	738
17	[40]. Application of the extended VBN theory to understand consumers' decisions about green hotels. *International Journal of Hospitality Management, 51*, 87–95.	59	721
18	[41]. Eco-friendly attitudes, barriers to participation, and differences in behavior at green hotels. *Cornell Hospitality Quarterly, 55*(1), 89–99.	65	719
19	[42]. From intentions to actions: A theory of planned behavior. In *Action control: From cognition to behavior* (pp. 11–39). Berlin, Heidelberg: Springer Berlin Heidelberg.	56	718
20	[43]. Predicting green hotel behavioral intentions using a theory of environmental commitment and sacrifice for the environment. *International journal of hospitality management, 52*, 107–116.	60	696

Source: Author interpretation based on VOSviewer analysis

competitiveness, as highlighted by Ref. [32]. The implementation of environmentally friendly practices by hotels not only satisfies client demands in the market but also reduces operating expenses by decreasing the amount of solid waste and energy/water use [45]. In recent years, there has been a notable trend among hotels to actively enhance their environmental performance to establish a unique position in the highly competitive lodging market. These hotels are actively seeking effective strategies to adopt environmentally friendly practices, as evidenced by studies conducted by Refs. [47,48]. According to Ref. [49], the internet is a viable platform for promoting a hotel's environmentally friendly activities directly to clients. Additionally, green hotels have the potential to enhance the image and reputation of industry stakeholders, therefore attracting environmentally conscious travellers who seek sustainable lodging options throughout their travels. The author also indicates that there is a willingness among hotel guests to pay a premium for eco-friendly amenities. Additionally, clients are willing to pay a higher price for environmentally sustainable options, provided a portion of the money spent is allocated towards supporting green.

- Cluster 2 (Green) comprises 22 publications titled "**Theories integration in smart hotel research**". In the early stages of this field, the Theory of Planned Behaviour (TPB) is the essential and central theory to investigate customers' behaviour in the hotel industry [24,34,50,51], while in the later stages, discussions shift towards exploring integrated theories and mediating roles within the field [33,46,52]. [24] use the Theory of Planned Behaviour (TPB) as a framework to elucidate the factors influencing the development of hotel customers' intentions to visit a green hotel. In accordance with the theoretical framework, the findings obtained from a structural equation analysis demonstrated that attitude, subjective norm, and perceived behavioural control had a favourable influence on the desire to remain at a green hotel [46]. propose an extension of the theory of planned behaviour (TPB) to provide a more thorough understanding of the factors influencing consumers' desire to revisit a hotel. The expanded Theory of Planned Behaviour (TPB) integrates key elements from the consumer behaviour and marketing literature, including service quality, customer satisfaction, overall image, and frequency of prior behaviour, into the original TPB model. The findings from the structural analysis indicate that the new model has a stronger alignment with the collected data. Furthermore, it offers a more comprehensive explanation for the variability seen in revisit intention compared to the Theory of Reasoned Action (TRA) and the

Theory of Planned Behaviour (TPB). The researchers discovered a mediating influence of satisfaction and attitude in their investigation [33]. proposed a theoretical framework that combines the Value-Belief-Norm Theory with the Theory of Planned Behaviour (TPB). This integration takes into account the moderating influence of certain factors [52]. extended the Theory of Planned Behaviour (TPB) by including environmental concern as a significant factor in green marketing. This extension aims to promote the achievement of the triple bottom line (TBL).

- Cluster 3 Blue) comprises 14 publications titled "**Consumers' decisions about green hotels**". The study conducted by Ref. [53] examines the influence of environmentally friendly practices on forming a distinct loyalty towards green hotels. Additionally, the research studies the mediating function of visitor pleasure in the relationship between these practices and guest loyalty. Additionally, it is noteworthy that consumers exhibit favourable recognition of the hotels' environmental commitment, which significantly impacts guest happiness and loyalty. According to Ref. [40], a positive association exists between green trust and the desire to visit a green hotel. According to Ref. [54], green trust is an important and essential factor in selecting a green hotel. Furthermore, it was observed that the lack of inclination to pay a higher price, perceived value, personal attitude, and subjective social norms were identified as factors that discourage individuals from selecting environmentally friendly hotels. The results above provide valuable information for managers seeking to design marketing strategies to promote the adoption of green hotels among tourists.

Table 2 provides a concise overview of the co-citation analysis. The table presents information pertaining to cluster labels, the number of publications, and representative publications.

3.3. Future trend of smart hotels

At least 17 occurrences were found for each of the 57 identified keywords. The co-word analysis identified "green hotel" as the most frequently used keyword, appearing 192 times. It was followed by "planned behavior" with 145 occurrences and "green hotels" with 103 occurrences. Table 3 displays the top 15 keywords that commonly appear together. Fig. 3 illustrates the network structure of keyword co-occurrences, comprising three distinct yet interconnected clusters. This study examines and discusses the characteristics of each cluster.

- Cluster 1 (Red): This cluster contains 23 keywords titled "**The New Era of Sustainable Tourism**". The hospitality industry is on the verge of a paradigm shift, fueled mainly by changing consumer attitudes toward sustainability and the rise of the "green hotel". Once considered a niche, sustainable tourism has emerged as a major determinant in consumer decision-making [72]. Consumers today are more concerned about the environment and see their travel choices as an extension of their pro-environmental behaviors [73]. As a result, hotels are under increasing pressure to adapt and innovate. According to extended theory, willingness-to-pay for green hotel services is influenced by a complex interplay of values, responsibility, and perceived participation benefits [16,74]. Guests are no longer passive consumers but active participants in sustainable practices who value transparency and authentic experiences. The green hotel concept capitalizes on this shift by leveraging technology to provide eco-friendly solutions to discerning consumers [75]. The green hotel, with its energy-saving room systems and waste-reduction innovations, exemplifies the industry's commitment to responsibility and future readiness [76]. As more travelers embrace these values, we can anticipate an increase in demand for hotels that not only 'talk the talk' but also 'walk the walk' in terms of environmental commitment. To thrive in this new environment, hoteliers must understand the delicate balance between consumers' inherent desire to make environmentally conscious choices and the determinants that shape these choices. Smart hotels that combine technology and sustainability will shape the future of the tourism industry.
- Cluster 2 (Green): This cluster contains 18 keywords broadly related to "**Elevating Standards and Guest Loyalty**". Green hotels are emerging as frontrunners in adopting sustainable practices, causing a profound transformation in the hospitality industry. As consumer preferences shift, there is a greater emphasis on the "go green" movement [77]. This shift is about more than being environmentally conscious; it is also about improving the overall guest experience. Successful green hotels now combine environmentally friendly practices with top-tier service quality [78]. Guests place a high value on such offerings, associating them with higher trust and satisfaction. A hotel's image is now inextricably linked to its environmental commitments and the quality of its services [79]. Aside from the tangible, the experiential aspect of a hotel stay is critical. Modern travelers seek enriching experiences that reflect their values [80]. In such an environment, perceived value is determined not only by room quality or amenities but also by the overall experience corresponding to their behavioral intentions. Importantly, in the hospitality industry, loyalty is closely linked to customer satisfaction [81]. When guests believe that a hotel genuinely invests in green practices and provides a superior experience, they become more loyal. As the industry moves toward a more sustainable and guest-centric future, this dynamic emphasizes the importance of meeting and exceeding expectations.

Table 2

Co-citation clusters of smart hotels.

Cluster	Cluster label	Number of publications	Representative publications
1 (Red)	Sustainable hotel and green hotel	22	[26,26,34,35,41,45,46,55–60]
2 (Green)	Theories integration in smart hotel research	22	[24,27,33,36,38,46,50–52,61–65]
3 (Blue)	Consumers' decisions about green hotels	14	[40,43,53,54,66–71]

Source: Author's interpretation derived from VOSviewer analysis

Table 3
Top 15 most used keywords.

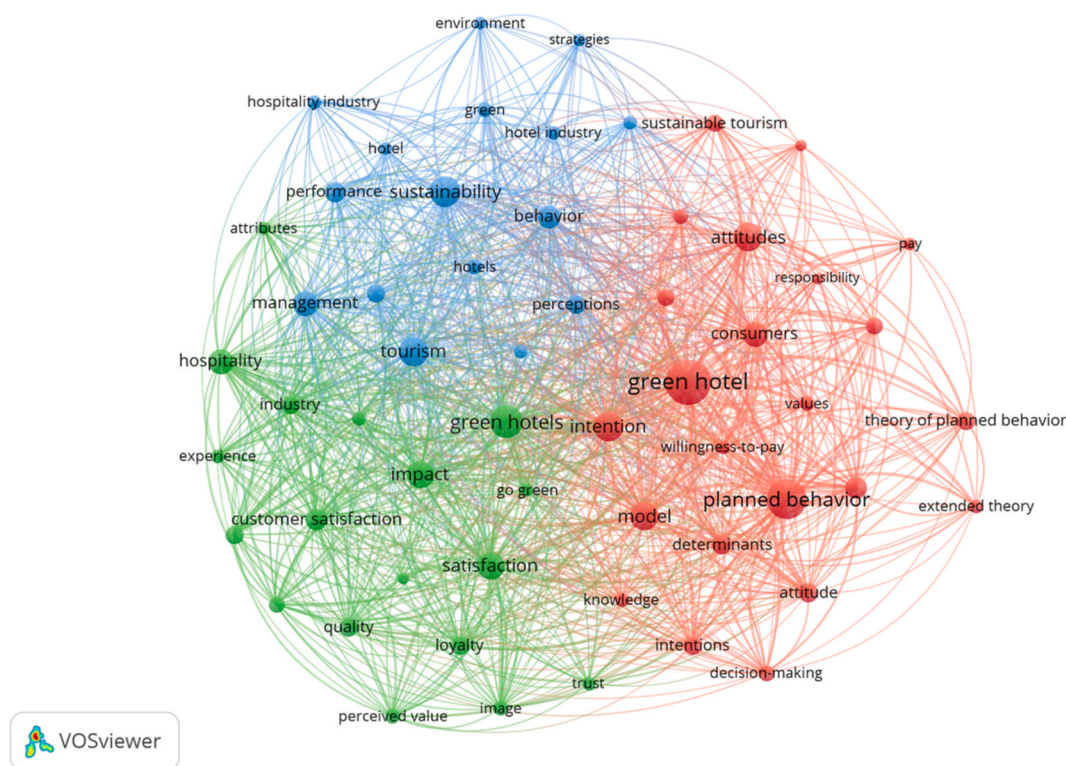| Rank	Keyword	Occurrences	Total link strength
1	Green hotel	192	789
2	Planned behavior	145	707
3	Green hotels	103	568
4	Intention	85	445
5	Model	83	429
6	Sustainability	91	408
7	Satisfaction	74	405
8	Tourism	87	404
9	Attitudes	80	392
10	Impact	76	386
11	Consumers	67	346
12	Hospitality	64	324
13	Management	64	303
14	Behavior	55	274
15	Pro-environmental behavior	52	270

Fig. 3. Co-word analysis of smart hotels (VOSviewer visualization).

- Cluster 3 (Blue): This 16-keyword cluster is centred on the theme of "**Hotels' New Sustainable Blueprint in Modern Travel**". The hospitality industry, particularly hotels, is at a crossroads as the global focus shifts toward sustainable development. Modern travelers are increasingly leaning toward environmentally friendly options [82]. Recognizing this, hotels quickly implement green strategies, incorporate conservation methods into their management practices, and move toward environmentally friendly operations. Beyond environmental concerns, corporate social responsibility (CSR) is gaining traction [83]. Hotels are realizing that their performance is measured not only by profit margins, but also by their commitment to the environment and societal well-being [84]. This emphasis on CSR has a dual benefit: It not only paves the way for long-term growth but also improves brand image in the eyes of the increasingly conscious traveler. Furthermore, many hotels implement conservation-focused technologies as part of their strategic overhaul [85]. Energy-saving systems, waste-reduction mechanisms, and water-saving solutions are no longer optional extras but necessities. The hospitality industry's future depends on the seamless integration of effective management, sustainable strategies, and a keen awareness of global conservation goals. With tourism being an ever-growing industry, hotels must champion sustainable development to ensure that the pleasures of travel remain accessible and enjoyable for future generations.

Table 4 provides a comprehensive overview of the co-word analysis conducted on smart hotels. The components encompassed in this are cluster labels, the number of keywords, and the representatives' keywords.

4. Implications

4.1. Theoretical implications

Research on smart hotels is of great significance to scholars and professionals in the hospitality industry. By researching smart hotels, scholars can better understand the field's current state, identify research trends and gaps, review the impact of research, and build evidence-based decision-making. This can help academia contribute to the advancement of smart hotel knowledge and help professionals stay abreast of the latest developments, make informed decisions, and improve the traveler experience. The theoretical implications include three domains. First, the study's identification of research voids in smart hotels, such as a more comprehensive investigation of theories and theories integration in smart hotel research and a more in-depth examination of the consumers' decisions about green hotels, highlights areas for future research and theoretical development about the balance between technological advancements and environmentally responsible products and services. Second, the study's use of co-citation analysis can contribute to developing a new theoretical framework of customer decisions and tourism behavior, which can introduce new dynamics into the smart hotel. Third, this study informs broader debates in smart hotels about the New Era of sustainable tourism, causing a profound transformation in the hospitality industry. Such a hotel genuinely invests in green practices and provide a superior experience, leading to customer loyalty.

4.2. Practical implications

The study of smart hotels helps to identify emerging technologies and trends that are likely to shape the future of hospitality, enabling researchers and practitioners to prepare for and adapt to these changes. There are three practical implications of studying smart hotels. First, the study identifies influential past research works and current prevalent themes in smart hotels, including the use of advanced technologies such as Artificial Intelligence, the Internet of Things, and Big Data. This study facilitates managers in formulating strategies that are both foresighted and adaptable. By comprehending the pivotal trends and cutting-edge technologies within the industry, managers can intelligently introduce and integrate technology based on research recommendations, propelling smart technologies to enhance the operational efficiency and market competitiveness of hotels. Simultaneously, the research uncovers the potential impact of smart technologies on customer experiences, offering managerial insights into refining customer relationship management. Managers can leverage smart technologies to provide more personalized and intelligent services, augmenting customer loyalty, satisfaction, and positioning the hotel prominently in a fiercely competitive market.

Second, the co-word analysis used in this study can serve as a useful tool for researchers and practitioners to systematically analyze smart hotel issues and identify knowledge gaps. Hotels should implement green strategies, incorporating conservation methods into their management practices and moving toward environmentally friendly operations. Policymakers can advance environmental practices in the hotel industry through policies supporting sustainable development, including incentives, regulatory standards to mitigate environmental impact, and encouragement of green technology adoption. For stakeholders, they can gain a comprehensive understanding of smart hotel research findings and help them proactively anticipate and adapt to industry changes. This may encompass training initiatives to adapt to new technologies and develop new skills, enabling stakeholders to better confront the challenges of the intelligent hotel environment. This empowers stakeholders to engage in industry collaborations actively, fostering the formulation of standards. Consequently, this ensures the overall health and development of the entire industry while concurrently presenting stakeholders with increased opportunities for business growth.

Third, the study's findings can inform the development of smart hotel and CSR strategies that hotels' new sustainable strategy in Modern Travel has a dual benefit, which not only paves the way for long term growth but also improves brand image in the eyes of the increasing conscious traveler. Policymakers can gain substantial insights from the study, providing a critical foundation for policies

Table 4
Co-word analysis on smart hotels.

Cluster No and colour	Cluster label	Number of keywords	Representative Keywords
1 (Red)	The New Era of Sustainable Tourism	23	Attitudes, consumers, consumption, decision-making, determinants, environmental concern, extended theory, green hotel, intentions, participation, pay, planned behavior, pro-environmental behavior, responsibility, sustainable tourism, values, willingness-to-pay.
2 (Green)	Elevating Standards and Guest Loyalty	18	Attributes, behavioral intentions, customer satisfaction, experience, go green, green hotels, green practices, hospitality, image, industry, loyalty, perceived value, satisfaction, service quality, trust.
3 (Blue)	Hotels' New Sustainable Blueprint in Modern Travel	16	Behavior, conservation, corporate social-responsibility, environment, green, hospitality industry, hotels, management, performance, strategies, sustainable development, tourism.

Source: Author's interpretation derived from VOSviewer analysis

supporting technological innovation and sustainable development (technology-guided policies). The research findings will help policymakers update relevant regulations, ensuring the intelligent hotel industry's adherence to an appropriate regulatory framework while encouraging innovation. Additionally, this study delves into key aspects of intelligent hotels, including customer experience, data usage, and environmental sustainability. This information guides policymakers to refine regulations, ensuring that intelligent hotels can maximize their potential while meeting regulatory standards, safeguarding consumer rights, and preserving data privacy (regulatory updates). In tackling the ethical issues associated with smart hotel technologies, especially data privacy and security, the paramount importance of safeguarding guest information is emphasized [86]. This entails balancing these technologies' increased convenience and personalization with the critical need to protect guest privacy. Compliance with international data protection regulations is critical for ethical compliance. Furthermore, the importance of strong cybersecurity measures to prevent data breaches and unauthorized access is also emphasized. The use of AI and automated systems has ethical implications, highlighting the potential for bias and the impact on employment in the hospitality industry. Furthermore, our discussion of environmental sustainability highlights the importance of ethical considerations in the industry's transition to sustainable tourism practices. These insights are critical for guiding policymakers in developing regulations that balance advances in smart hotel technologies with ethical considerations, consumer rights, and the importance of data privacy.

5. Conclusion, limitations, and future recommendations

This study provides a comprehensive bibliometric analysis of smart hotel research, addressing a gap in understanding the scholarly landscape. It identifies critical research works and prominent areas of investigation, including sustainable hotels, customer decisions, and social responsibility.

Cluster 1 highlights the importance of sustainable hotels and green hotels. Cluster 2 explores the theories and theories integration in smart hotel research. Cluster 3 indicates consumers' decisions about green hotels. Also, the study identified three prominent themes, namely, "The New Era of Sustainable Tourism," "Elevating Standards and Guest Loyalty," and "Hotels' New Sustainable Blueprint in Modern Travel" have been identified. These results showcase the prominence of information technology and digitalization trends in influencing the evolution and trajectory of hotel research.

This bibliometric investigation significantly enhances the smart hotel literature, offering researchers and practitioners valuable insights and potential directions. As technology continues to shape the hotel sector, future research should explore integrating advanced sensing technologies [5,13], such as computer vision, speech recognition, and sensor technology. This integration is envisioned to substantially elevate the perceptual acuity pertaining to customer needs and environmental dynamics within the hotel domain [87]. Such augmentation not only facilitates a nuanced comprehension of individual preferences and behaviors but also lays the groundwork for providing highly personalized services. Furthermore, the utilization of Augmented Reality (AR) and Virtual Reality (VR) technology is an important area that requires in-depth academic investigation in smart hotels [88,89]. By utilizing AR to provide instant information and navigation services and VR to provide immersive travel experiences, smart hotels have the potential to improve consumer engagement and satisfaction significantly. In addition, the current study of integrating IoT and Smart Devices is insufficient [90,91]. Integrating the Internet of Things (IoT) and smart devices permeates various facets of smart hotels, including smart room devices, energy management systems, and security protocols. The lack of research in this area may give rise to issues related to cost-effectiveness and business efficiency. Further research endeavors are crucial for refining intelligent operational systems. Additionally, future studies should examine the secure application of blockchain technology in smart hotel areas, for instance, addressing security concerns and improving transparency in the areas of consumer data management, payment systems, and supply chain logistics [4,92]. Moreover, understanding the societal, ethical, and environmental implications of digitalization in hospitality should be a priority for future investigations.

Despite its contributions, the study has limitations. It relies on data from the Web of Science database, excluding potential insights from other databases or non-English articles. Due to the limited scope of the Web of Science database, the omission of crucial literature may lead to an insufficient grasp of the comprehensive landscape within the research area and an inadequate comprehension of certain domains or specific subjects [93]. Future research can expand the analysis to include multiple databases, languages, and document types to guarantee a more extensive coverage, thereby facilitating a more thorough acquisition of information. A more qualitative approach can also provide deeper insights into the identified thematic areas. Additionally, the study reveals a need for more research focusing on smart hotels in different countries, presenting an opportunity for future exploration in this area. Substantial cultural variations exist among different countries, potentially resulting in significant differences in the demand, acceptance levels, and expectations for smart hotels. Furthermore, diverse regulatory and policy environments across nations may exert considerable influence on the development and implementation of smart hotels. Future research endeavors could adopt a multi-country research design comprehensively understand the impacts of distinct cultures and markets on smart hotels.

CRediT authorship contribution statement

Xiaoyan Liu: Writing – original draft, Visualization, Funding acquisition, Conceptualization. **Walton Wider:** Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Muhammad Ashraf Fauzi:** Writing – review & editing. **Leilei Jiang:** Writing – review & editing. **Lester Naces Udang:** Writing – review & editing. **Syed Far Abid Hossain:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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