

Riding the green wave: open innovation, ambidexterity and hotel green performance

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Abstract

Purpose – This study examines how green dynamic capabilities, green open innovation and hotel green ambidexterity can be strategically integrated to foster sustainability in hotels, addressing important gaps in the green management and hospitality literature. Specifically, the study aims to empirically validate the sequential mediating roles of green open innovation and hotel green ambidexterity in the relationship between green dynamic capabilities and hotel green performance.

Design/methodology/approach – Using 264 valid responses collected from three-, four- and five-star hotels across four major cities in Pakistan, the study adopts a quantitative research design. The proposed conceptual model is tested using partial least squares structural equation modeling (PLS-SEM) to examine direct, indirect and sequential mediation effects.

Findings – The results indicate that green dynamic capabilities positively influence green open innovation, which in turn enhances hotel green ambidexterity. Hotel green ambidexterity is found to significantly improve hotel green performance. Importantly, the findings demonstrate that green dynamic capabilities influence hotel green performance primarily through a sequential mediation pathway, rather than through isolated mediating paths. This highlights the critical role of green open innovation in enabling ambidextrous green practices that translate capabilities into performance outcomes.

Practical implications – The study offers actionable guidance for hotel managers, emphasizing the need to complement internal green capabilities with open innovation practices and ambidextrous green strategies. For policymakers, the findings suggest that sustainability initiatives in the hospitality sector should promote collaborative green innovation and organizational ambidexterity, rather than focusing solely on internal capability development in isolation.

Originality/value – This study provides novel empirical evidence on the sequential integration of green dynamic capabilities, green open innovation and hotel green ambidexterity in driving hotel green performance. By advancing a process-based explanation of sustainability in service organizations, the study extends dynamic capabilities, open innovation and ambidexterity theories in a hospitality setting.

Keywords Green dynamic capabilities, Green open innovation, Green ambidexterity, Hotel green performance, Sustainability, Hotel management

Paper type Research article

Introduction

In the face of escalating climate change and environmental degradation, global industries are under mounting pressure to align their operations with sustainable development objectives (Intergovernmental Panel on Climate Change [IPCC], 2021; United Nations, 2015). Among these, the tourism and hospitality sector has emerged as both a significant contributor to environmental harm and a promising domain for sustainable innovation. The hospitality industry, in particular, accounts for a substantial portion of tourism-related energy use, carbon emissions, and water consumption (Menegaki, 2025; Bux and Amicarelli, 2023; Gössling *et al.*, 2015; Bohdanowicz, 2006). According to the United Nations World Tourism Organization (UNWTO, 2019), accommodation services constitute one of the primary contributors to tourism-related environmental impacts. Despite its environmental footprint, progress toward sustainability in the hospitality sector has remained inconsistent and fragmented (Salim *et al.*, 2025; Torres-Díaz *et al.*, 2024; Jones *et al.*, 2016). This fragmentation reflects variation in managerial commitment, capability development, and



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the adoption of green innovation practices across hotels. Yet hotels, as central nodes in the tourism ecosystem, are uniquely positioned to influence both upstream supply chains and downstream guest behavior, making them strategically important for environmental transition (Casais and Ferreira, 2023; Popsa, 2023; Kasim, 2006). Accordingly, understanding how hotels can respond to environmental complexity through organizational decision-making and capability development has become an urgent concern. This issue is salient not only for academic researchers but also for industry practitioners and policymakers seeking to align business competitiveness with global climate goals (Font and Lynes, 2018; United Nations, 2015).

To navigate these complexities, many organizations have adopted green dynamic capabilities, which integrate environmental considerations into a dynamic capability framework, enabling firms to sense, seize, and reconfigure resources in response to green opportunities and environmental change (Xiaoyi *et al.*, 2023; Qui *et al.*, 2019; Bogers *et al.*, 2019). Green dynamic capabilities refer to the firm's capacity to embed environmental objectives into its sensing, seizing, and reconfiguring routines (Burton and Dickinger, 2025; Ali Albagawi and Hadi, 2024), thereby enhancing strategic flexibility in sustainability transitions. Prior studies have reported positive associations between green dynamic capabilities, green innovation, and organizational performance (e.g. Xiaoyi *et al.*, 2023; Li, 2022; Zhan *et al.*, 2020; Qui *et al.*, 2019; Chen *et al.*, 2015). However, in service-oriented sectors such as hospitality the effects of green dynamic capabilities are rarely linear or direct. For example, Merli *et al.* (2019) highlighted the indirect link between green initiatives and hotels' green performance, raising the critical question, "Why should hotels go green?" (p. 176). This observation points to a gap in understanding the processes through which green dynamic capabilities are converted into tangible environmental performance outcomes in hotels.

While existing literature acknowledges this indirect linkage, it often falls short of explicating the specific mechanisms through which green dynamic capabilities translate into measurable green performance. In particular, constructs such as green open innovation and green ambidexterity, which represent critical organizational processes, remain under-theorized and empirically underexplored in the hospitality context (Xiaoyi *et al.*, 2023; He and Wang, 2023; Chabbouh and Boujelbene, 2022; Yousaf, 2021; Pundziene *et al.*, 2022; Johannes *et al.*, 2021; Hwang *et al.*, 2021; De Aro and Perez, 2021; Jurksiene and Pundziene, 2016). Most prior models have been developed in manufacturing or high-technology settings, implicitly assuming production-oriented logics that may not fully capture the customer-facing, service-intensive, and resource-embedded nature of hotel operations. As a result, it remains unclear whether hotels are merely adopting symbolic green practices or genuinely transforming their organizational capabilities into sustained environmental performance. Addressing this gap is therefore critical for advancing both theory and practice in sustainable hospitality management.

From a contextual perspective, this study focuses on the hotel sector in Pakistan, a developing economy that offers a theoretically and empirically distinctive setting for examining green capability–performance mechanisms. Unlike developed economies, where environmental regulations, technological infrastructure, and sustainability standards are relatively institutionalized, hotels in Pakistan operate under conditions of regulatory volatility, limited access to green technologies, resource constraints, and uneven enforcement of environmental standards (Hussain *et al.*, 2024). These conditions heighten the strategic importance of organizational capabilities and external knowledge sourcing in achieving environmental performance. Consequently, the Pakistani hotel sector provides a critical context in which green dynamic capabilities cannot be assumed to translate directly into green performance, but must operate through intermediate organizational mechanisms such as green open innovation and green ambidexterity. Examining this context therefore allows the study to extend existing green management and innovation theories by

demonstrating how contextual constraints shape the pathways through which firms convert environmental capabilities into sustainable performance outcomes.

Green open innovation refers to two complementary processes: outside-in innovation, whereby external green knowledge is integrated into internal practices, and inside-out innovation, whereby internal green knowledge is shared externally through partnerships, collaborations, or licensing (Surya *et al.*, 2025; Thao and Xie, 2024; Yang and Roh, 2019). These processes are particularly salient in service-intensive sectors, where boundary-spanning interactions with suppliers, technology providers, and institutional actors enable rapid sustainability transitions. Green dynamic capabilities facilitate openness by strengthening absorptive capacity and outward orientation, thereby laying the groundwork for external collaboration and internal knowledge recombination. For instance, international hotel chains have adopted green innovations through alliances with cleantech firms, deploying smart systems and renewable energy solutions to reduce emissions, illustrating how openness can build on internal capabilities to support green outcomes.

At the same time, openness to green innovation is closely linked to green ambidexterity, defined as the ability of hotels to simultaneously explore new environmental opportunities while exploiting existing green practices to enhance efficiency (Kim *et al.*, 2025; Chen *et al.*, 2022, p. 7790; Peters and Buijs, 2022; Zhao *et al.*, 2021). Green exploration involves initiatives such as developing eco-friendly business models or adopting renewable energy systems, whereas green exploitation focuses on improving existing processes related to energy efficiency, waste reduction, and water conservation (Lee, 2025; Shoaib *et al.*, 2025; Ali Albagawi and Hadi, 2024). Openness to green innovation broadens the firm's environmental knowledge base, supporting exploration through diverse knowledge inflows and exploitation through the refinement and diffusion of existing practices.

Prior studies suggest that green ambidexterity is positively associated with organizational green performance (Hossain *et al.*, 2025; Johannes *et al.*, 2021; Úbeda-García *et al.*, 2022; Pundziene *et al.*, 2022; Hwang *et al.*, 2021; Yousaf, 2021). Similarly, Grimaldi *et al.* (2013) demonstrated that firms with strong dynamic capabilities are better positioned to support open innovation processes due to their ability to reconfigure resources and integrate external knowledge. Despite these insights, empirical research has rarely examined how green dynamic capabilities, green open innovation, and green ambidexterity operate together as a sequential mechanism, particularly in the hospitality sector. Consequently, the pathways through which hotels transform environmental capabilities into green performance remain insufficiently understood.

Against this backdrop, this study investigates the sequential mediating roles of green open innovation and green ambidexterity in the relationship between green dynamic capabilities and hotel green performance. By focusing on hotels operating in Pakistan (a developing economy where environmental regulation, resource constraints, and sustainability pressures intersect), the study provides a contextually grounded examination of these mechanisms in a service-dominated setting. By building and empirically testing an integrated model, the study responds to a pressing need for clarity on how organizational capabilities translate into environmental outcomes in hospitality firms. Theoretically, this study integrates dynamic capabilities, open innovation, and organizational ambidexterity to advance understanding of green performance in the hospitality sector. Empirically, it validates the sequential mediating roles of green open innovation and green ambidexterity, offering novel insight into the indirect pathways linking green dynamic capabilities to hotel green performance. Practically, the findings provide decision-relevant guidance for hotel managers and policymakers seeking to align environmental initiatives with global sustainability priorities, including the United Nations Sustainable Development Goals (UN SDGs), particularly Goals 8 (Decent Work and Economic Growth), 9 (Industry, Innovation, and Infrastructure), and 12 (Responsible Consumption and Production).

Literature review

Theoretical Underpinning

Grounded in the resource-based view (RBV) (Barney, 1991), this study integrates three complementary frameworks (green dynamic capabilities, green open innovation, and green ambidexterity) into a unified conceptual model to explain hotel green performance. From the RBV perspective, organizations achieve superior performance by developing resources and capabilities that are valuable, rare, inimitable, and non-substitutable. Within this logic, hotel green performance is conceptualized as an outcome of firm-specific green resources and capabilities, including the ability to balance exploratory and exploitative green activities (i.e. green ambidexterity). However, because hospitality firms operate in highly dynamic, customer-facing, and resource-intensive environments, RBV alone provides a static explanation that is insufficient to capture adaptive and innovation-driven responses to environmental change.

To address this limitation, the study draws on the dynamic capabilities framework, which extends RBV by emphasizing firms' abilities to integrate, build, and reconfigure internal and external competencies in response to environmental volatility (Teece et al., 1997). Dynamic capabilities enable organizations not only to possess valuable resources, but also to renew and redeploy them as environmental conditions evolve. In the hospitality context, where sustainability pressures, regulatory demands, and stakeholder expectations change rapidly, green dynamic capabilities are particularly critical for sensing environmental opportunities, seizing green initiatives, and reconfiguring operational routines accordingly (Widyantoro et al., 2025; Pereira-Moliner et al., 2021). These capabilities provide the foundation for transforming environmental intentions into actionable organizational practices.

However, even strong internal capabilities may be insufficient when organizations rely exclusively on internally generated knowledge. Accordingly, the open innovation perspective complements the dynamic capabilities framework by emphasizing the strategic role of external knowledge flows. Open innovation theory suggests that firms enhance their green knowledge base through outside-in processes (acquiring external green knowledge) and inside-out processes (sharing internal green knowledge with external actors) (Chesbrough, 2003; March, 1991). Green dynamic capabilities facilitate these processes by strengthening organizational learning, absorptive capacity, and flexibility, thereby enabling firms to engage more effectively in green open innovation. Building on this logic, green open innovation functions as a conduit through which green dynamic capabilities are operationalized, allowing hotels to access diverse environmental knowledge and embed it into innovation activities. These boundary-spanning knowledge flows, in turn, support green ambidexterity by enabling organizations to pursue both green exploration and green exploitation simultaneously. Exploration-oriented activities support the development of novel green solutions, while exploitation-oriented activities refine and improve existing environmental practices. The ability to balance these dual processes is particularly salient in hospitality settings, where sustainability improvements must be achieved without disrupting service quality or operational efficiency.

Taken together, this integrated theoretical perspective positions green dynamic capabilities as the foundational enabler, green open innovation as the knowledge transmission mechanism, and green ambidexterity as the capability through which environmental value is realized. Within this framework, hotel green performance emerges not as a direct outcome of isolated capabilities, but as the result of a structured and interdependent process linking internal capability development, external knowledge engagement, and ambidextrous innovation behavior. This theoretical integration provides a coherent foundation for examining the sequential relationships proposed in the study's conceptual model.

Green dynamic capabilities and green open innovation

To address rapidly changing environments while sustaining green organizational performance, organizations require green dynamic capabilities (Ma et al., 2025; Bağış et al., 2025; Yi and

Demirel, 2023; Teece, 2020; Qui *et al.*, 2019). Green dynamic capabilities refer to a firm's ability to integrate, reconfigure, and leverage internal and external green knowledge in response to environmental challenges (Rafique *et al.*, 2026; Anser *et al.*, 2025). These capabilities enable organizations to embed sustainability considerations into both operational routines and strategic decision-making processes. However, the strategic value of embedded green knowledge depends not merely on its possession, but on how effectively it is mobilized, recombined, and exchanged beyond organizational boundaries.

In this regard, green open innovation represents a critical organizational mechanism. Green open innovation is defined as a collaborative strategy through which firms engage external stakeholders to acquire and share green knowledge through inbound and outbound innovation processes (Alshibani *et al.*, 2026; Surya *et al.*, 2025; Yang and Roh, 2019). Through these processes, organizations complement internal environmental knowledge with externally sourced insights, technologies, and practices, thereby enhancing the scope and effectiveness of green innovation activities. Accordingly, green open innovation provides a structured pathway through which internal capabilities are translated into externally oriented green knowledge flows.

Prior research provides strong support for the linkage between dynamic capabilities and open innovation. Chabbouh and Boujelbene (2022) argue that effective open innovation requires managers who possess well-developed dynamic capabilities. Similarly, Grimaldi *et al.* (2013) demonstrate that firms with strong dynamic capabilities are more likely to engage in open innovation than firms with weaker capabilities. Other studies further emphasize that dynamic capabilities facilitate open innovation by strengthening organizational flexibility, learning, and absorptive capacity (Wang *et al.*, 2022; Chabbouh and Boujelbene, 2022; Pundziene *et al.*, 2022). Hervas-Oliver *et al.* (2021) also contend that the strategic management of open innovation is contingent on dynamic capabilities that enable firms to manage complex external knowledge flows effectively.

Despite this growing body of evidence, empirical research has paid limited attention to the relationship between green dynamic capabilities and green open innovation, particularly within service-oriented and hospitality contexts. Existing sustainability studies have largely examined these constructs in isolation or within manufacturing settings, leaving their interaction underexplored in environmentally intensive service industries (Luu, 2025; Tuan, 2025). Yan and Roh (2019) further emphasize that achieving environmental sustainability requires not only internal green innovation efforts but also collaborative engagement with external stakeholders, underscoring the relevance of green open innovation as an extension of internal capabilities.

Drawing on this theoretical logic, green dynamic capabilities are expected to enhance green open innovation by enabling hotels to sense environmental opportunities, absorb external green knowledge, and strategically reconfigure resources to support collaborative innovation. Accordingly, the following hypothesis is proposed:

H1. Green dynamic capabilities positively influence green open innovation.

Green open innovation and organizational green ambidexterity

Organizational ambidexterity is defined as the ability of an organization to simultaneously pursue exploitative and explorative innovation activities (Tushman & O'Reilly, 1996, p. 24). Prior research conceptualizes ambidexterity as the capability to exploit existing competencies while concurrently exploring new opportunities, often referred to as dual innovation or the balance between exploitative and explorative innovation (Elmakkawy *et al.*, 2025; Hadi and Sheikh, 2024; Martínez-Falcó *et al.*, 2024a; Ali Albagawi and Hadi, 2024; Mahmood *et al.*, 2019). In environmental management contexts, this logic is extended to organizational green ambidexterity, which captures firms' abilities to refine existing green practices while simultaneously developing novel environmental solutions.

Empirical evidence suggests that open innovation plays a critical role in enabling organizational ambidexterity. [Hwang et al. \(2021\)](#) demonstrate that open innovation fosters ambidextrous innovation behavior, which subsequently influences firm performance. However, their findings also indicate that the strength of this relationship depends on how openness is managed, as excessive openness may dilute core innovation capabilities. In contrast, [Johannes et al. \(2021\)](#), adopting a multidimensional perspective, report a strong and complementary relationship between open innovation and organizational ambidexterity. These findings collectively suggest that openness to innovation when strategically structured supports the simultaneous pursuit of exploration and exploitation. To stimulate effective ambidexterity, openness through both outside-in (external knowledge exploration) and inside-out (internal knowledge exploitation) processes is essential ([Sun et al., 2019](#); [Chen and Liu, 2018](#)).

Despite these insights, prior studies have largely overlooked the role of *green open innovation* in shaping organizational green ambidexterity. Although a limited number of studies have examined green ambidexterity as a mediating mechanism (e.g. [Gao et al., 2026](#); [Jabeen et al., 2025](#); [Viterouli et al., 2025](#); [Úbeda-García et al., 2022](#); [Chen et al., 2022](#); [Zhao et al., 2021](#); [Chen et al., 2015](#)), there is a notable absence of empirical research directly testing the effect of green open innovation on organizational green ambidexterity. Moreover, existing studies rarely quantify how green dynamic capabilities, green open innovation, and organizational green ambidexterity jointly interact to influence green performance outcomes ([Huang et al., 2026](#); [Shoaib et al., 2025](#); [Lee, 2025](#); [Peters and Buijs, 2022](#); [Chen et al., 2022](#); [Úbeda-García et al., 2022](#); [Zhao et al., 2021](#)). This study addresses this gap by positioning green open innovation as a critical antecedent of organizational green ambidexterity in the hotel context. Hotels that rely exclusively on internally generated green knowledge may encounter constraints in balancing exploration and exploitation. In contrast, green open innovation broadens the organizational green knowledge base through diverse external sources, enabling hotels to generate new environmental solutions while simultaneously refining existing green practices. Through structured inbound and outbound green knowledge flows, green open innovation supports the dual innovation logic required for organizational green ambidexterity in service-intensive hospitality settings. Drawing on this theoretical reasoning, the following hypothesis is proposed:

- H2.* Green open innovation positively influences organizational green ambidexterity in hotels.

Organizational green ambidexterity and organizational green performance

Previous studies have consistently shown that innovation is vital for sustaining firms' long-term growth and competitiveness ([Hafeez et al., 2025](#); [Hall and Wagner, 2012](#); [Hall and Vredenburg, 2003](#)). Organizational ambidexterity defined as the ability to simultaneously pursue exploration and exploitation has therefore been widely recognized as a critical source of competitive advantage ([Jabeen et al., 2025](#); [Kim et al., 2025](#); [Lee, 2025](#); [Jurksiene and Pundziene, 2016](#)). Advancing this line of inquiry, [Junni et al. \(2013\)](#) report a positive relationship between organizational ambidexterity and firm performance. Further conceptualizing ambidexterity as a mediating mechanism, [Hwang et al. \(2021\)](#) demonstrate that ambidextrous capabilities significantly enhance organizational performance by enabling firms to balance innovation efficiency with adaptability.

Building on this evidence, a systematic review by [Junni et al. \(2013, p. 308\)](#) concludes that in dynamic environments, performance sustainability over time is inherently uncertain, thereby reinforcing ambidexterity as a critical organizational capability for maintaining competitive advantage. These insights are particularly relevant for environmentally intensive industries, where firms must continuously adapt green practices while preserving operational efficiency. From a green innovation perspective, [Úbeda-García et al. \(2022\)](#) show that

organizational green ambidexterity defined as the ability to simultaneously engage in green exploration (e.g. adopting new eco-innovations) and green exploitation (e.g. improving existing sustainability practices) mediates the relationship between green high-performance work systems and environmental performance. Importantly, these authors emphasize the need for further research to unpack the mechanisms through which green ambidexterity connects to broader organizational outcomes (p. 41).

Related empirical studies further support the performance-enhancing role of green ambidexterity. [Chen et al. \(2015\)](#) find that green exploration and green exploitation learning mediate the relationship between green absorptive capacity and both green radical and incremental innovation. Similarly, [Viterouli et al. \(2025\)](#) and [Chen et al. \(2022\)](#) demonstrate that green exploratory and exploitative innovation mediate the relationship between green organizational identity and green competitive advantage. Other scholars highlight the need for future research to examine the mechanisms through which green innovation capabilities translate into environmental and competitive outcomes ([Nguyen et al., 2025](#); [Della Corte et al., 2025](#); [Hafeez et al., 2025](#); [Martínez-Falcó et al., 2024b](#); [Zhao et al., 2021](#)). Collectively, these studies position organizational green ambidexterity as a central capability for advancing environmental innovation and performance.

Despite this growing body of literature, the specific pathways through which organizational green ambidexterity contributes to environmental performance remain underexplored, particularly in service-oriented contexts such as hospitality. Hotels operate in environments characterized by high customer interaction, operational complexity, and resource intensity, which heightens the importance of balancing green exploration and exploitation. Accordingly, organizational green ambidexterity is expected to enhance hotels' capacity to implement innovative environmental practices while simultaneously improving the efficiency and effectiveness of existing sustainability initiatives. In dynamic and environmentally demanding contexts, such ambidextrous capability becomes essential for achieving sustained hotel green performance. Based on this theoretical reasoning, the following hypothesis is proposed:

H3. Organizational green ambidexterity positively influences hotel green performance.

Sequential role of green open innovation and hotel green ambidexterity

Green dynamic capabilities and green open innovation represent conceptually distinct yet interrelated organizational constructs ([Hadi and Ali, 2025](#)). Firms possessing strong green dynamic capabilities are able to sense environmental changes, reconfigure internal resources, and generate green products and services through internal capability renewal ([Larabi, 2025](#); [Yousaf, 2021](#), p. 54,866). Recent evidence further suggests that green dynamic capabilities operate as higher-order enabling mechanisms that shape firms' strategic responsiveness to environmental complexity, particularly in emerging and sustainability-oriented contexts ([Anser et al., 2025](#); [Essuman et al., 2025](#)). However, reliance on internally circulating knowledge alone may be insufficient to sustain superior green innovation outcomes ([Hadi et al., 2025](#)), particularly in dynamic and service-intensive environments such as hospitality. Accordingly, firms increasingly require a collaborative innovation strategy "green open innovation" that enables the systematic acquisition, sharing, and integration of updated environmental knowledge from external stakeholders.

Green open innovation facilitates both inbound and outbound green knowledge flows, each serving a distinct innovation function. The inflow of green knowledge from diverse external actors supports green explorative innovation, while the outflow of internal green knowledge enhances green exploitative innovation by refining, scaling, and diffusing existing practices. Recent studies emphasize that these bidirectional knowledge flows are especially critical in service industries, where innovation outcomes depend heavily on external partnerships and ecosystem-level collaboration ([Thao and Xie, 2024](#); [Surya et al., 2025](#)). Prior research suggests that both green exploration and green exploitation contribute positively to

organizational green performance (Martínez-Ros and Orfila-Sintes, 2009; Orfila-Sintes *et al.*, 2005). Despite the growing recognition of these relationships, the literature provides limited insight into how green dynamic capabilities translate into environmental performance through a structured and sequential capability-building process.

Empirical evidence further highlights the strategic importance of green performance outcomes in the hospitality context. For example, Merli *et al.* (2019), in their examination of guest experiences in green hotels, demonstrate that superior environmental performance significantly enhances guest loyalty, noting that “guests who stayed in green hotels are eager to return and recommend it to their friends” (p. 176). More recent hospitality studies reinforce this view by linking green innovation practices to competitive positioning and long-term sustainability outcomes (Elmakkawy *et al.*, 2025; Martínez-Falcó *et al.*, 2024a). Nevertheless, recent research continues to emphasize that the organizational mechanisms through which hotels achieve green performance remain insufficiently examined from a green management perspective (Zafar *et al.*, 2025; Muisyo *et al.*, 2022). In particular, limited attention has been given to understanding how internal capabilities, external knowledge engagement, and ambidextrous innovation behaviors interact as a coherent and sequential process.

To address this gap, the present study integrates insights from the green ambidexterity literature (Muisyo *et al.*, 2022; Úbeda-García *et al.*, 2022; Peters and Buijs, 2022; Zhao *et al.*, 2021) with the green open innovation framework (Yang and Roh, 2019). Building on recent extensions of green ambidexterity theory that highlight its role as a dynamic innovation capability rather than a static organizational trait (Martínez-Falcó *et al.*, 2024b; Hafeez *et al.*, 2025), the study conceptualizes a sequential mediation mechanism linking green dynamic capabilities to hotel green performance through green open innovation and organizational green ambidexterity. Sequential mediation refers to a process in which green dynamic capabilities first enable green open innovation, which subsequently fosters organizational green ambidexterity, ultimately enhancing hotel green performance.

This pathway suggests that the ability to absorb and share external green knowledge enables hotels to develop ambidextrous innovation strategies balancing green exploration and green exploitation which in turn lead to improved environmental performance. Recent empirical work supports this process logic by demonstrating that open innovation mechanisms are most effective when they translate into ambidextrous green innovation outcomes (Kim *et al.*, 2025; Gao *et al.*, 2026). Within this framework, green open innovation and organizational green ambidexterity function as complementary and interdependent mechanisms that transmit the effects of green dynamic capabilities onto green performance outcomes. Internal innovation efforts, when combined with structured collaboration among key stakeholders, therefore represent a critical capability-building pathway for advancing environmental sustainability in hotels. Based on this sequential capability logic, the following hypothesis is proposed:

- H4. Green open innovation and organizational green ambidexterity sequentially mediate the relationship between green dynamic capabilities and hotel green performance.

Methodological approach

The theoretical foundation of the present study is grounded in three complementary perspectives: the dynamic capabilities framework, the open innovation framework, and the organizational ambidexterity framework. These perspectives guided the development of the conceptual model and the associated research hypotheses. Given the study's objective of examining relationships among latent constructs and testing a sequential mediation mechanism, a quantitative research design was employed for data collection and analysis.

Data were collected using a purposive sampling technique, as the study specifically targeted managerial-level hotel employees who possess relevant knowledge of green practices, innovation strategies, and environmental decision-making. This approach is

consistent with prior sustainability and innovation research in hospitality contexts, where managers are considered appropriate key informants due to their involvement in strategic and operational decisions. Two modes of data collection online and offline were used following respondents' informed and voluntary agreement to participate.

Data were collected at a single point in time from three-star, four-star, and five-star hotels located in four major Pakistani cities: Peshawar, Islamabad, Rawalpindi, and Lahore. Three-star and above hotels were selected because they are more likely to engage in both exploitative and explorative activities and to implement structured sustainability initiatives (Ghantous and Alnawas, 2020). Moreover, approximately 95% of three-star and above hotels in Pakistan are concentrated in major urban centers, which justifies the selection of the four targeted cities. The hotel industry operates in a highly competitive environment (Moise *et al.*, 2021), creating strong pressure to adopt green performance practices. Recent evidence indicates that nearly two-thirds of travelers prefer environmentally responsible hotels (Frasson, 2018). Similarly, Merli *et al.* (2019) and Saura *et al.* (2023) report that guests staying in green hotels are more likely to return and recommend such hotels to others. Despite this growing emphasis on sustainability, the organizational mechanisms underlying hotel green performance remain insufficiently examined (Muisyo *et al.*, 2022). In addition, Takalo *et al.* (2021), in a review of 178 studies on green innovation, explicitly call for greater attention to knowledge-sharing and innovation practices in service industries, while Guaita-Martínez *et al.* (2021) emphasize the role of social sustainability in enhancing competitiveness and growth in tourism. Based on these considerations, the population for this study was defined as three-star and above hotels operating in the four selected Pakistani cities.

To ensure data quality and construct validity, managerial-level employees were targeted. A total of 341 hotel managers were approached, distributed as follows: 65 in Peshawar, 115 in Lahore, 101 in Islamabad, and 60 in Rawalpindi. Of the distributed questionnaires, 292 responses were received, resulting in a response rate of 85.6%. After excluding 28 responses due to missing data or straight-lining response patterns, 264 valid responses were retained for final analysis. All respondents were informed about the purpose of the study, participation was voluntary, and anonymity was assured. Ethical guidelines were followed in accordance with standard academic research practices.

Given the use of self-reported survey data, potential common method bias was addressed through both procedural and statistical remedies. Procedurally, respondents were assured of anonymity and confidentiality, and participation was voluntary, thereby reducing evaluation apprehension and social desirability bias. Statistically, Harman's single-factor test was conducted, and the results indicated that a single factor accounted for 36% of the total variance, which is below the recommended threshold of 50% (Podsakoff *et al.*, 2003). In addition, full collinearity variance inflation factors (VIFs) were examined following PLS-SEM guidelines, and all VIF values were below the conservative threshold of 3.3, indicating that common method bias is unlikely to be a serious concern (Kock, 2015). Given the presence of higher-order constructs and the study's focus on testing direct, indirect, and sequential mediation relationships, the proposed model was analyzed using partial least squares structural equation modeling (PLS-SEM) with SmartPLS v4.1.1.6. This approach is well suited for complex models involving hierarchical constructs and mediation analysis and is consistent with recent methodological recommendations for sustainability and hospitality research.

Instrumentation

To empirically test the integrated research model, this study employed validated instruments adapted from previous studies. The scale used to measure green dynamic capabilities was adapted from Zhang *et al.* (2020, p. 2929) and comprises three dimensions and nine items (e.g. "Our hotel often observes the market's demand for green technology to identify new green development opportunities"; "Our hotel is able to digest and absorb the green knowledge it finds"; "Our hotel is able to assign employees green knowledge so that their professional

skills can be further developed”). In line with measurement theory (Hadi, 2022), this construct is modeled as reflective-formative. Similarly, green open innovation and hotel green ambidexterity were also measured using reflective-formative models. Green open innovation was measured using a two-dimensional scale (inbound and outbound), adapted from (Chen and Liu, 2018, p. 12). Sample items include: “Our hotel often acquires technological green knowledge from outside for internal use” (inbound), and “Our hotel welcomes others to purchase and use our technological green knowledge” (outbound).

Hotel green ambidexterity was measured using a two-dimensional approach-exploitative and explorative green innovation, adapted from (Úbeda-García *et al.*, p. 45). The scale includes six items. Sample items include: “Our hotel actively improves green products, processes, and services” (exploitative) and “Our hotel actively adopts new green products, processes, and services” (explorative). The hotel’s green performance was assessed using a five-item reflective scale adapted from (Úbeda-García *et al.*, 2022, p. 45), with a sample item being: “Increase in the number of eco-friendly products/services developed.” Full details of all measurement items are presented in Table 1.

Data analysis

Profile of Participants

A total of 264 valid responses were collected from hotel managers across four major cities in the Punjab and Khyber Pakhtunkhwa (KP) provinces, representing the hotel industry in these regions. Regarding age, 101 respondents (38.3%) were aged 56 and above, 150 (56.8%) were between 41 and 55 years, 10 (3.8%) were between 26 and 40 years, and only three respondents were below 25 years of age. In terms of gender, 196 respondents (74.2%) were male and 68 (25.8%) were female. With respect to education, 123 respondents (46.6%) held a bachelor’s degree, 87 (33%) held a master’s degree, 11 (4.2%) had a qualification higher than a master’s, and 43 (16.3%) held a diploma in tourism and hospitality. As for monthly income, 191 respondents (72.3%) earned between PKR 86,000 and PKR 100,000. Regarding work experience, 94 respondents (35.6%) had 4–6 years of experience, 87 (33%) had 1–3 years, and 48 (18.2%) had more than seven years of experience. In terms of organizational position, 114 respondents (43.2%) were middle-level managers, 87 (33%) were senior-level managers, and 63 (23.9%) were supervisors.

Factor loadings and collinearity

Table 1 presents the standardized factor loadings and variance inflation factor (VIF) values for all first-order indicators associated with the study’s second-order constructs, as estimated using SmartPLS v4.1.1.6. The results provide evidence regarding indicator reliability, convergent validity, and multicollinearity, which are essential prerequisites for structural model assessment in PLS-SEM.

Indicator reliability and convergent validity. Across all constructs, the standardized factor loadings exceed the recommended minimum threshold of 0.70, indicating satisfactory indicator reliability (Hair *et al.*, 2022). Specifically, the loadings range from 0.715 to 0.909, demonstrating that all items exhibit a strong association with their respective latent constructs. This suggests that the indicators adequately capture the conceptual domains they are intended to measure. For green dynamic capabilities, all indicators related to green sensing, green seizing, and green reconfiguring display high loadings, reflecting a robust operationalization of the firm’s ability to sense environmental opportunities, absorb and apply green knowledge, and reconfigure organizational resources. In particular, items related to green reconfiguring show especially strong loadings (up to 0.909), highlighting the centrality of resource reallocation and structural flexibility in green capability development within hotels. Similarly, the indicators measuring green open innovation demonstrate satisfactory loadings for both inbound and outbound dimensions. The consistently high loadings across items indicate that

Table 1. Nature of constructs, loadings, and collinearity assessment

Second-order construct	First-order construct	Items description	Loadings	Collinearity (VIF)
Green dynamic capabilities (GDC)	<i>Green sensing (GSEN_C)</i>	GSEN_C1 - “Our hotel often observes the market’s demand for green technology to identify new green development opportunities”	0.872	1.862
		GSEN_C2 - “Our hotel often observes the market and analyzes the impact of the development of green technology on customers”	0.858	1.784
		GSEN_C3 - “Our hotel regularly reviews its green activities to ensure they meet customers’ needs”	0.792	1.517
	<i>Green seizing (GSEZ_C)</i>	GSEZ_C1 - “Our hotel is able to digest and absorb the green knowledge it finds”	0.883	2.160
		GSEZ_C2 - “Our hotel has procedures in place to develop new green knowledge”	0.852	1.794
		GSEZ_C3 - “Our hotel can apply the green knowledge it has learned”	0.869	2.160
	<i>Green reconfiguring (GR)</i>	GR_C1 - “Our hotel is able to rearrange its structure to accept changes”	0.909	2.616
		GR_C2 - “Our hotel is able to assign employees green knowledge so that the professional skills of employees can be further developed”	0.819	1.759
		GR_C3 - “Our hotel is able to successfully allocate resources and carry out green technology innovation activities”	0.848	1.906
	<i>Inbound green open innovation (GI_OI)</i>	GI_OI1 - “Our hotel tends to build greater ties with external parties and rely on their green knowledge”	0.844	2.162
		GI_OI2 - “Our hotel proactively reaches out to external parties for better technological green knowledge”	0.814	1.854
		GI_OI3 - “Our hotel often acquires technological green knowledge from outside for internal use”	0.838	2.023
		GI_OI4 - “Our hotel regularly searches for external green ideas that may create value for us”	0.774	1.584
		GO_OI1 - “Our hotel welcomes others to purchase and use our technological green knowledge”	0.858	2.191
		GO_OI2 - “Our hotel is proactive in managing outward green knowledge flows”	0.812	1.866
		GO_OI3 - “Our hotel makes it a formal practice to sell technological green knowledge in the market”	0.843	1.944
		GO_OI4 - “Our hotel has dedicated promoters to commercialize green knowledge”	0.715	1.440
Green open innovation (GOI)	<i>Outbound green open innovation (GO_OI)</i>			

(continued)

Management
Decision

Table 1. Continued

Second-order construct	First-order construct	Items description	Loadings	Collinearity (VIF)
Hotel's green ambidexterity (HGP)	<i>Green exploitation</i>	EXPL_1 - "Our hotel actively improves green products, processes, and services"	0.838	1.933
		EXPL_2 - "Our hotel actively strengthens the current green market"	0.726	1.374
		EXPL_3 - "Our hotel actively strengthens current green technology"	0.777	1.275
	<i>Green exploration</i>	EXPR_1 - "Our hotel actively adopts new green products, processes, and services"	0.860	2.385
		EXPR_2 - "Our hotel actively exploits new green products, processes, and services"	0.909	2.626
		EXPR_3 - "Our hotel actively discovers new green markets"	0.824	1.690
		The actions developed in my hotel to take care of the environment have had an impact on: HGP1 - "increase in the number of eco-friendly products/ services developed"	0.860	2.349
	Hotel's green performance (HGP)	HGP2 - "Reduction of total direct and indirect toxic emissions"	0.866	2.369
		HGP3 - "Increase in the volume of recycled materials"	0.823	2.000
		HGP4 - "Increase in the rate of renewable energy consumption"	0.758	1.670
		HGP5 - "Reduction of total direct and indirect energy consumption"	0.726	1.658

Source(s): Adapted from [Zhang et al. \(2020, p. 2929\)](#), [Úbeda-García et al. \(2022, p. 45\)](#), [Chen and Liu \(2018, p. 12\)](#)

the scale effectively captures both external green knowledge acquisition and outward green knowledge dissemination practices. This supports the conceptualization of green open innovation as a multidimensional construct encompassing inbound and outbound knowledge flows.

For hotel green ambidexterity, both green exploitation and green exploration items exhibit strong loadings, confirming that the construct adequately reflects the hotel's ability to balance incremental improvements in existing green practices with the pursuit of novel environmental solutions. The high loadings for green exploration items (up to 0.909) suggest that proactive engagement in new green products, processes, and markets is a salient aspect of ambidexterity in the hospitality context. Finally, the indicators of hotel green performance demonstrate solid loadings across environmental outcome dimensions, including emissions reduction, energy efficiency, recycling, and renewable energy usage. These results indicate that the construct captures a comprehensive range of environmental performance outcomes relevant to hotel operations. Collectively, the magnitude and consistency of the factor loadings provide strong support for indicator reliability and convergent validity across all constructs.

Assessment of multicollinearity. To evaluate potential multicollinearity issues at the indicator level, item-wise VIF values were examined. As shown in [Table 1](#), all VIF values range between 1.275 and 2.626, remaining well below the conservative threshold of 3.3 and the more liberal threshold of 5.0 commonly applied in PLS-SEM ([Podsakoff et al., 2003](#)). These results indicate that multicollinearity is not a concern among the measurement

indicators. The absence of high VIF values suggests that each item contributes unique explanatory information to its respective construct, without excessive overlap with other indicators. This further strengthens confidence in the stability and interpretability of the estimated measurement model.

Reliability and convergent validity assessment

Table 2 reports the results of the internal consistency reliability and convergent validity assessment for all constructs included in the model. Following established PLS-SEM guidelines, construct reliability was evaluated using Cronbach's alpha, composite reliability (ρ_a and ρ_c), while average variance extracted (AVE) was used to assess convergent validity (Hair *et al.*, 2019).

Internal consistency reliability. Across the constructs, Cronbach's alpha values range from 0.683 to 0.877, indicating acceptable to strong internal consistency reliability. Although Cronbach's alpha values slightly below the conventional 0.70 threshold are observed for green exploitation (EXPL = 0.683), this is considered acceptable in PLS-SEM, particularly for constructs with a limited number of indicators and exploratory research contexts. Moreover, Cronbach's alpha is known to be a conservative reliability estimate, especially in variance-based SEM. To address this limitation, composite reliability measures (ρ_a and ρ_c) were examined, which are more appropriate reliability indicators in PLS-SEM. The results show that all constructs exceed the recommended threshold of 0.70 for both ρ_a and ρ_c , with composite reliability (ρ_c) values ranging from 0.824 to 0.904. These findings confirm that all constructs demonstrate satisfactory internal consistency and reliability. Notably, higher-order constructs such as green dynamic capabilities (GDC), green open innovation (GOI), hotel green ambidexterity (HGA), and hotel green performance (HGP) exhibit strong composite reliability values, indicating that their underlying dimensions are consistently represented by the observed indicators.

Convergent validity. Convergent validity was assessed using average variance extracted (AVE), which reflects the proportion of variance captured by a construct relative to the variance due to measurement error. As shown in Table 2, AVE values for most constructs exceed the recommended threshold of 0.50, ranging from 0.539 to 0.754, thereby providing

Table 2. Reliability and convergent validity

Construct	Cronbach's alpha	Composite reliability (ρ_a)	Composite reliability (ρ_c)	Average variance extracted (AVE)
GDC	0.864	0.867	0.892	0.499
GI_OI	0.835	0.836	0.890	0.669
GOI	0.877	0.880	0.903	0.539
GO_OI	0.822	0.832	0.883	0.654
GR_C	0.822	0.833	0.894	0.738
GSEN_C	0.793	0.801	0.879	0.708
GSEZ_C	0.837	0.836	0.902	0.754
HGA	0.852	0.863	0.891	0.581
EXPL	0.683	0.698	0.824	0.611
EXPR	0.831	0.833	0.899	0.748
HGP	0.867	0.883	0.904	0.654

Note(s): GDC: green dynamic capabilities; GSEN-C: green sensing capability; GSEZ-C: green seizing capability; GR-C: green reconfiguration capability; GOI: green open innovation; GI-OI: green inbound open innovation; GO-OI: green outbound open innovation; HGA: hotel green ambidexterity; EXPR: explorative; EXPL: exploitative; HGP: hotel green performance

Source(s): Author own work

strong evidence of convergent validity. An exception is observed for green dynamic capabilities (GDC), which reports an AVE value of 0.499, slightly below the conventional cutoff. However, this value remains acceptable for higher-order constructs in PLS-SEM, particularly when composite reliability is high ($\rho_c = 0.892$). Prior methodological research suggests that AVE values marginally below 0.50 can be tolerated when construct reliability is well established, as is the case here. Overall, the AVE results indicate that the indicators share a substantial amount of variance with their respective constructs, confirming that the measurement items adequately represent the intended latent variables.

Discriminant validity (HTMT). Discriminant validity was assessed using the heterotrait–monotrait (HTMT) ratio, which is recommended as a robust criterion for evaluating discriminant validity in PLS-SEM (Henseler *et al.*, 2016). As shown in Table 3, all HTMT values are below the conservative threshold of 0.85 (Kline, 2016), with the highest value being 0.821. These findings indicate that the constructs included in the model are empirically distinct, including conceptually related variables such as green dynamic capabilities, green open innovation, organizational green ambidexterity, and hotel green performance. Accordingly, discriminant validity of the measurement model is established.

Discriminant validity was further assessed using the Fornell–Larcker criterion (Fornell and Larcker, 1981). As reported in Table 4, the square root of the AVE for each construct (diagonal values) exceeds its correlations with all other constructs, indicating adequate discriminant validity. Consistent with established guidelines for construct validity assessment in PLS-SEM (Hair *et al.*, 2022), these results confirm that each construct captures a distinct conceptual domain.

Hypotheses testing

Table 5 reports the direct effects estimated using PLS-SEM with bootstrapping. The results show that green dynamic capabilities have a positive and significant effect on green open innovation ($\beta = 0.259$, $t = 4.318$, $p < 0.001$), supporting H1. This indicates that hotels with stronger green dynamic capabilities are more likely to adopt open approaches to green innovation. The direct effect of green dynamic capabilities on hotel green ambidexterity is not significant ($\beta = -0.020$, $t = 0.340$, $p = 0.734$), suggesting that dynamic capabilities alone do not directly translate into ambidextrous green innovation behavior. This non-significant path underscores the importance of intermediate mechanisms. Green dynamic capabilities exhibit a positive and significant direct effect on hotel green performance ($\beta = 0.174$, $t = 3.248$, $p = 0.001$), indicating that capability development contributes directly to environmental outcomes. Further, green open innovation positively influences hotel green ambidexterity

Table 3. Discriminant validity (HTMT)

	EXPL	EXPR	GI_OI	GO_OI	GR_C	GSEN_C	GSEZ_C	HGP
EXPL	–							
EXPR	0.821	–						
GI_OI	0.408	0.419	–					
GO_OI	0.346	0.467	0.755	–				
GR_C	0.089	0.124	0.143	0.171	–			
GSEN_C	0.107	0.100	0.294	0.298	0.628	–		
GSEZ_C	0.094	0.095	0.274	0.212	0.523	0.608	–	
HGP	0.524	0.371	0.498	0.469	0.244	0.257	0.276	–

Note(s): GSEN-C: green sensing capability; GSEZ-C: green seizing capability; GR-C: green reconfiguration capability; GI-OI: green inbound open innovation; GO-OI: green outbound open innovation; EXPR: explorative; EXPL: exploitative; HGP: hotel green performance

Source(s): Author own work

Table 4. Fornell-Larck criterion

	EXPL	EXPR	GI_OI	GO_OI	GR_C	GSEN_C	GSEZ_C	HGP
EXPL	0.782							
EXPR	0.710	0.865						
GI_OI	0.322	0.350	0.818					
GO_OI	0.273	0.386	0.628	0.809				
GR_C	0.036	0.105	0.096	0.145	0.859			
GSEN_C	0.033	0.084	0.239	0.240	0.513	0.841		
GSEZ_C	0.038	0.072	0.231	0.179	0.437	0.499	0.868	
HGP	0.416	0.324	0.428	0.407	0.213	0.217	0.242	0.808

Note(s): GSEN-C: green sensing capability; GSEZ-C: green seizing capability; GR-C: green reconfiguration capability; GI-OI: green inbound open innovation; GO-OI: green outbound open innovation; EXPR: explorative; EXPL: exploitative; HGP: hotel green performance

Source(s): Author calculations

Table 5. Direct effects

Direct paths	β	STDEV	<i>t</i> statistics	<i>p</i> values	LLCI	ULCI
GDC → GOI	0.259	0.060	4.318	0.001	0.143	0.378
GDC → HGA	−0.020	0.059	0.340	0.734	−0.135	0.098
GDC → HGP	0.174	0.053	3.248	0.001	0.072	0.276
GOI → HGA	0.409	0.052	7.800	0.001	0.303	0.509
GOI → HGP	0.317	0.060	5.326	0.001	0.196	0.433
HGA → HGP	0.252	0.058	4.323	0.001	0.138	0.366

Note(s): GDC: green dynamic capabilities. GOI: green open innovation. HGA: hotel green ambidexterity. HGP: hotel green performance; LLCI: lower limit confidence interval; ULCI: upper limit confidence interval

Source(s): Author calculations

($\beta = 0.409$, $t = 7.800$, $p < 0.001$), providing strong support for H2. This result highlights the role of openness in enabling hotels to balance green exploration and exploitation.

Green open innovation also shows a significant positive effect on hotel green performance ($\beta = 0.317$, $t = 5.326$, $p < 0.001$), indicating that boundary-spanning green knowledge practices directly enhance environmental performance. Finally, hotel green ambidexterity has a positive and significant effect on hotel green performance ($\beta = 0.252$, $t = 4.323$, $p < 0.001$), supporting H3 and confirming that the simultaneous pursuit of green exploration and exploitation improves hotels' environmental outcomes (Figure 1).

Specific indirect effects and sequential mediation. Table 6 reports the specific indirect effects estimated using bootstrapping to examine the mediating mechanisms linking green dynamic capabilities to hotel green performance. The results reveal a clear pattern that underscores the importance of sequential mediation. The indirect effect of green dynamic capabilities on hotel green performance through hotel green ambidexterity alone is not significant ($\beta = -0.005$, $t = 0.328$, $p = 0.743$). This finding indicates that green dynamic capabilities do not translate into improved green performance through ambidexterity in isolation, highlighting the absence of a simple one-step mediation mechanism.

In contrast, the indirect effect of green open innovation on hotel green performance via hotel green ambidexterity is positive and significant ($\beta = 0.103$, $t = 3.596$, $p < 0.001$), suggesting that openness to green innovation becomes performance-enhancing only when it enables ambidextrous green innovation behavior. Further, green dynamic capabilities exert a significant indirect effect on hotel green ambidexterity through green open innovation ($\beta = 0.106$, $t = 3.615$, $p < 0.001$), confirming that open innovation is a critical conduit through

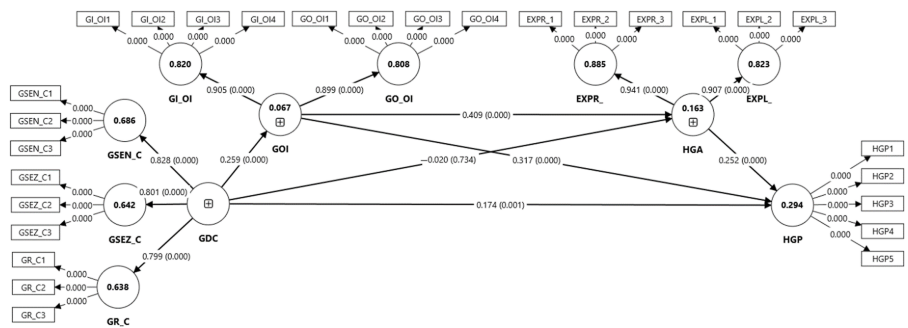


Figure 1. Structural model. Note. GDC: green dynamic capabilities; GSEN-C: green sensing capability; GSEZ-C: green seizing capability; GR-C: green reconfiguration capability; GOI: green open innovation; GI-OI: green inbound open innovation; GO-OI: green outbound open innovation; HGA: hotel green ambidexterity; EXPR: explorative; EXPL: exploitative; HGP: hotel green performance. Source: Author own work

Table 6. Specific indirect effects

Indirect paths	β	STDEV	<i>t</i> statistics	<i>p</i> values	LLCI	ULCI
GDC → HGA → HGP	−0.005	0.015	0.328	0.743	−0.037	0.025
GOI → HGA → HGP	0.103	0.029	3.596	0.001	0.052	0.166
GDC → GOI → HGA	0.106	0.029	3.615	0.001	0.054	0.171
GDC → GOI → HGP	0.082	0.024	3.366	0.001	0.040	0.136
GDC → GOI → HGA → HGP	0.027	0.010	2.639	0.008	0.011	0.051

Note(s): GDC: green dynamic capabilities. GOI: green open innovation. HGA: hotel green ambidexterity. HGP: hotel green performance; LLCI: lower limit confidence interval; ULCI: upper limit confidence interval

Source(s): Author calculaitons

which capabilities are converted into ambidextrous outcomes. Similarly, the indirect effect of green dynamic capabilities on hotel green performance via green open innovation is significant ($\beta = 0.082$, $t = 3.366$, $p = 0.001$), reinforcing the central role of openness.

Most importantly, the sequential indirect effect green dynamic capabilities → green open innovation → hotel green ambidexterity → hotel green performance is positive and statistically significant ($\beta = 0.027$, $t = 2.639$, $p = 0.008$). This result provides direct empirical support for H4, demonstrating that green dynamic capabilities influence hotel green performance primarily through a sequential process, rather than through isolated mediating paths (Figure 1). Together, the presence of a significant sequential mediation alongside a non-significant single-step mediation highlights that green open innovation and hotel green ambidexterity operate as complementary and interdependent mechanisms. Hotels must first open their innovation boundaries to external green knowledge before ambidextrous green practices can emerge and translate capabilities into superior environmental performance.

Explanatory power. The explanatory power of the structural model was assessed using the coefficient of determination (R^2). R^2 indicates the proportion of variance in an endogenous construct explained by its exogenous predictors and reflects the model's in-sample explanatory power (Hadi et al., 2016; Shmueli and Koppius, 2011; Rigdon, 2012). R^2 values range from 0 to 1, with higher values indicating greater explanatory capability.

As a general guideline, Cohen (1988) suggested that R^2 values of approximately 0.26, 0.13, and 0.02 may be interpreted as substantial, moderate, and weak, respectively. However, acceptable R^2 values are highly context-dependent, and in management, behavioral, and service research, lower R^2 values are often considered meaningful due to the complexity of organizational phenomena (Raithel et al., 2012).

As shown in Table 7, the results indicate that green dynamic capabilities explain a modest proportion of variance in green open innovation ($R^2 = 0.067$), while green open innovation explains additional variance in hotel green ambidexterity ($R^2 = 0.163$). Together, green open innovation and green ambidexterity explain a meaningful proportion of variance in hotel green performance ($R^2 = 0.294$). These values suggest that, although the model does not aim for maximal variance explanation, it demonstrates acceptable explanatory power given the multi-theoretical, service-oriented, and behavioral nature of the constructs examined.

Overall, the R^2 results support the adequacy of the proposed model in explaining variation in key endogenous constructs and provide a sound basis for interpreting the sequential mediation effects examined in the study.

Discussion

This study examines the role of green dynamic capabilities (GDC), green open innovation (GOI), and hotel green ambidexterity (HGA) in driving hotel green performance (HGP). The findings provide empirical evidence that green dynamic capabilities contribute to hotel green performance both directly and indirectly, with green open innovation and hotel green ambidexterity operating as key transmission mechanisms rather than as isolated drivers. From a dynamic capabilities perspective, these results reinforce the view that capabilities create value not by their mere possession, but through their deployment within structured organizational processes. In doing so, the study advances a process-oriented explanation of how environmental capabilities are translated into sustainability outcomes in service-sector contexts.

First, the study confirms that green dynamic capabilities have a positive and significant effect on green open innovation, supporting the view that dynamic capabilities are essential for facilitating green-oriented innovation processes. This finding aligns with prior research emphasizing the role of dynamic capabilities in managing innovation and knowledge flows (Chabbouh and Boujelbene, 2022; Pundziene *et al.*, 2022) and is consistent with recent evidence highlighting green dynamic capabilities as microfoundations of sustainability-oriented transformation (Larabi, 2025; Essuman *et al.*, 2025). Extending this literature to the hospitality sector, the results demonstrate that green sensing, green seizing, and green reconfiguring capabilities enable hotels to proactively identify external green knowledge, absorb it, and recombine it with internal resources. This empirically extends dynamic capabilities theory into service-dominated settings, where value creation depends less on internal R&D and more on relational and boundary-spanning activities. Accordingly, green dynamic capabilities allow hotels to manage both inbound and outbound green knowledge flows, thereby strengthening green open innovation practices.

Table 7. Explanatory power, effect sizes, and predictive relevance

Endogenous construct	R^2	Adjusted R^2	f^2 (key predictors)	Q^2 (PLS-Predict)
Green Open Innovation (GOI)	0.067	0.064	0.102 (GDC → GOI)	0.059
Hotel Green Ambidexterity (HGA)	0.163	0.157	0.070 (GOI → HGA)	0.112
Hotel Green Performance (HGP)	0.294	0.286	–	0.169
Sequential effect (GOI & HGA omitted)	–	–	0.296 (GDC → HGP)	–

Note(s): R^2 and adjusted R^2 indicate in-sample explanatory power. F^2 values were calculated using the omission procedure to assess effect size. Q^2 values were obtained using the PLS-Predict procedure and indicate out-of-sample predictive relevance. All Q^2 values exceed zero, suggesting adequate predictive relevance of the model (Hair *et al.*, 2022)

Source(s): Author own work

Second, the results support H2, showing that green open innovation has a strong and positive effect on hotel green ambidexterity. From an open innovation lens, this finding clarifies that openness is not a performance outcome in itself, but a necessary enabling mechanism for ambidextrous green innovation. Inbound green open innovation broadens the environmental knowledge base of hotels, fostering exploratory initiatives such as new eco-friendly services and green technologies, while outbound green open innovation supports exploitative activities by refining and diffusing existing green practices. By empirically demonstrating this linkage in the hospitality context, the study extends earlier work (e.g. [Úbeda-García et al., 2022](#); [Chen et al., 2022](#); [Takalo et al., 2021](#)) and complements recent research showing that ambidextrous green innovation increasingly depends on inter-organizational knowledge exchange rather than internal capability accumulation alone ([Martínez-Falcó et al., 2024a](#); [Kim et al., 2025](#)). The findings suggest that openness is a prerequisite for ambidexterity in service-oriented green innovation, where firms rely less on proprietary technological assets and more on collaborative knowledge recombination.

Third, the findings provide support for H3, indicating that hotel green ambidexterity positively influences hotel green performance. This result strengthens ambidexterity theory by confirming that the simultaneous pursuit of green exploration and green exploitation is a critical driver of environmental performance in dynamic service environments. Rapid changes in customer expectations, regulatory pressures, and sustainability standards require hotels to continuously improve existing green practices while simultaneously experimenting with new solutions. By empirically validating this relationship, the study contributes to the limited but growing literature on green ambidexterity and performance outcomes in service industries ([Chen et al., 2022](#); [Peters and Buijs, 2022](#); [Elmakkawy et al., 2025](#)).

Most importantly, the study provides strong support for H4 by validating the sequential mediation model. While green dynamic capabilities exhibit a direct positive effect on hotel green performance, the findings show that green dynamic capabilities do not directly translate into hotel green ambidexterity. Instead, the effect unfolds through a sequential process, whereby green dynamic capabilities first enhance green open innovation, which subsequently enables hotel green ambidexterity, ultimately leading to improved green performance. This finding refines both dynamic capabilities and ambidexterity theories by demonstrating that ambidexterity does not emerge automatically from internal capabilities, particularly in service contexts. Rather, hotels must first open their innovation boundaries to external green knowledge before ambidextrous green practices can be effectively developed.

This sequential mechanism represents a novel contribution to the literature by demonstrating that green open innovation and hotel green ambidexterity are complementary and interdependent mechanisms, rather than parallel or substitutable paths. By empirically confirming this pathway-dependent logic, the study responds directly to recent calls for mechanism-based explanations of green performance ([Muisyo et al., 2022](#); [Takalo et al., 2021](#)) and aligns with emerging evidence emphasizing sequential capability orchestration in sustainability research ([Hafeez et al., 2025](#); [Lee, 2025](#)). In this sense, the study shifts the focus from isolated capability–performance relationships toward a process-based and theory-integrative understanding of green performance in hospitality organizations.

Conclusion

This study integrated and empirically examined the relationships among green dynamic capabilities, green open innovation, hotel green ambidexterity, and hotel green performance, addressing mechanisms that have received limited attention in prior literature. Based on 264 valid responses from hotels, the findings confirm that green open innovation plays a critical role in shaping hotel green ambidexterity and that green open innovation and hotel green ambidexterity operate as a sequential mediating mechanism linking green dynamic capabilities to hotel green performance.

Importantly, the results indicate that green dynamic capabilities do not translate into hotel green performance through ambidexterity alone, but rather through a processual pathway in which openness to green innovation first reshapes the hotel's knowledge base, enabling ambidextrous green practices to emerge. This conclusion reinforces the central argument of the study: hotel sustainability is not driven by isolated capabilities, but by their effective orchestration through openness and ambidexterity. Accordingly, the study concludes that the sequential relationship between green dynamic capabilities, green open innovation, and hotel green ambidexterity is central to achieving sustained hotel green performance, particularly in dynamic and resource-constrained service environments.

Theoretical implications

This study offers several important theoretical contributions. First, it advances green management and hospitality literature by explicitly linking green dynamic capabilities, green open innovation, and hotel green ambidexterity within a single sequential framework, addressing a notable gap in prior research that has largely examined these constructs in isolation (e.g. [Úbeda-García et al., 2022](#); [Chen et al., 2022](#); [Muisyo et al., 2022](#)). By empirically demonstrating their interdependent and sequential roles, the study moves beyond additive explanations and provides a process-based account of how sustainability outcomes emerge in hotels. Second, the findings extend and refine dynamic capabilities theory by showing that green dynamic capabilities alone are insufficient to generate ambidextrous green outcomes in service settings. While prior studies often assume a direct translation of capabilities into ambidexterity or performance, the non-significant indirect path through hotel green ambidexterity alone reveals that capabilities must first be activated through openness to external green knowledge. This insight qualifies existing assumptions in the ambidexterity literature, which frequently treats ambidexterity as a direct outcome of internal capability development, particularly in manufacturing contexts ([Peters and Buijs, 2022](#); [Junni et al., 2013](#)).

Third, the study refines open innovation theory by demonstrating that green open innovation is not merely a complementary strategy, but a necessary intermediate mechanism through which green dynamic capabilities are transformed into ambidextrous green practices. The finding that green open innovation alone does not directly mediate the capability–performance relationship challenges linear innovation logics and reinforces the importance of sequential and conditional mechanisms in explaining sustainability outcomes ([Takalo et al., 2021](#); [Yang and Roh, 2019](#)). In this sense, the study reveals that openness creates value only when it enables ambidextrous green innovation, rather than operating as an independent driver of performance. Finally, by empirically validating the integrated application of dynamic capabilities, open innovation, and ambidexterity frameworks in the hospitality sector, the study clarifies the theoretical value of combining these perspectives. Their integration explains the full transformation process from capability development, to knowledge openness, to ambidextrous innovation, and ultimately to green performance that none of the three theories can adequately explain on their own. In doing so, the study responds to recent calls for mechanism-oriented and context-sensitive research on hotel green performance and extends the applicability of these theories to service-dominated sustainability contexts.

Managerial implications

This study offers clear and actionable insights for hotel managers seeking to enhance environmental performance. The findings indicate that investments in green dynamic capabilities alone are insufficient to generate superior green outcomes unless hotels deliberately open their innovation processes. Accordingly, hotel managers should move beyond inward-looking sustainability initiatives and actively engage external actors, such as green technology providers, suppliers, consultants, and regulatory bodies, to systematically enrich their environmental knowledge base. Importantly, the results suggest that green open innovation should be treated as a strategic enabler rather than an isolated managerial practice.

Hotel managers are encouraged to institutionalize green open innovation by establishing formal mechanisms such as strategic partnerships, joint pilot projects, and structured knowledge-sharing platforms that support both inbound and outbound green knowledge flows. These mechanisms enable hotels to simultaneously pursue green exploration (e.g. experimenting with new eco-friendly solutions) and green exploitation (e.g. improving energy efficiency and waste reduction practices), thereby strengthening hotel green ambidexterity and translating innovation efforts into measurable environmental performance.

From a policy perspective, the study highlights that initiatives aimed solely at developing green capabilities, without fostering openness and ambidexterity, may yield limited sustainability outcomes. Policymakers should therefore design support programs, incentives, and regulatory frameworks that simultaneously promote inter-organizational collaboration and ambidextrous green innovation, particularly in developing economies where financial and technological constraints are more pronounced. In this regard, the study contributes to ongoing sustainability policy discussions and supports the achievement of SDG 12 (Responsible Consumption and Production) by emphasizing structured and sequential green innovation pathways within the hospitality sector.

To operationalize these insights, hotel managers may adopt a sequential implementation logic aligned with the study's findings. First, managers should assess their existing green dynamic capabilities by evaluating their ability to sense environmental opportunities, seize green knowledge, and reconfigure internal resources. Second, hotels should formalize green open innovation by identifying a focused set of external partners and establishing low-cost collaboration mechanisms, such as pilot projects or shared learning initiatives. Third, managers should deliberately allocate resources to both green exploration and green exploitation activities, ensuring that experimentation with new green solutions is balanced with efficiency-driven improvements to existing practices. Managers should also anticipate common implementation barriers, including financial constraints, resistance to change, and scale limitations, and address them incrementally rather than pursuing comprehensive green transformations at once.

Limitations and future Directions

Despite its contributions, this study has several limitations that offer avenues for future research. First, the findings are based on cross-sectional data, which constrains causal inference, particularly in the context of sequential mediation. Future studies employing longitudinal or process-based designs could provide deeper insights into how green dynamic capabilities, green open innovation, and ambidexterity evolve over time.

Second, the study focuses on hotels operating in Pakistan, which may limit the generalizability of the findings. Replicating the model in other developing and developed economies would help assess the contextual robustness of the proposed sequential mechanism and identify potential institutional contingencies. Third, future research could extend the model by incorporating moderating variables, such as environmental regulatory pressure, organizational green learning, or technological turbulence, to examine boundary conditions of the observed relationships. Sequential moderated-mediation models may offer a more nuanced understanding of when and for whom green dynamic capabilities are most effective.

Finally, future studies could further unpack the dimensional effects of green dynamic capabilities, green open innovation, and hotel green ambidexterity, using advanced PLS-SEM techniques to explore alternative configurations and complementarities among these constructs. Such extensions would deepen theoretical understanding and enhance practical relevance in sustainability-oriented service research.

Declaration of generative AI and AI-assisted technologies

During the revision process, I used Grammarly solely for limited language-related tasks, including grammar, typographical, and consistency checks. No AI tools were used to generate scientific content,

conduct analyses, or draw conclusions. All revisions were reviewed and finalized by the author, who takes full responsibility for the accuracy and integrity of the manuscript.

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