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From digital tools to sustainable change: How change agents enable the twin transition in hospitality

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ABSTRACT

This study explores how change agents drive sustainable service change in hospitality networks through engagement in the twin transition—combining digitalization and sustainability. Using a multi-level sensemaking framework (extraorganizational, intraorganizational, intraindividual), we analyze the role of a local hoteliers' association promoting a business intelligence solution (BIS) to support this transition. Drawing on a case study of 43 hotels in northeastern Italy, supplemented by a simulation study, we examine how twin transition engagement mediates the effects of social capital, category-based sensemaking, and stewardship on sustainable service change. Findings show that structural and cognitive social capital influence sustainability directly, but not twin transition engagement, underscoring the critical role of the change agent. Category-based sensemaking is fully mediated, while stewardship affects sustainability but not digital adoption. The study contributes to hospitality research by linking sensemaking and stewardship to digital–sustainability innovation, and highlights simulation as a useful method to validate findings in data-constrained environments.

1. Introduction

In recent years, the concept of the *twin transition*, i.e., the integration of digitalization and sustainability, has become central to European policy and corporate discourse (European Commission, 2022; Pinkse and Kolk, 2010). Yet, despite its growing rhetorical appeal, the notion remains largely untested in management and hospitality research (Diodato et al., 2023; Kovacic et al., 2024). This study offers the first empirical examination of the twin transition within a hospitality context, providing a framework that links digital and sustainable transformation through a multi-level sensemaking lens (Aguinis and Glavas, 2019).

Hospitality firms—typically small, owner-managed, and highly service-oriented—operate under intense pressure to address digital transformation (e.g., business intelligence solutions, data analytics) while simultaneously advancing sustainability initiatives such as resource efficiency and eco-certifications (Gomezelj, 2016; Brooker and Joppe, 2014). Digital solutions hold significant potential to reshape operational practices in the hospitality industry, particularly in terms of how firms adopt and diffuse innovations and evaluate their environmental, social, and economic impacts (Shin and Perdue, 2022). However, many hotels remain unprepared to incorporate integrated sustainable practices, such as those associated with the twin transition, into their everyday operations "despite their favourable organizational conditions, or deny any sort of social responsibility due to their small firm size or lacking motivation of the owner-manager" (Baumann-Pauly et al., 2013, p. 702). Prior research has shown that hospitality managers often lack both the technological infrastructure and the cognitive or cultural readiness to drive transformation (Lam and Law, 2019; Busulwa et al., 2022), while sustainability studies emphasize that environmental and social practices are rooted in organizational culture and employees' sustainability awareness (Oriade et al., 2021). Yet, these streams have rarely converged to explain how digital and sustainable transitions interact or co-evolve in hospitality networks. Engaging in the twin transition entails a cognitive organizational reorientation (Fiss and Zajac, 2006) through which managers and employees engage in sensemaking, that is, constructing shared meaning about their evolving organizational context and interpreting how strategic change can be understood, communicated, and enacted within their firms (Giuliani et al., 2021; Hahn et al., 2014; Maitlis and Christianson, 2014; Weick, Sutcliffe and Obstfeld, 2005; Mikel-Hong et al., 2024).

We fill this gap by analysing how a local hotelier's association in

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north-eastern Italy, acting as a change agent, facilitates the twin transition among its member hotels through the adoption of a business intelligence solution (BIS). Drawing on Aguinis and Glavas's (2019) three-level sensemaking framework, we conceptualize the determinants of sustainable service change at three interrelated levels: *extraorganizational* (social capital as a cognitive representation of network relationships; Nahapiet and Ghoshal, 1998; Visentin et al., 2021), *intraorganizational* (category-based sensemaking that helps individuals attach meaning to complex situations; Weick, 2010; Hahn et al., 2014), and *intraindividual* (moral obligation or stewardship as an internalized motivation to act responsibly; de Ruyter et al., 2009; Hernandez, 2012).

We test this multi-level model using an industry-level case study that encompasses the entire population of hotels in a single destination—an approach suited to exploring context-dependent mechanisms (Yin, 2018; Getz and Carlsen, 2005). To reinforce robustness and address potential Type I and II statistical errors, we complement the empirical analysis with a simulation study (Nowok et al., 2016; Sarstedt et al., 2024), confirming the stability of the observed causal relationships.

In doing so, this study provides the first empirical grounding of the twin transition and advances hospitality management research by showing how change agents enable digital–sustainability integration through multi-level sensemaking. The findings reveal that twin transition engagement positively drives sustainable service change, with the change agent playing a pivotal role in coupling digital and environmental objectives. While category-based (intraorganizational) sensemaking emerges as the key mechanism activating engagement, extraorganizational sensemaking—reflected in social capital—shows limited diffusion of shared knowledge within the hotel community. This gap underscores the strategic importance of the change agent in aligning goals, facilitating collective BIS adoption, and compensating for deficiencies in digital readiness and motivation across the network.

This study offers several theoretical contributions to the hospitality literature, by responding to recent calls for research on managerial enablers, network diffusion, and sustainability impacts of service innovation (Shin and Perdue, 2022). Specifically, we (i) advance Aguinis and Glavas's (2019) multi-level framework by specifying a change--agent–enabled sensemaking mechanism for the twin transition (Kovacic et al., 2024; Mikel-Hong et al., 2024; Van der et al., 2012); (ii) conceptually and empirically integrate stewardship and sensemaking, revealing an asymmetric pattern whereby stewardship drives sustainability but not digital adoption, thereby refining stewardship theory (Casoli et al., 2025; de Ruyter et al., 2022); (iii) nuance the role of social capital by showing its direct influence on sustainability alongside its reliance on a change agent for digital uptake; and (iv) identify category-based sensemaking as the mediating pathway that links cognitive reframing to sustainable—and, under the change-agent mechanism, digital—service change (Aguinis and Glavas, 2019; Mikel-Hong et al., 2024).

The remainder of the paper presents the empirical setting, develops the theoretical framework, describes the empirical methods, and reports the results of both statistical and simulation analyses. We conclude by discussing theoretical and managerial implications, limitations, and future research directions on digital–sustainability integration in hospitality.

2. The empirical setting

An industry-level case study approach (e.g., Beverland and Lindgreen, 2010) is appropriate for exploring the phenomenon of a change agent catalyzing a sensemaking process that results in the decision to undertake the twin transition—sustainability and digitalization—through the adoption of a business intelligence solution aimed at improving the sustainability of hotel services. Case studies are particularly well-suited for investigating complex, context-dependent phenomena (e.g., Yin, 2018; Mikalef et al., 2021). In hospitality management, case studies have been widely employed to uncover organizational dynamics in small and medium-sized enterprises, where direct observation and in-depth inquiry are feasible (Getz and Carlsen, 2005).

In our case, multiple actors operate within the context under investigation, collectively shaping how the process of BIS adoption—as a manifestation of twin-transition engagement—and the subsequent service change unfold. The local hoteliers' association represents one of these actors and, together with the network of relationships among hotels, helps describe the broader social structure in which these dynamics take place. It promoted the adoption of a BIS that connects each hotel's Property Management System to a platform offering benchmarking data on economic KPIs. An optional "green module" also estimates CO_2 emissions, allowing for the assessment of environmental performance alongside financial metrics. The adoption of the BIS proposed by the local hoteliers' association can be interpreted as the hotels' engagement in the twin transition. Indeed, the role of the BIS extends beyond the deployment of digital tools; it may function as a catalyst for systemic change (Giuliani et al., 2015; Fleming et al., 2007; Hoy and Hellriegel, 1982; Mikel-Hong et al., 2024; Van der Heijden et al., 2012), supporting organizations in their process of service innovation aimed at achieving sustainability goals. We therefore argue that organizations may realize greater potential for sustainable service transformation when they engage in twin transitions through the adoption of a BIS. Notably, the decision to adopt the BIS is not imposed from the top down; rather, it is discretionary.

We selected our research setting because, although it is small in scale, it is accessible, highly collaborative, and allows for the inclusion of the entire population under study—thereby minimizing sampling bias. More importantly, this setting provides a unique opportunity to observe the interaction among variables in relative isolation from external confounding factors, thereby enhancing the internal validity of our findings. Under these conditions, our investigation offers a rare opportunity to capture and analyze the mechanisms through which a change agent exerts influence, yielding novel insights into the causal relationships among key variables—an area largely underexplored in the existing hospitality literature.

3. Theoretical background

The *twin transition* entails a double layer of complexity, as organizations must integrate digital transformation and sustainability within a single strategic and operational trajectory. This challenge is particularly acute in the hospitality sector, where hotels must navigate the simultaneous demands of adopting digital technologies (Lam and Law, 2019; Busulwa et al., 2022) and meeting sustainability goals (Chen et al., 2010; Oriade et al., 2021), often without the structural and cognitive capabilities required to manage such intertwined change (Gomezelj, 2016; Brooker and Joppe, 2014).

In such complex contexts, a *change agent* may play a crucial role in helping organizations identify which new information, technologies, or practices are most relevant to their strategic and operational challenges. Change agents support firms in transforming abstract knowledge into actionable capabilities, helping them bridge the knowing–doing gap (Corredoira and McDermott, 2020; Perez-Aleman, 2011; Shevchenko et al., 2016). They often act as knowledge brokers and catalysts for collective learning, transferring principles, activating networks, and reducing both technical and cognitive barriers to innovation (Mikel-Hong et al., 2024; Van der Heijden et al., 2012). Similar to agricultural extension officers (Hoy and Hellriegel, 1982) or oenologists in the wine industry (Giuliani et al., 2015), change agents in hospitality facilitate the creation of local ties, the diffusion of practices, and the alignment of organizational mindsets toward shared goals. Through this process, they help firms anticipate and respond to the threats and opportunities associated with future, ambiguous, and uncertain actions.

Within the context of the twin transition, the change agent can

therefore lead organizations to adopt sustainable practices enabled by digital technologies—allowing them to measure, report, and reduce their social and environmental impacts (Montresor and Vezzani, 2023; Shevchenko et al., 2016). The change agent—here, a local hoteliers' association—can initiate a "cognitive organizational reorientation" (Fiss and Zajac, 2006, p. 1173), whereby individuals collectively interpret and make sense of the profound changes affecting their organizational environment. Through this process of sensemaking, managers and employees seek to understand and give coherence to the evolving dynamics of digitalization and sustainability, continuously interpreting how new information, technologies, and expectations reshape established routines and strategic orientations (Giuliani et al., 2021; Hahn et al., 2014; Maitlis and Christianson, 2014; Weick et al., 2005; Mikel-Hong et al., 2024).

Building on this premise, we posit that when proposing the adoption of a BIS, the change agent stimulates a multi-level sensemaking process within the hotel community. Drawing on Aguinis and Glavas's (2019) three-level framework, this process unfolds across *extraorganizational*, *intraorganizational*, and *intraindividual* levels of analysis (Lepoutre et al., 2007; Weick et al., 2005; Van der Heijden et al., 2012). Sensemaking, activated at these three levels, shapes the decision to adopt the BIS—an expression of *twin transition engagement*—which in turn drives hotels toward *sustainable service change*, i.e., the reconfiguration of organizational practices toward more sustainable and digitally integrated service provision.

For this reason, we posit that, when proposing the adoption of the BIS, the change agent (namely, the local hoteliers' association) stimulates a process of sensemaking at the extraorganizational, intraorganizational and intraindividual levels. Sensemaking will result in the decision to adopt the BIS that, in turn, ultimately drives local actors toward sustainable service change. Fig. 1 presents our theoretical framework:

3.1. Extraorganizational level: sensemaking

As the general realm of CSR strategies and actions, engaging in twin transition entails a consideration of the environment and a wide array of social actors' expectations (e.g., Hahn et al., 2014). In fact, business actions are embedded within a network of relationships, that influence the process of sensemaking depending on the interactions with external stakeholders (Aguinis and Glavas, 2019; Maitlis and Christianson, 2014; Mikel-Hong et al., 2024). The accumulation of the relationships with external actors and their networks forms *Social Capital* (García-Villaverde et al., 2017; Nahapiet and Ghoshal, 1998; Visentin et al., 2021). Scholars suggest that *Social Capital* may act on a company's ability to innovate and adapt to change, and positively impacts several social outcomes, including knowledge, motivation and the capability to collaborate (García-Villaverde et al., 2017; Hatzakis et al., 2005; Hoi et al., 2018; Visentin et al., 2021). Specifically, the *structural dimension* of the *Social Capital*, which accounts for the connection among actors, may facilitate resource-sharing and knowledge spillover contributing to the adoption of change; the *relational dimension* of the *Social Capital*, as the sense of proximity among actors, sustains an informal environment in which information circulates, facilitating the adoption of change; and the *cognitive dimension*, which includes shared codes, culture and narratives, can shape the culture of the organization driving service change (García-Villaverde et al., 2017; Visentin et al., 2021). In turn, these factors have a positive effect on operational outcomes and on the possibility of improving the quality and efficiency of the implementation of strategic decision-making (Hatzakis et al., 2005). Thus, *social capital* has the potential to support or constraint sustainability actions and policies of organizations (Hoi et al., 2018; Mikel-Hong et al., 2024), as it infiltrates a local organization to enable positive CSR actions and triggers a process of local isomorphism leading to mimic other local organizations' CSR activities. These speculations converge to indicate that mapping the external local relational environment is a fundamental aspect of the process of sensemaking when the CSR decisions are at stake (Basu and Palazzo, 2008; Christianson and Barton, 2020; Hahn et al., 2014; Mikel-Hong et al., 2024). Specifically, this perspective informs our context, in which the decision to engage in twin transition is under consideration. As a consequence, we expect that making sense of the three dimensions of *Social Capital* may lead hotels to engage in a twin transition with the final aim of making the services more sustainable, in line with stakeholders' expectations. In other terms:

H1. Twin transition engagement mediates the positive relationship between (H1a) the structural, (H1b) the cognitive, and (H1c) the relational dimensions of a company's social capital and its ability to implement sustainable service change.

3.2. Intraorganizational level: category-based sensemaking

The decision to reorient the organization towards a sustainable service change can generate conflicting views, ambiguity and uncertainty (Kovacic et al., 2024; Lepoutre et al., 2007; Mikel-Hong et al., 2024). In the context of sustainability, managers face the tension between the business case frame, which prioritizes profit maximization, and the so-called *paradoxical* frame, which embraces tensions between economic, environmental, and social concerns (Hahn et al., 2014). This

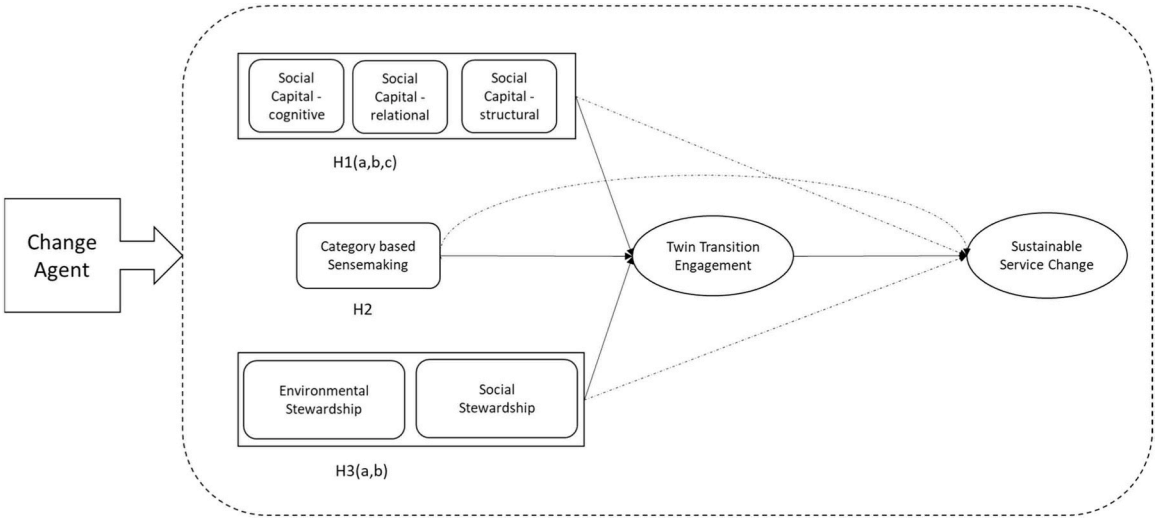


Fig. 1. The theoretical model.

tension creates a sensemaking process, where managers must continuously navigate conflicting pro-environmental and pro-financial logics, allowing radical departures from established routines (Aguinis and Glavas, 2019; Carroll and Shabana, 2010; Giuliani et al., 2021).

On the one hand, by integrating advanced technologies, organizations can optimize productivity, enhance resource efficiency, reduce environmental footprints, and innovate service delivery models (Dean and McMullen, 2007; Diodato et al., 2023; Heyman et al., 2021). On the other hand, the digital dimension of the twin transition requires understanding costs, cybersecurity risks and vulnerability of employees due to job automation, among others (Kovacic et al., 2024). The result is a complex, ambiguous and conflicting situation, that requires organizational sensemaking to shift from "being perception based to being category based" (Hahn et al., 2014, p. 464; see also Weick, 2010). This means that managers interpret and make sense of ambiguous and complex signals, by associating their perceptions to categories and schemas. As a consequence, we expect that engaging in a twin transition with the final aim to make the services more sustainable requires category-based sensemaking to attach meaning to a complex situation in which coupling the sustainable development of the company with the digital transformation may exacerbate the complexity of the environment. In other words:

H2. Twin transition engagement mediates the positive relationship between category-based sensemaking and sustainable service change.

3.3. Intraindividual level: stewardship

Strong value systems play a crucial role in guiding decision-making in complex sustainability challenges (Aguinis and Glavas, 2019; Hahn et al., 2014; Mikel-Hong et al., 2024). When managers pursue sustainable service change to achieve financial gains or enhance their reputation, their motivation is rooted in self-interest, and the behaviour follows a means-end rationality. Differently, when they follow an inborn impulse toward taking care of their natural and social environment acting consistently, they play the role of *stewards* (e.g., de Ruyter et al., 2009; Hensen et al., 2016a; 2016b; Hernandez, 2008; 2012). Stewardship may enable organizations to address digital and sustainable transformations simultaneously, fostering integrated solutions for service innovation (van Lieshout et al., 2021; Mallen Broch et al., 2020). Specifically, *Environmental Stewardship* refers to authentic, environmental-friendly behaviours characterized by a sense of responsibility for the sustainable management of natural resources for current and future generations (de Ruyter et al., 2009; 2022; Hensen et al., 2016a; 2016b). Leaders committed to sustainability transition often take personal responsibility for achieving long-term benefits, even at the expense of short-term personal interests, suggesting a role of environmental stewardship in guiding companies toward sustainable service change. *Social Stewardship* embodies a deep sense of responsibility for the community's well-being by ensuring that strategies and decisions prioritize giving back and improving future conditions. Organizations can adopt a stewardship perspective through accountability and responsibility for their holistic impact, balancing immediate needs with the greater good and making sacrifices (e.g., financial, time, or convenience) when necessary (Hensen et al., 2016a,2016b; Hernandez, 2012). Thus, we advance that:

H3. Twin transition engagement mediates the positive relationship between (H3a) environmental stewardship, (H3b) social stewardship and sustainable service change.

From a methodological point of view, hypotheses H1-H3 require the estimation of three mediated paths (e.g., Hayes, 2018), which entails the estimate of the direct effects involved. More specifically, extra-organizational, intraorganizational and intraindividual levels are supposed to exert an effect on sustainable service change via the twin transition engagement. However, the estimate of such relationships includes the estimate of the respective alternative hypotheses given by the direct effects. In this regard, we do not hypothesize the direct effects of the three layers of sensemaking on sustainable service change, given that we take for granted that hotels are eager to strive for sustainability (Statista, 2025), even without adopting an IT tool such as the BIS.

4. Method

The study follows a twofold methodological design. First, we empirically test hypotheses H1-H3 within a population of 76 hotels in a tourist area in the north-east of Italy, coordinated by a local hoteliers' association. Data resulting from this survey provided the empirical foundation for testing the proposed multi-level sensemaking model. Second, to assess the robustness and generalizability of our findings, we employed a simulation-based approach using the *synthpop* package in R (Nowok et al., 2016) to generate a synthetic dataset. The algorithm reproduced 430 simulated cases preserving the original data structure and multivariate relationships, allowing us to examine whether the observed causal mechanisms remained stable across a wider set of hypothetical observations.

4.1. Study 1: the survey

Two trained research assistants visited each hotel in person, requested an interview with the hotelier, i.e. the owner or hotel's manager responsible for BIS adoption, introduced the study purpose, and administered the questionnaire.

4.1.1. Summary of the sample characteristics

Overall, 43 hotels out of 76 participated. The average number of rooms of hotels participating resulted in 41.09(sd=17.64), with no significant difference compared to non-participating ($p(t = .060$, $df=61.973)= .952$). The hotels category was measured by recording the number of stars. We measured 4 two-star hotels, 32 three-star hotels, 7 four-star hotels, with no significant difference compared to non-responding ($p(\chi^2=4.747$, $d.f.=3)= .191$). Among participants, 20 hotels adopted the basic version of the BIS; among them, 8 adopted the green module. As expected, this proportion is significantly different among non-participants ($p(\chi^2=7.460$, $df=2)= .024$), suggesting that those who did not positively answer to the call of the local association to engage in twin transition, are less willingness to participate in our survey – which was endorsed by the same local association. We defined the mediator variable as *Twin Transition Engagement* by using a 3-level variable defined by 0 = "no adoption", 1 = "basic BIS module", 2 = "green module". More specifically, the basic BIS module enables hotels managers to monitor a set of economic KPIs and to benchmark them with competitors on the associated platform; and it can be extended by a green module that provides a measure of the hotels' environmental performance by estimating CO2 emissions related to operations. Since the "green module" requires the "basic BIS module" (the opposite does not hold), the 3 levels of the mediator are correctly defined as a measure of the engagement of the respondent with the twin transition.

4.1.2. The questionnaire

The questionnaire started by briefly presenting the definition of twin transition and asking to express the opinion about it, with the opportunity to freely verbalize the answer within a box including 5 blank lines. This section was aimed at focusing the attention of respondents on twin transition in their context. Then, we asked to specify the level of implementation of 25 service change categories and 11 sustainability-driven change categories. To do so, we adopted the approach of Thomas et al. (1993) and Visentin et al., (2021) to measure *Service Change*, and we mixed service change and sustainability-driven changes to maintain high the attention. For each category we asked to indicate if 0 = "is not a project", 1 = "we are about to implement it" or 2 = "this

change is already active". Ultimately, this method provided our dependent variable *Sustainable Service Change*, obtained by summing up, for each hotel, the related measure of sustainability-driven changes. Specific service change categories are reported in Table 1.

We then included the *Structural*, *Relational* and *Cognitive* components of the *Social Capital* to measure extraorganizational sensemaking (hypothesis H1). Items were adapted following García-Villaverde et al. (2017) and Visentin et al. (2021). Then, we presented a 15-item measurement scale for *Category-Based Sensemaking*, adapting existing scales to the present context (Thomas et al., 1993; Visentin et al., 2021) to measure intraorganizational sensemaking (hypothesis H2). We finally measured intraindividual sensemaking (hypothesis H3) by including a scale of *Environmental and Social Stewardship* by adapting the scales from de Ruyter et al. (2009), Hensen et al. (2016a) and Hensen et al. (2016b).

4.1.3. Factorial structure

To assess the adequacy of the data for factor analysis, we computed the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity on the polychoric correlation matrix, given that the indicators were measured on ordinal Likert scales (Holgado-Tello et al., 2010). The KMO value (0.389) and the highly significant Bartlett's test ($\chi^2 = 3400.33$, df = 861, $p < .001$) indicate that sufficient inter-item correlations exist to justify factor extraction in small ordinal datasets (Kaiser, 1974; Bartlett, 1954; Dziuban and Shirkey, 1974).

Table 1
Sustainable and digital service change categories.

Sustainable Service Change Categories	Digital Service Change Categories
Partnership with local supplier network and use of 0 km food products	Use of a cloud-based property management system
Communication of the commitment to sustainability activities with employees and customers	Online website with direct booking system
Implementation of resource efficiency systems (energy, water, waste)	Use of an online reputation system to collect
Use of environmentally sustainable materials	ADV and email marketing with external partners
Tools to reduce food waste	Implementation of a CRM strategy
Incentive schemes for reuse of towels (e.g., tree planting/vouchers)	Implementation of a strategy to reduce dependency on OTAs
Use of renewable electricity	Periodic analysis of tourists' online behavior
Investing a proportion of profits in local sustainability or community projects	Implementation of a hotel's central system
Programmes to provide guests with information on local ecosystems, heritage and culture, and how to behave in the local community	Use of social media
Tools to monitor its CO2 emissions	Integrating social activities with CRM
Offsetting at least 10 % of total CO2 emissions	Concierge service via chatbot
	Partnering with local supplier network and tour operators to develop experiences
	Offering of tailored services based on data analysis and guest preferences
	Creation of bespoke itineraries based on data and guest preferences
	Implementation of augmented reality and/or virtual reality experiences
	Delivering of hyper-targeted communications with the support of AI platforms and internal management
	Deployment of ML and AI programs to provide market insights and insights and trends
	Real-time monitoring of inventory, supplier activity and tracking system
	Paperless service management tools
	Use of smart devices and sensors in common areas
	Smart rooms with technological devices and equipment
	Use of robotics and automation
	Use of artificial intelligence
	Data analysis software
	Contactless payments

We first factor analyzed separately each independent variable to avoid overlapping in the covariance structures, since constructs were borrowed from existing literature. More specifically, a 3-factor exploratory factor analysis (cumulative variance explained.794) provided 3 items for the variable *Structural Social Capital* ($\alpha = .91$), 2 items for the variable *Relational Social Capital* ($\alpha = .93$), and 3 items for the variable *Cognitive Social Capital* ($\alpha = .94$). Then, a recursion between exploratory factor analysis and Cronbach's α items purification, allowed us to retain 8 items for the variable *Category-Based Sensemaking* ($\alpha = .94$). Finally, a 2-factor exploratory factor analysis (cumulative variance explained.715) indicated the existence of the two expected factors, namely an *Environmental Stewardship* factor (5 items, $\alpha = .93$) and a *Social Stewardship* factor (2 items, $\alpha = .86$) without overlapping.

Then, we put together all the independent variables and found a 6-factor exploratory factor analysis (cumulative variance explained.804) supporting the structure of *Structural Social Capital, Cognitive Social Capital, Relational Social Capital, Category based Sensemaking*, *Social Stewardship, and Environmental Stewardship*. Table 2 reports the text of the items and the main characteristics of the six factors.

A 1-factor exploratory factor analysis on the 6 factors explains only.328 of variance, supporting no common variance. Then, relying on a confirmatory factor analysis performed with R package Lavaan (Rosseel, 2012), we found all AVEs above.5, thus ensuring convergent validity of the construct; and that all AVE are above the largest squared inter-factor correlation for each factor, thus ensuring discriminant validity of constructs. Moreover, we calculated composite reliabilities, and documented these analyses in Table 3. Despite the small size of the sample (which is given, in turn, by the small size of the population), all these statistics converge to indicate a good and reliable set of factors.

To test our conceptual model, we finally calculated the variables as the average value of items. Inter-factors correlations and distributions are reported in Fig. 2.

4.2. Results of the survey

To test our set of hypotheses we adopted an analytical strategy based on mediated models (e.g.: Hayes, 2018; Model 4). Hayes's nonparametric approach is particularly appropriate in our context, as it provides bootstrap-based estimates and confidence intervals without assuming normality of the sampling distribution of indirect effects. This makes it more robust and reliable than the traditional parametric procedure proposed by Baron and Kenny (1986), especially when working with small or bounded populations such as ours. Overall, the effect of *Twin Transition Engagement* on *Sustainable Service Change* is significant and positive in all the models.

4.2.1. Extraorganizational sensemaking: the effect of social capital

The three social capital variables define the corresponding paths: *Structural Social Capital* → *Twin Transition Engagement* → *Sustainable Service Change* (Hypotheses H1a); *Relational Social Capital* → *Twin Transition Engagement* → *Sustainable Service Change* (Hypotheses H1b); *Cognitive Social Capital* → *Twin Transition Engagement* → *Sustainable Service Change* (Hypotheses H1c). The results of these three paths are reported in Table 4.

Results partially support H1. Specifically, data highlight a direct effect of *Social Capital* on *Sustainable Service Change*. More specifically, data do not support an indirect effect via *Twin Transition Engagement* of the three components of *Social Capital*. Moreover, the *Structural* and *Cognitive* components display a direct effect on the dependent variable, while the *Relational* dimension has no effect.

4.2.2. Intraorganizational sensemaking: the effect of category-based sensemaking

The *Category-Based Sensemaking* variable defines the corresponding path: *Category-Based Sensemaking* → *Twin Transition Engagement* →

Table 2
Independent variables.

Variable (Number of items)	Item text	Factor loading	Inter item Correlation (Min-Max)	Cronbach alpha
Structural Social Capital (4)	The resources and information exchanged with our contacts are similar	.780	.73 −.80	$\alpha = .91$
Adapted from García Villaverde et al. (2017), Visentin et al., (2021)	Our company's regular contacts know each other	.932	.80 −.81	
	The hotel's contacts that provide useful information know each other	.707	.73 −.81	
Relational Social Capital (2)	The relationships with our contacts are characterized by mutual respect at multiple levels	.825	.87	$\alpha = .93$
Adapted from García Villaverde et al. (2017), Visentin et al., (2021)	The relationships with our contacts are characterized by mutual trust	.926	.87	
Cognitive Social Capital (4)	Our hotel and our contacts tend to agree on how to manage the relationship	.883	.84 −.86	$\alpha = .94$
Adapted from García Villaverde et al. (2017), Visentin et al., (2021)	The business practices and operational mechanisms of our contacts are very similar to ours	.873	.86 −.86	
	The corporate culture and management style of our contacts is very similar to ours	.824	.84 −.86	
Sensemaking (8)	We perceive that benefits will come from this twin transition	.780	.56 −.79	$\alpha = .94$
Adapted from Thomas et al. (1993), Visentin et al. (2021)	We feel the future will be better because of this twin transition	.932	.69 −.87	
	We label this twin transition as a potential gain	.707	.55 −.73	
	We feel we have the capability to address this twin transition	.730	.59 −.70	
	We see this twin transition as having positive implications for the future	.805	.60 −.81	
	We feel that there is a high probability of losing a great deal	.753	.58 −.73	
	We feel that there is a high probability of gaining a great deal from this twin transition	.817	.55 −.82	
	We label this twin transition as something positive	.871	.58 −.87	
Organisational Stewardship (5)	We, as a hotel, are willing to make sacrifices for the good of the environment and society.	.695	.61 −.83	$\alpha = .93$
Adapted from de Ruyter et al. (2009) Hensen et al. (2016a);(2016b)	We carry responsibility for the environmental and societal impact of our decisions and actions.	.760	.68 −.83	
Barbuto and Wheeler (2006)	We need to help maintaining a green environment for society.	.880	.61 −.82	
	In our service to society, we, as a hotel, should balance short-term personal goals with long-term environmental goals.	.868	.63 −.82	
	Our hotel feels responsible for the environmental impact of our activities and decisions on future generations	.719	.63 −.81	
Environmental Stewardship (2)	We feel it is inappropriate, for us as a hotel, to do business without considering its environmental and societal impact	.871	.76 −.76	$\alpha = .86$
Adapted from de Ruyter et al. (2009) and Hensen et al. (2016a);(2016b)	In addressing customer problems, we attempt to come up with solutions that are best for the environment.	.624	.76 −.76	
Barbuto and Wheeler (2006)				

Sustainable Service Change (Hypotheses H2). Results are reported in Table 5.

Results provide full support of hypothesis H2, since *Category-based Sensemaking* displays an indirect positive effect on *Sustainable Service Change* but not a direct effect, leading to a full mediation.

4.2.3. The intraindividual level: the effect of stewardship

The two stewardship variables define the corresponding paths: *Environmental Stewardship* → *Twin Transition Engagement* → *Sustainable Service Change* (Hypotheses H3a); and *Social Stewardship* → *Twin Transition Engagement* → *Sustainable Service Change* (Hypotheses H3b). The results of these three paths are reported in Table 6.

As in the case of *Social Capital*, *Stewardship* has a direct positive effect on *Sustainable Service Change* but not an indirect effect via the *Twin Transition Engagement*, providing no support to hypothesis H3.

4.2.4. Additional analysis of digital service change

Even though we did not develop a specific set of hypotheses on the determinants of the digital service change, we included specific measures in the questionnaire for methodological purposes (see Table 1), as explained above. However, the corresponding data offers the opportunity to add nuances to the explanation of the role of sensemaking and the change agent in the local community of hotels analyzed, by adding empirical evidence using the corresponding variable *Digital Service Change*. More specifically, using the framework of Fig. 1, we repeated the mediation analyses using the digital service change categories as dependent variable, namely *Digital Service Change*, as a substitute of the formerly used *Sustainable Service Change*. By adopting the same analytical strategy described above, we obtained the results reported in Table 7.

The results of Table 7 show that *Social Capital* and *Stewardship* have no effect, neither direct nor indirect, on *Digital Service Change*. *Category Based Sensemaking* displays a significant (full) mediated path. Importantly, the direct effect of *Twin Transition Engagement* on *Digital Service Change* is always positive and significant.

Sensitivity analysis: Given the limited sample size (i.e., N = 43), we conducted a sample-size sensitivity analysis to assess the stability and robustness of the mediation results. Specifically, we combined repeated subsampling procedures with nonparametric bootstrap estimation of indirect effects within Hayes' mediation framework (Preacher and Hayes, 2008; Cumming, 2014; Hayes, 2018). While bias-corrected bootstrap confidence intervals are well suited for testing mediation under non-normality, they do not directly address issues of statistical power or the stability of path estimates in small samples (Hayes, 2018). For this reason, we repeatedly re-estimated the mediation models on randomly drawn subsamples of varying sizes, allowing us to evaluate the sensitivity of the direct and indirect effects to sample-size reductions and sampling variability (Cumming, 2014; Walters and Campbell, 2005; Tian et al., 2014; Amalnerkar et al., 2020; Goldenholz et al., 2023; Qin, 2024). Overall, these analyses indicate that the observed pattern of mediated versus non-mediated effects is not an artifact of the limited sample size, but instead reflects meaningful differences in the mechanisms through which distinct antecedents influence sustainable service change.

4.3. Simulation study

Even though the present paper adopts a case study approach (Getz and Carlsen, 2005; Beverland and Lindgreen, 2010; Yin, 2018; Mikalef et al., 2021), we acknowledge that the sample size employed in our analysis is relatively small. However, as demonstrated, it is representative of the target population, which is itself limited in size (43

Table 3
Summary statistics of factors.

	Structural Social Capital	*Relational Social Capital*	*Cognitive Social Capital*	*Sensemaking*	*Social Stewardship*	*Environmental Stewardship*
Structural Social Capital						
Relational Social Capital	.376					
Cognitive Social Capital	.516	.514				
Sensemaking	.158	.206	.457			
Social Stewardship	.434	.096	.174	.457		
Environmental Stewardship	.457	.359	.495	.411	.444	
AVE	.763	.877	.844	.685	.702	.759
CR	.766	.832	.844	.853	.799	.678

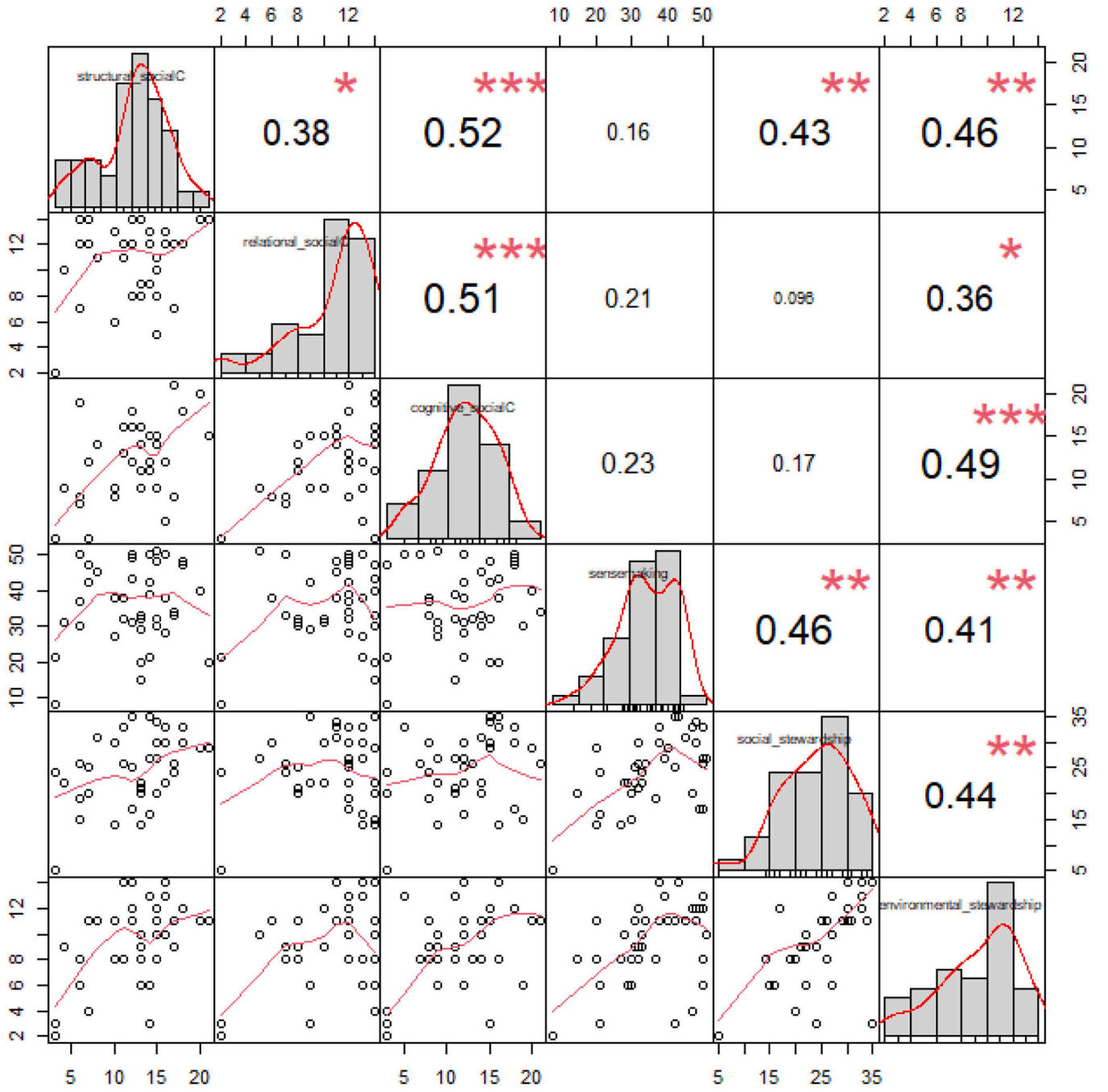


Fig. 2. Summary statistics of variables.

Table 4
The extraorganizational level – the effects of social capital.

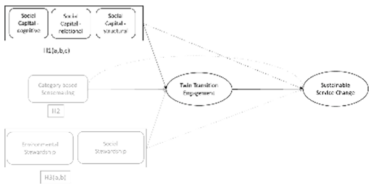
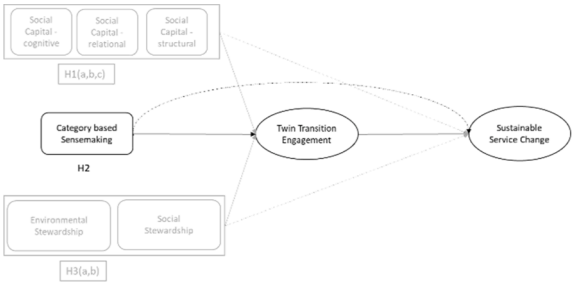
		Social Capital		
		Structural	Relational	Cognitve
	Direct Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.3536 (.0735 −.6337)	.1509 ns	.2975 (.0423 −.5527)
	Indirect Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.0911 ns	.0830 ns	.0530 ns
	Twin Transition Enabler *Estimate* *(95 %LLCI – 95 %ULCI)*	2.4494 (1.0507–3.8480)	2.7201 (1.2392–4.2010)	2.5954 (1.1979–3.9929)

Table 5
The intraorganizational level – the effects of sensemaking.

		Sensemaking
	Direct Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	0841 ns
	Indirect Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.1003 (.0171–2008)
	Twin Transition Enabler *Estimate* *(95 %LLCI – 95 %ULCI)*	2.1606 (0.3677–3.9534)

observations out of a total of 71 firms). This observation has two main implications. First, the significance levels obtained from the PROCESS models may be affected by statistical artifacts introduced through the use of bootstrapping to estimate confidence intervals. Specifically, to obtain three-digit probability values, PROCESS applies 1000 bootstrap replicates to a sample of only 43 original observations. Second, given both the small size of the population and the fact that the presence of a change agent is a rare and difficult-to-replicate condition in similar contexts, assessing the robustness and potential generalizability of our findings requires additional methodological support. In other words, replicating the specific conditions of our study in a different context is not feasible, which is why we opted to conduct a simulation study rather than a traditional replication. Notably, researchers in management studies have only recently begun to recognize the value of this approach for making inferences (e.g., Sarstedt et al., 2024). We build upon this emerging perspective and propose the use of a synthetic dataset to further support our empirical analysis. Our goal was to test the robustness of the original findings by examining whether the mediation effects observed in the empirical dataset would remain stable under simulated conditions that preserve the underlying structure and associations of the original sample. This approach enables us to evaluate the internal consistency of the model while offering an additional indication of the generalizability of the results in contexts where empirical replication is constrained by the rarity of the phenomenon under investigation.

To this end, we employed a simulation-based approach using the `synthpop` package in R to generate a synthetic dataset (Nowok et al., 2016). The synthetic data were generated using the function `syn(data, m = 1, k = 430)`, which produces one synthetic dataset (m = 1) consisting of 430 cases (k = 430). The algorithm used by `synthpop` learns the joint distribution of the original data and draws simulated observations that preserve the variable types and the observed multivariate relationships, thereby allowing us to test the stability of our findings across a broader range of hypothetical observations while maintaining consistency with the original empirical structure.

We then used the synthetic dataset to replicate the mediation analyses reported in the previous section.

Table 6
The intraindividual level – the effects of stewardship.

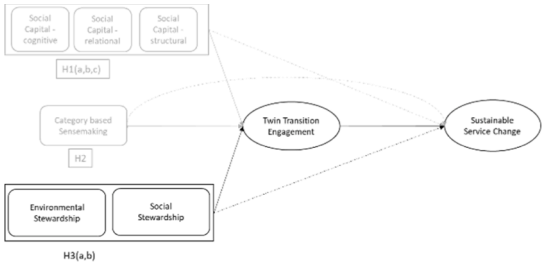
		Stewardship	
		Environmental	Social
	Direct Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.7604 (.4084–1.1124)	.2126 (.0265 −.3988)
	Indirect Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.1150 ns	.0657 ns
	Twin Transition Enabler *Estimate* *(95 %LLCI – 95 %ULCI)*	2.3082 (1.0695–3.5470)	2.4435 (1.0210 3.8660)

Table 7
Results digital service change.

	Social Capital			Sensemaking	Stewardship	
	Structural	Relational	Cognitve		Environmental	Social
Direct Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.1150 ns	-.1276 ns	.3593 ns	.0176 ns	.3838 ns	-.0505 ns
Indirect Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.2371 ns	.1993ns	.1278 ns	.2947 (.1479 −.4749)	.3046 ns	.1764 ns
Twin Transition Engagement *Estimate* *(95 %LLCI – 95 %ULCI)*	6.3731 (3.5635–9.1827)	6.5283 (3.7493–9.3073)	6.2599 (3.5478 – 8.9719)	6.3510 (2.9458–9.7561	6.1142 (3.3843 – 8.8481)	6.5591 (3.7349–9.3833)

4.4. Results of the simulation study

Overall, the silicon sample provided by the simulated dataset supports all the causal relationships that were supported by the original dataset collected by the authors within the local community of hoteliers under scrutiny. Nevertheless, other significant effects emerge from the simulation. Specifically, by focusing on the variable *Service Change Sustainable*, the simulation provides support to all the direct effects found by using the empirical data (Table 8). Furthermore, the *Relational Social Capital* still has no indirect effect. Overall, the simulation does not contradict the picture provided by the original data. Nevertheless, the sample size of the synthetic dataset lets surface also direct effects of *Category-based Sensemaking* and *Stewardship*. These new significant effects add nuances which stimulate further research.

Replicating the approach of the original analysis, we use the simulated dataset also in the case of the variable *Service Change Digital* (Table 9).

In this case the interpretation of the results of the simulation is more complex. Overall, simulation further supports the significant effects found in the original analysis. Nevertheless, it adds the indirect effect of the Structural Social Capital, a partial mediation of the Cognitive component, a partial mediation of two components of Stewardship. Further research could also investigate whether these relationships hold in real-world settings, beyond the simulated environment used in this study.

5. Discussion

In this paper we propose and test a framework to explain how a change agent, presenting the opportunities of a BIS to enhance sustainable efforts, compels hotels' managers within a local community to make sense of the decision to engage in twin transition, ultimately driving companies towards sustainable service change. By using an industry-level case study approach, we provide empirical support of our framework within a population of hotels in the north-east part of Italy. Furthermore, we conduct a simulation study, which resulted in further support of the empirical study.

We found that *Structural* and *Cognitive Social Capital* exert a direct effect on *Sustainable Service Change*, but the direct effect on *Twin Transition Engagement* is not significant (and consequently, nor is the indirect effect on *Sustainable Service Change*). Moreover, the *Relational* dimension of *Social Capital* does not exert any effect, suggesting that its action is overwritten by the change agent activity. This result is corroborated by the evidence on *Digital Service Change*. Interestingly, when analyzing data on the digital side of the story, we found that the only factor facilitating service change is the adoption of a BIS, which acts as a twin transition enabler. Thus, *Social Capital* exerts no effect, offering further support to the role of the change agent in substituting the local community to drive companies to adopt the BIS. More specifically, the absence of effects (both direct and indirect) of the *Social Capital* reflects the overall lack of digital knowledge and competencies among the peers of the local community of hotels. This does not mean that the community of hotels does not pay attention to sustainable service change, rather it means that it is not eager or ready to adopt a digital tool. The change agent compensates this lack.

The full support to the mediation path of *Category-Based Sensemaking* on *Sustainable Service Change* via *Twin Transition Engagement* offers empirical support to the need for a category-based meaning to attach to a complex situation (Hahn et al., 2014; Weick, 2010). Coupling sustainable change with digital change exacerbates the *paradoxical frame* of sustainability, requiring a radical departure from established routines (Giuliani et al., 2021; Hahn et al., 2014; Mikel-Hong et al., 2024). This result is reinforced when inspecting the corresponding estimates for *Digital Service Change* in Table 7. Nevertheless, like in the case of *Sustainable Service Change*, a pivotal role is played by *Category-Based Sensemaking*, consistent with the complexity of the digital transition (Giuliani et al., 2021; Hahn et al., 2014; Kovacic et al., 2024; Mikel-Hong et al., 2024; Weick, 2010).

As far as the system of values accounted for by *Social* and *Environmental Stewardship*, data support that when managers are committed to sustainability, they actively reshape the daily routine to align with their principles, embodying the direct effect of environmental and organizational stewardship and sustainable service change. *Sustainable Service Change* may be implemented virtually without digital transition, in that the digital transformation of the company enhances, speeds up and boosts the effects of sustainable change (Kovacic et al., 2024; Van

Table 8
Simulation study on sustainable service change.

	Social Capital			Sensemaking	Stewardship	
	Structural	Relational	Cognitve		Environmental	Social
Direct Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.1621 (.0627 −.2615)	.1607 (.0257 −.2957)	. 2962 (.2059 −.3865)	.1261 (.0869 −.1653)	.7089 (.5897 −.8281)	.2305 (.1673 −.2938)
Indirect Effect *Estimate* *(95 %LLCI – 95 %ULCI)*	.0388 (.0029 −.0772)	0069 ns	.0519 (.0207 −.0873)	.0314 (.0173 −.0483)	.0796 (.0423 −.1254)	.0510 (.0291 −.0781)
Twin Transition Engagement *Estimate* *(95 %LLCI – 95 %ULCI)*	1.7961 (1.3212–2.2710)	1.8686 (1.3937–2.3436)	1.6280 (1.1655–2.0905)	1.4907 (1.0182–1.9633)	1.3377 (.9120–1.7635)	1.4221 (.9537–1.8906)

Table 9
Simulation study on digital service change.

	Social Capital			Sensemaking	Stewardship	
	Structural	Relational	Cognitve		Environmental	Social
Direct Effect	.0891 ns	.1466 ns	.3235	.1415	.8884	.1330
Estimate			(.1617 −.4854)	(.0714 −.2117)	(.6652–1.1115)	(.0171 −.2489)
(95 %LLCI – 95 %ULCI)						
Indirect Effect	.1125	.0192 ns	.1576	.1006	.2700	.1776
Estimate	(.0105 −.2178)		(.0645 −.2547)	(.0606 −.1453)	(.1546 −.3954)	(.1100 −.2516)
(95 %LLCI – 95 %ULCI)						
Twin Transition Engagement	5.2121	5.2057	4.9415	4.7800	4.5379	4.9505
Estimate	(4.3750–6.0493)	(4.3744–6.0370)	(4.1123–5.7707)	(3.9346–5.6254)	(3.7410–5.3348)	(4.0919–5.8092)
(95 %LLCI – 95 %ULCI)						

Lieshout et al., 2021). Moreover, it requires putting in perspective the contingent operational actions, to tackle grand challenges (Hahn et al., 2014; Mikel-Hong et al., 2024; Van Lieshout et al., 2021). Nevertheless, while the latter is rooted in a system of values, the digitalization of the company is the consequence of the adoption of a BIS. Thus, our results support that the system of values already acted as a catalyzer of *Sustainable Service Change* (displaying only a direct effect), irrespective of the digital dimension, which requires an external role of the change agent (Mikel-Hong et al., 2024). Consistently, when inspecting the results of *Digital Service Change*, we found no effect, which corroborates our interpretation. This fact raises a point about the mechanisms underlying stewardship-driven change. In particular, it suggests that it may function independently of digital enablers, since companies may adopt sustainability measuring systems based on IT solution to follow the indication of a trustworthy change agent, rather than for stewardship-driven motives.

As a final note, the results of the sample adequacy tests for factor analysis (Kaiser, 1974; Bartlett, 1954; Dziuban and Shirkey, 1974) and the sensitivity analyses for result stability (Cumming, 2014; Walters and Campbell, 2005; Tian et al., 2014; Amalnerkar et al., 2020; Goldenholz et al., 2023; Qin, 2024) can be read jointly as convergent evidence supporting the overall robustness of our empirical framework. Moreover, the simulation-based study further strengthened the empirical analysis (Sarstedt et al., 2024; Nowok et al., 2016). Taken together, these three methodological safeguards jointly indicate that our empirical results are robust with respect to sample size both at the ex-ante analytical stage (i.e., KMO and Bartlett's test) and at the ex-post inferential stage (i.e., sensitivity analysis of results), and that they also display meaningful generalizability properties (i.e. simulation), allowing our findings to extend beyond the necessarily bounded confines of the focal case study.

5.1. Theoretical contributions

The current study makes several theoretical contributions. First, this study responds to recent calls within the hospitality literature to deepen our understanding of the managerial factors that facilitate innovation adoption, the mechanisms through which innovations diffuse across networks, and the broader sustainability outcomes linked to service innovation (Shin and Perdue, 2022; Busulwa et al., 2022). Second, this paper is one of the few attempts focusing on twin transition engagement (Kovacic et al., 2024). We add to this literature by shedding light on the role of sensemaking as the mediating pathway that links cognitive reframing to sustainable—and, under the change-agent mechanism, digital—service change (Aguinis and Glavas, 2019; Mikel-Hong et al., 2024). Third, we contribute to the lacking literature on the role of change agent in service industries facing grand challenges (Mikel-Hong et al., 2024; Van der Heijden et al., 2012). Indeed, analogous to change agents in other sectors, our findings show that hoteliers' association acted as a catalyst for collective adoption of a BIS-enabling twin transition and it stimulates a multi-level sensemaking. Fourth, we contribute to the literature on stewardship theory by adding empirical evidence from a business-to-business marketing perspective (de Ruyter et al., 2022; Casoli et al., 2025). Building on Casoli et al. (2025), we extend this stream of research by grounding our argument in a comprehensive theoretical framework and establishing the first theoretical and empirical linkage between the construct of stewardship and observable organizational behaviors—specifically, the adoption of a BIS as an expression of twin-transition engagement and the ensuing sustainable service change. In particular, our study shows that stewardship values motivate sustainable behavior but do not automatically lead to digital tool adoption. This refines stewardship theory in B2B contexts, suggesting that moral obligation must be coupled with external stimuli (e.g., change-agent facilitation) to drive digital–sustainability integration. Fifth, while social capital is generally viewed as enabling innovation and CSR, our findings nuance this view: social capital directly supports sustainable service change. The change agent thus becomes critical in mobilizing the network.

5.2. Methodological contribution

This study also offers a methodological contribution by integrating a traditional survey-based analysis with a simulation-based procedure. To our knowledge, this is the first application of such an approach within a management study to complement empirical findings derived from a bounded population. Rather than compensating for sample size, the simulation extends the analytical power of case-based research to contexts that are inherently small and non-replicable—such as those typical of hospitality, where entire populations may consist of only a few dozen actors. By testing the stability of causal relationships under controlled synthetic conditions that preserve the covariance structure of the original dataset, this approach strengthens analytical generalization and mitigates potential Type I and Type II statistical errors. Overall, it provides an innovative pathway for studying complex organizational phenomena in small-scale hospitality settings with greater methodological rigor.

5.3. Managerial implication

Our findings offer actionable guidance for hospitality associations, intermediaries, and individual firms seeking to navigate the twin transition. These implications draw directly from our findings on multi-level sensemaking and the role of a change agent in coordinating collective adoption of a BIS.

Smaller hotels often lack the financial or technical resources to implement sophisticated digital tools individually. To accelerate the twin transition, associations can negotiate or develop shared platforms (e.g., a collective BIS) that pool costs, centralize technical support, and standardize economic, social and environmental benchmarks. Furthermore, associations should organize workshops or roundtables where hoteliers collaboratively frame the twin transition and initiatives in terms familiar to their operations. Emphasizing dual benefits of digital-sustainability tool (as the BIS) —such as improved operational efficiency alongside environmental performance—helps resolve paradoxical logics

and reduces uncertainty. These "sensemaking meeting" may be helpful to surface concerns, allow the sharing of experiences, and build consensus, increasing the likelihood of adoption. After initial adoption, associations should schedule regular meetings where members jointly interpret results, discuss emerging patterns, and identify incremental improvements should be organized. This continuous sensemaking and peer feedback loop sustains engagement, reinforces the value of the BIS platform, and helps hotels iteratively refine practices. Over time, these forums cultivate a learning culture that supports both digital maturity and sustainable service innovation.

Finally, banks, technology providers, or other stakeholders can strengthen uptake by positioning themselves as stewards of the twin transition. For example, offering financial incentives (e.g., subsidized fees, favorable loan terms), technical assistance (e.g., integration support) reinforces the change-agent role and builds trust. Collaborative initiatives with such partners signal commitment, reduce perceived risk, and motivate hotels to participate in collective digital–sustainability projects.

5.4. Limitation

Despite our study's strengths, we must also acknowledge some limitations. First, as we focused on a single local community, our study suffers from the limitations of single industry case studies and limited generalizability. Although we conducted three complementary robustness checks—ex-ante tests of sample adequacy (KMO and Bartlett's test), ex-post sensitivity analyses assessing result stability, and a simulation-based assessment of generalizability—the study remains constrained by the limited sample size. Importantly, this limitation is structural rather than procedural: even surveying the entire focal population would have resulted in a similarly bounded sample. Consequently, while our findings are robust within this industry-level context, future research could profitably extend the analysis to larger and more heterogeneous communities, thereby testing the observed mechanisms in broader empirical settings and further strengthening external validity. Second, all the companies in the population have a small size. In line with research on the relationship between size and CSR practices (Colucci et al., 2020; Wickert et al., 2016), future studies could use our conceptualization to broaden the focus on medium and large companies. Finally, given the strategic role of twin transition in driving sustainable change and tackling grand challenges, we hope that our research will stimulate further studies on this topic.

6. Conclusion

In an era of pressing grand challenges, hospitality firms must integrate digital innovation with sustainability goals—a "twin transition" requiring cognitive reorientation and the navigation of paradoxical logics. Our study shows that, even when sustainability motivations are strong, digital adoption often depends on external facilitation and framing. By proposing a multi-level sensemaking framework and the pivotal role of change agents, we advance understanding of how hotels navigate integrated digital–sustainability innovations. From a managerial perspective, hospitality associations, financial institutions and technology partners should collaborate to frame innovations effectively and coordinate collective initiatives that align business performance with social and environmental objectives. As the hospitality sector continues to confront evolving challenges, coordinated, sensemaking-driven approaches to the twin transition will be essential for achieving lasting sustainable impact.

CRediT authorship contribution statement

Giuseppe Cappiello: Writing – review & editing, Validation, Supervision, Resources, Investigation, Data curation, Conceptualization. **Debora Casoli:** Writing – review & editing, Writing – original draft, Validation, Supervision, Investigation, Formal analysis, Data curation, Conceptualization. **Annamaria Tuan:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Marco Visentin:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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.

Data availability

Data will be made available on request.

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