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RESEARCH ARTICLE OPEN ACCESS

A Paradox Perspective on Business Model Innovation in Sustainability-Oriented Industries: A Longitudinal Case Study in the Energy Sector

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ABSTRACT

This study examines how Business Model Innovation (BMI) unfolds in sustainability-oriented industries, where institutional complexity, technological interdependence, and environmental imperatives generate persistent sustainability-related paradoxical tensions. Drawing on a longitudinal case of a European system integrator in renewable energy and electric mobility, based on interviews and internal documentation, we trace how a strategic-level paradox propagates across organizational layers. The thematic coding analysis reveals the multilevel tensions shaping the case. By tracing how these tensions evolve over time, we identify a recurrent paradox-enactment process composed of paradox recognition and integrative framing. We show that the organizational locus of first recognition conditions how tensions are interpreted, which heuristics emerge, and whether enactment proceeds through top-down cascade or bottom-up escalation, with managerial agency and resource slack moderating the depth of the response. Critically, these dynamics condition BMI trajectories: Tensions governable within an existing value logic produce single-loop adjustments, while persistent misalignment triggers double-loop reframing of value creation, delivery, and capture. In doing so, we advance paradox theory by showing that BMI trajectories are tension-conditioned rather than purely opportunity-driven.

1 | Introduction

Sustainability goals such as decarbonization, circularity, and efficiency compel firms to reconfigure how they create, deliver, and capture value (Foss and Saebi 2017; Massa et al. 2017; Parida et al. 2019). The pressure is particularly acute in energy-related activities and the mobility domain, which together account for roughly 73% of global greenhouse-gas emissions and are central to net-zero strategies in regions such as Europe (International Energy Agency 2024). We refer to these settings as *sustainability-oriented industries*, where environmental and social imperatives are central to a firm's competitiveness and where transition dynamics reshape markets, technologies, and institutions (Markard et al. 2012; Parida et al. 2019).

In these industries, systemic uncertainty disrupts innovation paths and established value logics, that is, the relatively stable configurations linking *for whom* a firm creates value, *what* value is offered, and the *activities* through which value is delivered and monetized (Foss and Saebi 2017; Teece 2010). This uncertainty stems from evolving and sometimes conflicting policy targets (Bolton and Hannon 2016; Markard et al. 2012), technological interdependence, the increasing convergence of energy, digital, and mobility infrastructures (Hacklin et al. 2010), and mounting environmental performance requirements (Evans et al. 2017; Hall et al. 2022). Together, these conditions generate structurally distributed and interdependent demands that manifest unevenly across organizational domains, accelerating the search for sustainable business models capable of integrating

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economic, environmental, and social value (Boons et al. 2013; Evans et al. 2017; Geissdoerfer et al. 2018) through purposeful redesign of activities, resources, and value capture configurations (Boons et al. 2013; Evans et al. 2017; Lanzolla and Markides 2021). From this perspective, sustainability-oriented business model innovation (BMI) involves redesigning business models to enhance sustainability performance and support broader societal and industrial transitions (Spieth et al. 2025; Todeschini et al. 2017).

This redesign process also exposes firms to underlying tensions between competing objectives: Economic, environmental, and social goals frequently generate paradoxical tensions (Best et al. 2021; Hahn and Pinkse 2022; van Bommel 2018), namely, contradictory yet interrelated elements that exist simultaneously and persist over time, requiring ongoing adaptation rather than permanent resolution (Smith and Lewis 2011). Such paradoxes, for instance, arise between short-term financial returns and long-term sustainability investments, and between experimentation and the need for standardized, scalable solutions (Edwards 2021; Smith and Lewis 2011). Importantly, these paradoxes are embedded in broader transition dynamics, making them persistent, cross-level, and interdependent. As sustainability imperatives permeate organizational structures, paradoxical tensions surface across corporate, business-unit, and operational domains, rather than being confined to a single organizational layer (Berti and Cunha 2023; Best et al. 2021; Hahn et al. 2018).

However, two critical issues remain underexplored. First, while paradox theory documents how sustainability-related tensions pervade organizations (Carmine and De Marchi 2023; Hahn et al. 2018) and must be sensed and framed (Schad et al. 2016; Smith and Lewis 2011), it largely treats the organization as a unitary site of recognition, paying comparatively less attention to *where* within organizations tensions are first recognized and responses are initially set in motion. Because tensions in sustainability transitions are structurally distributed across heterogeneous regulatory, technological, and institutional domains (Bolton and Hannon 2016; Markard et al. 2012), this question is particularly salient. Second, while process perspectives explain how firms iteratively reconfigure their business models (Demil and Lecocq 2010; Frankenberger et al. 2013), they provide more limited insights into how tension enactment conditions the *trajectory* of that reconfiguration, shaping whether responses remain within an existing value logic or trigger a business model change. As a result, current literature provides only limited insight into how organizations move from fragmented, localized experiences of sustainability tension to coordinated BMI trajectories. Against this backdrop, we investigate the following research questions (RQs):

RQ1. *How do sustainability-related tensions emerge and propagate across organizational levels?*

RQ2. *How do sustainability-related tensions influence the business model innovation trajectory in terms of the scope and depth of business model change?*

To address these questions, we combine paradox theory (Schad et al. 2016; Smith and Lewis 2011) and processual perspectives on BMI (Bachmann and Jodlbauer 2023; Frankenberger et al. 2013). Empirically, we draw on a 12-year longitudinal case, from 2012 to 2024, of a system integrator operating at the intersection of energy storage and charging services for electric vehicles (EVs). The company underwent multiple BMI cycles, expanding from business-to-business (B2B) to business-to-consumer (B2C) offerings.

This study makes two contributions. First, we extend paradox theory by articulating a paradox-enactment process, comprising *recognition* followed by *integrative framing*, through which tensions propagate across organizational levels in sustainability-oriented industries. Central to this process is the locus of first recognition: The organizational location where a tension first becomes organizationally actionable, turning from a perceived issue into an object of deliberate organizational response. This locus conditions how the tension is encoded, which heuristics are developed, and whether enactment proceeds through top-down cascade or bottom-up escalation, with managerial agency and resource slack moderating the depth of the response. Second, building on the distinction between single- and double-loop responses (Berti and Cunha 2023), we show that this process helps explain why BMI trajectories are tension-conditioned rather than purely opportunity-driven: Tensions governable within an existing value logic tend to produce incremental single-loop adjustments, whereas persistent misalignment is more likely to trigger double-loop reframing of value creation, delivery, and capture.

2 | Theoretical Background

We draw on two complementary streams of literature that shed light on how BMI unfolds under sustainability imperatives: (i) research on sustainability-oriented BMI and (ii) research on paradoxical tensions in the BMI process. Together, these streams provide the foundation for examining how sustainability-related tensions emerge, interact, and influence BMI dynamics.

2.1 | The Role of Business Model Innovation in Sustainability Transitions

BMI scholarship in sustainability transitions has theorized firms' responses to competing institutional logics, tightly coupled technological systems, and evolving regulatory frameworks (Bolton and Hannon 2016; Hacklin et al. 2010; Hahn et al. 2018; Markard et al. 2012). Accordingly, sustainable innovation extends beyond technological change, requiring a revision of organizational purpose and value architecture (Boons et al. 2013; Varadarajan 2017) and reconfiguring interdependent activities, resources, and relationships across organizational and systemic boundaries (Demil and Lecocq 2010; Foss and Saebi 2017; Massa et al. 2017).

BMI unfolds as an iterative process in which firms recombine interdependent activities while balancing exploration and exploitation (Demil and Lecocq 2010; Frankenberger et al. 2013; Lanzolla and Markides 2021; Sosna et al. 2010). In sustainability transitions, this complexity and recursiveness are amplified because business model changes require recurrent realignment

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between environmental targets, financial objectives, and heterogeneous stakeholder claims (Bocken et al. 2014; Evans et al. 2017). Recent scholarship emphasizes the role of heuristics, modular architectures, and cross-boundary coordination mechanisms in enabling such adaptation. Simple rules and heuristics support experimentation where exhaustive planning is infeasible (Bingham and Eisenhardt 2011). Modular product and organizational architectures facilitate continuous adaptation to local environmental and regulatory conditions while preserving scalable standardization (Bachmann and Jodlbauer 2023), for instance by varying peripheral components to meet country-specific requirements while retaining a common technical core. Through such mechanisms, BMI unfolds as an ongoing reconfiguration of activities and resources (Lanzolla and Markides 2021) in response to sustainability-related demands (Parida et al. 2019).

However, as sustainability imperatives permeate organizational structures and decision-making systems (Aagaard et al. 2021; Bolton and Hannon 2016), this ongoing adaptation gives rise to persistent tensions, as firms attempt to reconcile economic, environmental, and social demands under conditions of institutional and technological uncertainty (Best et al. 2021; van Bommel 2018). Over time, these tensions may become embedded in organizational processes and start to shape subsequent strategic and organizational decisions, highlighting the need to understand how they are recognized and managed across organizational levels (Berti and Cunha 2023).

2.2 | Managing Multilevel Tensions During Sustainability-Oriented BMI

Paradoxical tensions are commonly categorized into performing, organizing, learning, and belonging domains: Performing tensions arise when organizations pursue conflicting goals; organizing tensions emerge when structuring and leading practices must simultaneously foster collaboration and competition, empowerment and direction, and control and flexibility; learning tensions surface between building on and transforming past capabilities; and belonging tensions involve competing identities and values (Smith and Lewis 2011). In sustainability-oriented organizations, the performing and organizing dimensions are most salient at the strategic level, as economic and environmental goals collide and must be accommodated within concrete roles, processes, and governance arrangements (Best et al. 2021; Hahn et al. 2018; van Bommel 2018). Our focus is accordingly on tensions that exhibit this paradoxical profile rather than on resolvable trade-offs or dilemmas (Berti and Cunha 2023). These tensions are further shaped by three structural conditions of sustainability transitions, namely, institutional complexity, technological interdependence, and regulatory fragmentation (Bolton and Hannon 2016; Geels 2002; Markard et al. 2012), which jointly complicate how they are interpreted and addressed within firms.

Tensions, however, do not automatically translate into organizational responses (Berti and Cunha 2023). Two conditions shape whether they do. The first is managerial agency: the capacity of managers to shape the course of organizational action through interpretation, sensemaking, and the mobilization of resources and actors, while operating within structural, relational, and institutional constraints (Berti and Cunha 2023). Agency is thus not reducible to formal authority or managerial will; it is enabled or curtailed by the structural conditions, including governance arrangements, within which actors operate. The second is the character tensions assume: Generative paradoxes stimulate learning and adaptation (Schad et al. 2016; Smith and Lewis 2011), whereas pathological paradoxes arise when tensions are denied, suppressed, or framed as mutually exclusive dilemmas (Berti and Cunha 2023). Whether tensions become generative or pathological is shaped by cognitive and cultural orientations that help actors interpret contradictions as dualities rather than zero-sum choices (Hahn et al. 2014).

These dynamics are not confined to isolated projects: Empirical studies show that sustainability-related tensions are embedded in business models (Best et al. 2021; Daddi et al. 2019; Hahn et al. 2018; Runfola et al. 2025), span organizational levels and stages of the BMI process (Best et al. 2021; Engwall et al. 2021; van Bommel 2018); and are increasingly conceptualized as systemic, cross-level dynamics within broader socio-economic systems (Berti and Cunha 2023; Carmine and De Marchi 2023). Because such tensions cannot be definitively resolved, navigating them requires "both/and" responses, strategies that engage both poles of a tension simultaneously, rather than resolving it by privileging one pole over the other in an either/or logic (Hahn et al. 2018; Smith and Lewis 2022). Such responses, however, involve more than cognitive reframing. They may entail single-loop adjustments that refine existing routines and activities, or double-loop shifts that reorient underlying assumptions and structures (Berti and Cunha 2023; Berti and Simpson 2021).

Both forms are enacted through a set of organizational elements: sensing, routines, organizational structures, resource slack, and heuristics. However, prior research treats these elements in a dispersed and only partially specified manner. *Sensing* refers to the interpretive processes through which actors recognize and label persistent contradictions (Berti and Cunha 2023; Hahn et al. 2014; Lewis 2000; Lüscher and Lewis 2008; Smith and Lewis 2011). *Routines* capture recurring practices that stabilize responses and make tension handling predictable over time (Jarzabkowski et al. 2013). *Organizational structures* define how responsibilities are allocated and how competing demands are governed across units (Smith and Lewis 2011).

Resource slack, the cushion of actual or potential resources that allows an organization to adapt to pressures and initiate strategic change (Bourgeois 1981), enables experimentation and absorbs the cost of pursuing competing demands simultaneously, with meta-analytic evidence confirming a positive though contingent association with performance and adaptation (Daniel et al. 2004). In paradox management, slack is thus more than background context: It conditions whether recognized tensions can be worked through or must be absorbed through local, temporary adjustments.

Among these elements, *heuristics* deserve particular attention as they provide simple rules that guide action when uncertainty or complexity prevents exhaustive analysis (Bingham and Eisenhardt 2011). Rather than biased shortcuts, heuristics can be ecologically rational: Their effectiveness depends on the fit

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between the structure of the rule and that of the environment in which it is applied, what Marewski et al. (2024) call Simon's scissors (Luan et al. 2019; Maitland and Sammartino 2015). Once articulated and shared, heuristics operate as organizational artifacts, condensing persistent trade-offs into actionable decision criteria that can be tested, refined, and embedded in routines and product architectures, a property that makes them a plausible bridge between the recognition of paradoxical tensions and their translation into business model responses.

Despite this progress, paradox research on sustainability has largely emphasized cognitive framing and high-level strategy, devoting less attention to the concrete organizational processes through which tensions are recognized, enacted, and translated into business model changes (Berti and Cunha 2023; Carmine and De Marchi 2023; Hahn et al. 2014, 2018; Smith and Lewis 2011). Specifically, we still lack a clear understanding of where tensions are first recognized across organizational levels (locus), how routines, heuristics, and structures propagate them, and when these dynamics lead to single-loop adjustment versus double-loop reframing in BMI trajectories. Recognition itself is not untheorized: Research on organizational attention (Ocasio 1997), issue interpretation (Dutton and Jackson 1987), and sensemaking (Weick 1995) offers rich accounts of how issues come to be noticed and interpreted. Where paradoxical tensions first become actionable within organizations, however, has received far less attention.

These gaps are particularly consequential in sustainability-oriented industries, which the literature characterizes through three structural properties that make them a demanding context for paradox management. First, institutional complexity exposes firms to simultaneously incommensurable evaluative logics (economic, environmental, and social) that cannot be reduced to a common metric or resolved through optimization (Carmine and De Marchi 2023; Hahn et al. 2018). Second, technological interdependence embeds organizational activities in tightly coupled systems where changes in one component propagate across others, limiting the effectiveness of localized responses (Hacklin et al. 2010; Markard et al. 2012). Third, regulatory fragmentation distributes compliance expectations across jurisdictions and actor networks, making tensions both externally driven and internally differentiated (Bolton and Hannon 2016; Markard et al. 2012). These three properties are not uniform features of a homogeneous category: They vary substantially in degree and configuration across sustainability contexts (Carmine and De Marchi 2023). Circular strategies in agri-food or textiles, for instance, combine strong institutional complexity with comparatively loose technological coupling (Daddi et al. 2019), whereas energy and mobility systems feature tight interdependence and infrastructure dependence (Bolton and Hannon 2016; Geels 2002). In contexts of this kind, tensions are structurally distributed and resistant to single-level resolution (Berti and Cunha 2023), making their locus and enactment pivotal open questions.

3 | Research Design

This research adopts a qualitative, longitudinal single-case study design in the energy and charging infrastructure industries. The study follows a qualitative analysis consistent with the Gioia methodology, combining inductive coding grounded in informants' accounts (Gioia et al. 2013) with abductive interpretation through engagement with existing theory (Corley and Gioia 2004; Magnani and Gioia 2023). Paradox theory served as a sensitizing lens during the interpretive stages, guiding the theoretical interpretation of emerging patterns. This approach captures how the firm managed sustainability-related tensions across organizational levels, developing theory grounded in longitudinal evidence (Glaser and Strauss 1967; Yin 2018). The analysis covers 2012–2024, combining retrospective reconstruction of earlier events (2012–2021) with real-time data collection (2021–2024), following Pettigrew's (1990) framework for longitudinal process research.

3.1 | Case Selection and Description

The case was selected through purposeful sampling (Eisenhardt and Graebner 2007) as it offered a fertile setting to examine how firms pursue BMI while managing tensions and organizational complexity inherent to sustainability transitions. In energy and mobility, and particularly in Europe, decarbonization targets such as the Green Deal's 55% emission reduction by 2030 concentrate technological, institutional, and market transformations in sectors like EVs and distributed energy storage. Firms in these sustainability-oriented industries must navigate fragmented supply chains, evolving system architectures, and heterogeneous sustainability logics (Chasin et al. 2020; Franzò and Urbinati 2023).

B2B system integrators in renewable energy storage occupy a critical yet often underappreciated position. Linking battery suppliers and other upstream producers with utilities pursuing decarbonization, they orchestrate the technical and digital interfaces that make cleaner, interoperable infrastructures viable (Kivimaa et al. 2019). For these actors, sustainability is a strategic prerequisite for market access, investment, and long-term contracting. Their hybrid role exposes them to fragmented institutions and diverging demands from original equipment manufacturers (OEMs), utilities, and investors, creating competing pressures, such as scaling versus customization or short-term financial goals versus long-term environmental value (Delmas and Burbano 2011; Smith and Lewis 2011).

Within this context, the case focuses on *Alpha Group*, a European engineering-led group founded in the mid-2000s. It grew from a start-up to a listed company with roughly a quarter of a billion euros in annual revenues and more than 500 employees by 2024. Alpha Group operates through three business units (see Table 1).

The case is considered revelatory and selected for three main reasons. First, Alpha Group is an early mover in sustainability-oriented industries undergoing rapid transformation driven by climate policy, electrification, and decentralized energy generation. Both Alpha0 and Alpha1 entered their respective low-carbon markets and began product development before clear technological or regulatory standards existed, making them especially exposed to uncertainty and early-mover tensions linked to sustainability transitions. Second, the company has a

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TABLE 1 | Alpha Group's business units and entry-stage regulatory context.

Business unit	Description	Core activities	Revenue model	Geographical market	Regulatory context at the time of entry
Alpha0	*Large-scale energy storage.* The founding unit and technological backbone of the group, developing turnkey battery storage systems to support renewable integration and grid flexibility	Engineering, procurement, and system integration unit with strong in-house R&D capabilities	B2B	Global	Development phase; no industry standards for distributed storage integration (2012)
Alpha1	*Ultrafast charging infrastructure.* Operates in fast EV charging infrastructure, positioned as both a charging point operator and distributed storage integrator	Deploys and manages ultrafast-charging stations with integrated systems (storage, solar); provides energy management and aggregates distributed assets into a virtual power plant, coordinating decentralized resources to deliver grid services	B2B and B2C	Southern Europe	Development phase; no European interoperability standards for EV charging (2018–2019)
Alpha2	*Smart residential charging.* Joint venture specializing in manufacturing and distributing residential EV wall boxes with integrated smart features	Design, manufacture, and commercialization of residential charging systems with smart control features	Product sales (mostly B2C)	Europe and North America	Product standards emerging; service standards still undefined (2018)

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diversified intraorganizational structure with three distinct yet interconnected business divisions, providing a natural setting to observe how sustainability-related tensions emerge and evolve in a multibusiness, geographically distributed environment. While the units share a common technological base supporting sustainable energy solutions, they differ substantially in revenue models, core activity systems, governance, and innovation rhythms. This generates tensions across sustainability strategy, operational alignment, organizational design, and stages of business maturity (Edwards 2021). Third, Alpha Group operates in a revealing context (Yin 1994) where ongoing strategic reconfigurations make paradoxical tensions observable in vivo across organizational levels.

3.2 | Data Collection

Combining retrospective and real-time data (Pettigrew 1990), we used multiple sources to (i) understand the organizational dynamics of BMI in depth and (ii) triangulate evidence to enhance reliability and validity (Patton 2014). We organized data collection into primary and secondary sources.

Primary data were collected through 21 in-depth interviews (30–75 min), yielding approximately 335 pages of interview transcripts (see Appendix A). These interviews targeted key informants involved in strategic decision-making, sustainability initiatives, and business model development and were gathered in three phases between 2021 and 2024. All sessions were audio-recorded and transcribed verbatim except for four interviews conducted in Phase 1 where recording was not authorized; in these cases, detailed notes were taken. The core semistructured interview guide remained consistent across the first two phases, with minor adaptations to respondents' areas of expertise (see Appendix B).

Secondary data included press releases, sustainability and financial reports, and internal documents (technical roadmaps, project documentation, and product platform evolution), covering both public and internal company materials. In total, we collected approximately 556 pages of reports and 613 min of executive presentations. Secondary data (see Appendix A) were used to (i) reconstruct the firm's technological, regulatory, and sustainability maturity stages; (ii) trace the chronological evolution of the BMI process; and (iii) contextualize how uncertainty and tensions were managed during organizational growth phases.

Data collection unfolded in three longitudinal phases.

3.2.1 | Phase 1 (December 2021–November 2023)

Initial access was established through a formal invitation letter to the chief executive officer (CEO) and vice president (VP) of Alpha Group. Subsequent participants were identified through purposive and snowball sampling to ensure theoretical relevance and informational depth, consistent with the Gioia methodology (Gioia et al. 2013). Although company management facilitated access to potential informants, the researchers independently selected participants based on the "knowledgeable informant" criterion—individuals with direct knowledge of decision-making and implementation processes (Gioia et al. 2013). Phase 1 interviews included chief-level executives (CEO of Alpha Group, chief technology officer [CTO]) and mid-level managers from Alpha Group, Alpha0, and Alpha1 (head of sustainability, head of human resources [HR], head of product strategy, head of research and development (R&D), sustainability specialists).

3.2.2 | Phase 2 (December 2023–August 2024)

One author was embedded as an external strategic analyst (750 h) across organizational units, attending internal meetings and collecting secondary and archival data to retrospectively reconstruct Alpha Group's trajectory (2012–2021). Six follow-up interviews were conducted with chief-level executives and selected managers to validate emerging findings and capture organizational adjustments as the sustainability strategy evolved. These interviews followed the Phase 1 protocol, with minor refinements to clarify ambiguities identified during Phase 1 analysis; all were audio-recorded and transcribed.

3.2.3 | Phase 3 (September–December 2024)

Follow-up conversations with key informants validated emerging insights and confirmed relationships, mechanisms, and managerial patterns identified in Phases 1 and 2. Phase 3 interviews were shorter and more focused (30–45 min), targeting specific clarifications rather than exploratory depth.

Alpha2, majority-owned by an external OEM partner, operates under a different governance structure than Alpha0 and Alpha1. Because this ownership and reporting arrangement places Alpha2 outside the group's standard managerial and operating model, we did not interview Alpha2 employees directly. Instead, we relied on boundary-spanning informants, CEO of Alpha Group, VP of Alpha Group, head of HR, head of sustainability, and Alpha1 executives with formal responsibilities in Alpha2, complemented by internal documentation and shared project reports. Our analysis focuses on how Alpha2's activities interface with Alpha Group's strategy and interunit coordination rather than on its internal routines; we make no claims beyond what this triangulated evidence supports.

3.3 | Researcher Role and Ethical Considerations

One of the authors was involved as an external pro-bono strategic analyst, gaining access to internal meetings, C-level discussions, and project documentation. Access to data was formalized through a nondisclosure agreement, and all sensitive data were stored in line with university ethics protocols (Cunliffe and Alcadipani 2016). Reflexivity was embedded through an analytic diary and regular debriefing sessions with co-authors (Alvesson and K. Sköldberg 2018; Corley and Gioia 2004), and a sustained distinction between observed practices and self-reported narratives (Eisenhardt 1989; Gioia et al. 2013), enabling triangulation between embedded observations, interviews, and archival sources (Gehman et al. 2018). Multilevel sampling

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across hierarchical levels and departments balanced managerial and operational perspectives (Klag and Langley 2013), mitigating potential power asymmetries from ownership transitions during fieldwork.

These safeguards were reinforced by the positionality of the research team, which combined insider and outsider perspectives (Bourke 2014). The embedded author occupied a partial-insider position, with real-time access to strategic discussions and decision-making, yet without employment ties, hierarchical dependence, or financial interests in the organization, while the remaining authors, fully external to the focal organization, contributed primarily to coding refinement, analytical interpretation, and theoretical abstraction. This division of interpretive labor served as a concrete safeguard against selective interpretation and overidentification with managerial narratives: Interpretations relying primarily on embedded observations were flagged and cross-checked against interview and archival evidence; alternative explanations were actively entertained during debriefings, with co-authors assuming a devil's-advocate role; and theoretical categories were refined only when supported by evidence independent of the embedded observation stream.

3.4 | Data Analysis

The analysis followed a qualitative procedure consistent with the Gioia methodology. In line with recent clarifications of this approach, the analytical process combined inductive and abductive reasoning: The initial coding phase relied on inductive identification of informant-centric concepts, whereas subsequent stages involved an abductive dialogue between emerging empirical patterns and existing theoretical lenses (Magnani and Gioia 2023). Paradox theory (Schad et al. 2016; Smith and Lewis 2011) provided conceptual sensitivity, helping us recognize tensions in managerial accounts, while the coding process ensured that categories remained grounded in the empirical material. Analysis proceeded through four integrated stages, combining open coding, hierarchical aggregation, temporal embedding, and validation, consistent with process-oriented research in sustainability contexts (Langley 1999; Pesce et al. 2024).

3.4.1 | Initial Coding

Primary and secondary data were openly coded using an informant-centric approach, privileging managers' vocabulary and framings. Transcripts were segmented into meaning units (one to three sentences capturing a single decision, rationale, or event), and each meaning unit was assigned a provisional first-order concept representing a concrete situation. These empirical codes emerged through iterative comparison and memo writing. Paradox theory was introduced only in later interpretive stages and did not serve as an a priori coding template, allowing categories to emerge inductively from the data. Coding was conducted by the lead author using NVivo 14, with constant comparison across interviews and documents to identify recurring patterns. Coding decisions were discussed iteratively across the research team to challenge emerging interpretations and reduce the influence of any single researcher's perspective.

3.4.2 | Hierarchical Aggregation of Tensions

First-order concepts that recurred across interviews and business units were clustered into broader, researcher-interpreted second-order themes, which synthesized patterns of organizational tension observed in practice. These first-order concepts captured concrete managerial situations involving competing demands. Recurrent examples include reworking the core control logic while keeping the platform roadmap stable, as standardized product architectures confronted the need to adapt system functionalities to evolving sustainability requirements and customer needs; scaling system-level solutions while coping with cross-border rule fragmentation, given the difficulty of replicating modular architectures across heterogeneous national regulatory regimes; reconciling long-term capital needs with tightening investor control and timelines, as the patient capital required for sustainability innovation met the hierarchical governance models imposed by investors. Further examples include managing environmental, social, and governance (ESG) certification timelines that misalign with product iteration cycles, where lengthy life cycle assessment (LCA) and certification processes lagged behind rapid product development and commercialization; and balancing system performance with ESG traceability demands, involving trade-offs between high-performing technical components and suppliers able to provide full ESG compliance and documentation.

The aggregation followed a transparent procedure. First-order codes were merged when they consistently referred to the same underlying tension and were supported by conceptually similar meaning units, yielding three second-order themes. *Product orientation* versus *system integration* captures tensions between maintaining standardized product architectures and adapting integrated system solutions to evolving technological and sustainability requirements. *Patient capital* versus *scalability* reflects tensions between the long-term investments required to develop sustainable infrastructure and the governance and financial discipline imposed by investors to accelerate scaling. *Sustainability mandates* versus *operational efficiency* describes tensions between compliance with ESG requirements and the need to maintain cost efficiency, performance, and speed in operational processes.

Although these themes capture distinct organizational tensions, informants consistently described them as interdependent pressures arising from the firm's simultaneous pursuit of rapid expansion, industrial scalability, and diversification across technologies and markets. For this reason, the three second-order themes were abstracted into a single aggregate dimension representing the speed–scale–scope paradox, which captures the overarching strategic challenge of balancing pressures related to speed, scale, and scope in the firm's growth trajectory (see Figure 1).

Rather than representing separate dimensions, each second-order theme reflects a specific organizational domain in which these three pressures interact. In *product orientation* versus *system integration*, speed manifests as pressure to rapidly adapt product architectures to evolving technological and sustainability requirements, scale as the need to industrialize solutions across multiple installations and infrastructures,

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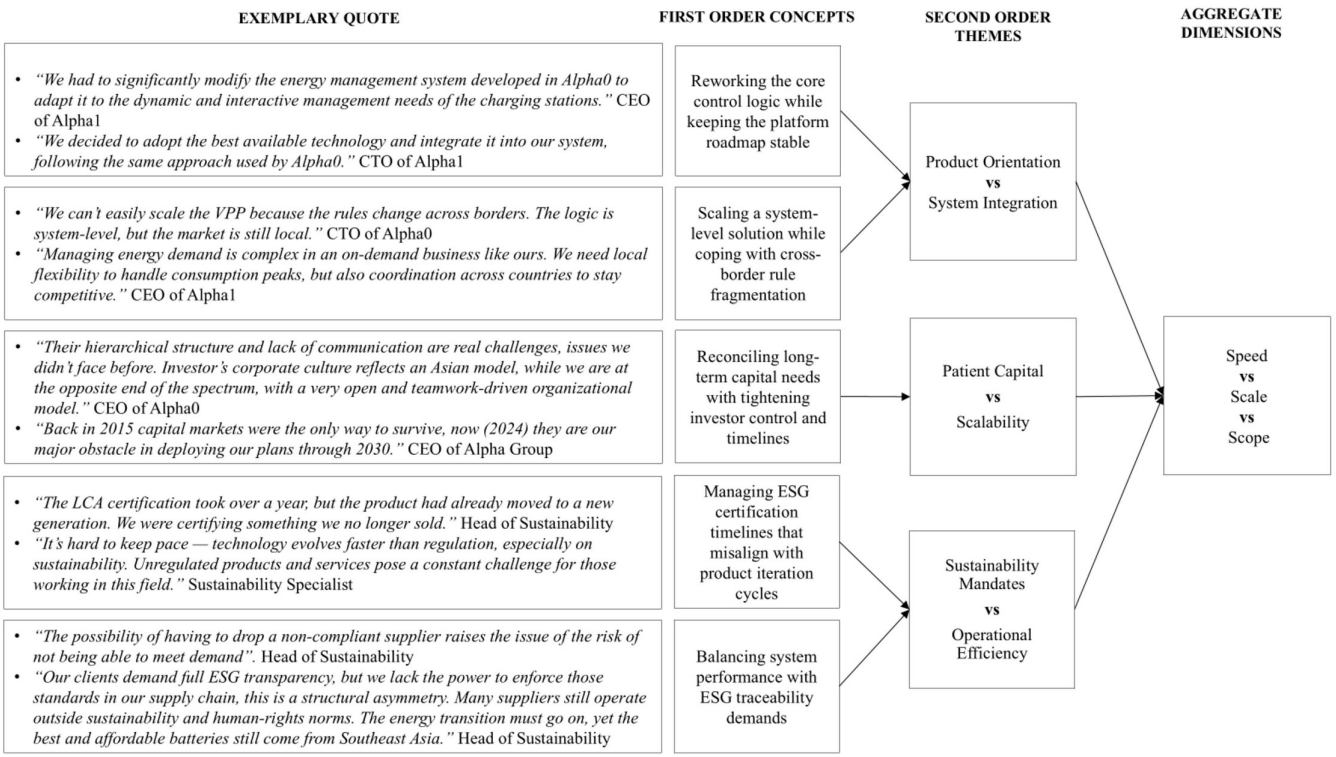

FIGURE 1 | The thematic coding analysis.

and scope as the expansion from standardized products toward integrated system-level solutions. In *patient capital* versus *scalability*, the same pressures take the form of investor demands to accelerate deployment and commercialization, the mobilization of large-scale investments in sustainable infrastructure, and the diversification of projects across markets, technologies, and business domains. In *sustainability mandates* versus *operational efficiency*, they surface as the need to maintain fast development and deployment cycles, to ensure scalable operations and supply chains, and to extend ESG compliance frameworks across suppliers, technologies, and regulatory environments. In this sense, all three themes embody the same underlying paradox, articulated in different parts of the organization.

3.4.3 | Temporal Embedding of Categories

Building on the timeline approach described in Section 4.1, we developed a temporal map linking each tension to specific sustainability-related issues, such as low-carbon market entry, resource-efficient product architecture, local sustainability compliance, and governance for sustainable growth. This process enabled us to trace how tensions emerged, evolved, and were addressed across Alpha Group's BMI trajectory (Section 4.5). It also allowed us to connect localized responses to broader shifts in the business model.

3.4.4 | Triangulation and Iterative Validation

To ensure coherence and external validity, emerging codes and themes were iteratively compared against archival and observational data on the firm's sustainability strategy and operations (Miles et al. 2014). Intercoder reliability was assessed on a stratified subset of interview transcripts that covered corporate, Alpha0, Alpha1, and boundary-spanning accounts concerning Alpha2 (see Appendix C). The reliability sample comprised five interviews, yielding approximately 120 meaning units, which served as the units of analysis. Two trained external researchers independently applied the first-order codebook to this subset. Percent agreement was computed as the proportion of meaning units for which both external coders assigned the same first-order code, yielding 0.85 for the first-order codebook (Miles et al. 2014). Disagreements were discussed jointly and resolved by consensus.

When we reintegrated the emergent categories into the temporal narrative, informants' accounts showed that macro-level priorities were progressively translated into business-level and operational tensions. We moved from the Gioia data structure to process theorizing by identifying repeated sequences linking recognition events to framing artifacts (heuristics/routines) and subsequent BMI moves, and by validating these sequences through temporal bracketing across phases. Figure 1 reports the inductively derived data structure, while Figure 2 maps how the same strategic paradox propagates across organizational levels over time. Importantly, following a process-tracing logic, we observed that the sequences were not deterministic. While several tensions triggered recognition and integrative framing leading to subsequent BMI moves, other tensions remained localized or resulted in temporary adjustments without escalating across organizational levels. Examining these contrasting episodes allowed us to trace when and how tensions escalated into integrative responses and when they did not, strengthening the plausibility of the process interpretation. These variations are

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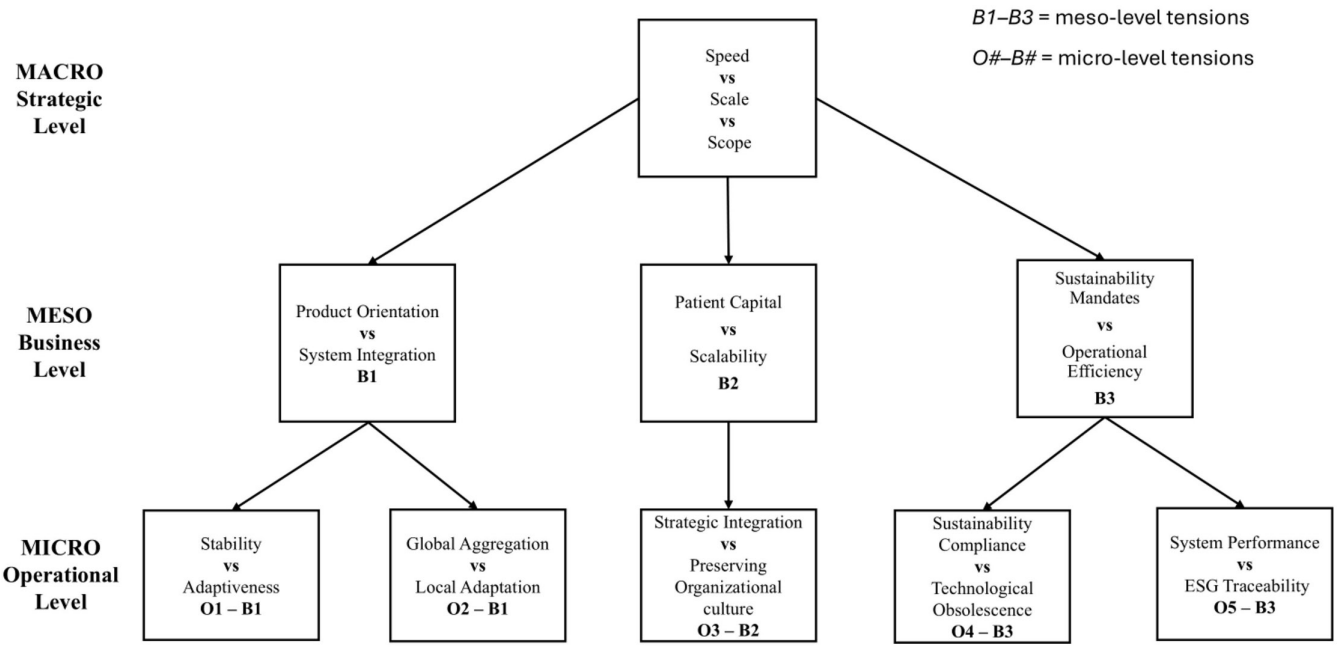

FIGURE 2 | Multilevel propagation of a sustainability-related paradox in BMI.

illustrated in the Findings section. Figure 2 depicts an analytically derived process model that captures the recurrent patterns observed across the case, rather than a fixed or deterministic sequence of events.

To strengthen the credibility of the process account, the analysis incorporated a process-tracing logic that examined not only the episodes in which tensions escalated into integrative responses, but also those in which they did not. For each tension, the analysis examined whether recognition produced integrative framing and, when it did not, identified the conditions that prevented it. This involved comparing episodes in which tensions were sensed but remained localized (e.g., O4–B3 and certification-product cycle misalignment) with those in which recognition eventually triggered cross-level escalation and architectural adjustment (e.g., the bottom-up escalation observed for B1 and the cumulative single-loop dynamics observed for B3). The contrast between these cases, rather than a focus on successful enactment alone, allowed us to identify the boundary conditions (managerial agency and resource slack) that moderate the locus–enactment relationship and to distinguish structural from contingent explanations.

Throughout the paper, we use *multilevel propagation* to describe how the strategic paradox becomes articulated across organizational levels over time (Figure 2). Within this overall pattern, we reserve the term *cascade* for the top-down articulation of the paradox from strategic priorities into business and operational domains, and the term *escalation* for bottom-up processes through which operational frictions are surfaced and reinterpreted at higher organizational levels.

In addition, to distinguish between refinement (single-loop) and reframing (double-loop) responses (Berti and Cunha 2023), we relied on three analytical criteria. First, we examined the nature of the change: Single-loop responses modify routines, coordination mechanisms, or design features, whereas double-loop responses reinterpret the underlying value architecture of the business model. Second, we assessed the level of impact: Single-loop responses remain localized within functional domains, while double-loop responses involve cross-level reconfiguration affecting multiple components of the business model. Third, we evaluated whether the change altered the firm's logic linking value creation, delivery, and capture. Changes confined to operational routines were classified as single-loop responses, whereas changes that redefined this configuration were classified as double-loop reframing. These criteria are applied in Section 5.2 to distinguish tension-conditioned response patterns across the empirical cases.

4 | Findings

To enhance clarity, findings are organized following their empirical emergence, starting from the macro-level speed–scale–scope paradox (Section 4.1) and then detailing its meso- (Sections 4.2–4.4) and micro-level expressions (Section 4.5).

4.1 | Opportunities and Sustainability-Related Tensions Stemming From Balancing Speed–Scale–Scope

4.1.1 | Strategic Expansion Into Sustainability Markets

Before expanding into new markets, Alpha Group operated exclusively through Alpha0, initially focused on general energy storage and, from 2016 onward, strategically repositioned toward renewable-energy storage. This business unit served as the core technical and organizational platform of the firm's sustainable business model. Between 2018 and 2021, its system integration model transitioned from microgrids to renewable large-scale storage systems, increasing project capacity and reinforcing the importance of scale economies in a price-sensitive

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market shaped by ambitious carbon-reduction targets. To support this shift, the firm expanded core technological components—including the energy management system (EMS), battery procurement, and proprietary software for distributed energy load management. These capabilities provided the technical foundation for entering adjacent sustainability-oriented markets: EV charging services for public-space (Alpha1) and residential (Alpha2) segments, operationalized through two dedicated business units. Each new business unit operated as a product-focused division, sharing the engineering foundation built within Alpha0; several senior managers from Alpha0 took on boundary-spanning roles across the new units (Appendix A), preserving coherence in technical architecture and product strategy.

To secure first-mover advantages, Alpha1 developed high-power EV charging infrastructures before regulatory and technical standards had stabilized (particularly regarding interoperability, payment systems, and vehicle-to-grid integration), exposing the firm to significant uncertainty across markets. As the CTO of Alpha0 noted: "We can't easily scale the virtual power plant (VPP) because the rules change across borders. The logic is system-level, but the market is still local."

Institutional uncertainty was particularly visible in the residential charging market (see Table 1), where service standards remained underdeveloped and installation practices varied widely across installers, municipalities, and housing configurations. Hence, Alpha2 relied on continuous field learning to surface friction points and translate them into design refinements, co-developing solutions with customers in a logic of "shaping the market as it entered it" (VP of Alpha Group). Supported by its OEM partner, the unit extended its value chain by coupling standardized hardware with iteratively developed service layers. Early installation failures exposed how missing electrical components could create friction for user adoption, prompting the development of an integrated turnkey solution. As VP of Alpha Group recalled, "[...] the decision to pre-install the Schuko socket in the Alpha2 charger originated from a problem the CEO personally experienced during an installation."

4.1.2 | Competing Strategic Imperatives: Speed, Scale, and Scope

At the strategic level, the firm simultaneously pursued three competing imperatives: rapid market entry (*speed*), expansion of operations (*scale*), and diversification across technologies and geographies (*scope*). These ambitions unfolded under significant resource constraints, including limited managerial bandwidth and finite deployable capital. The quest for early entry and first-mover advantages conflicted with the need to build scalable operations and to diversify in parallel. Although the business units shared a common engineering and software foundation, they operated in heterogeneous market contexts requiring adaptation. As a result, the BMI logic diverged across the three divisions (Table 2).

Operating across large-scale renewable storage (Alpha0), public EV charging (Alpha1), and residential smart charging (Alpha2), the firm leveraged a shared technological base to broaden its strategic scope from centralized storage in technologically advanced markets toward distributed, end-user–centric solutions across both the energy and mobility sectors. This diversification intensified the speed–scale–scope tension, as attempts to scale standardized solutions repeatedly collided with heterogeneous regulatory regimes, customer requirements, and the need for context-specific adaptation across markets.

TABLE 2 | Business model innovation timeline.

Period	Strategic action	Description	Evidence of BMI
2012–2015	Proprietary software development	Early development of proprietary EMS for distributed energy management Technological foundation for grid-integrated energy orchestration	New value capture mechanism through proprietary technology Shift from passive energy asset management to active software-driven grid interaction
2015–2018	Vertical integration into inverter design and power systems	Upstream integration into power-electronics design and manufacturing Strategic repositioning, moving toward sustainable business model	Fundamental shift in vertical integration scope Supply chain internalization enables end-to-end system optimization and reduces reliance on external suppliers Value proposition change: from storing energy to storing renewable energy Value logic extends from software to hardware integration
2018–2024	Foundation of Alpha1 and Alpha2	Simultaneous entry into EV charging (Alpha1) and residential smart charging (Alpha2) alongside continued large-scale storage (Alpha0) Geographic and market diversification supporting the sustainable mobility transition	Expansion into new customer segments (charging networks, households) with new value propositions (end-user clean mobility, household renewable integration) alongside existing large-scale offerings Portfolio value capture logic becomes multisegment

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4.1.3 | Regulatory Fragmentation and the Amplification of Scope Tension

Local market conditions significantly amplified scope tensions. Across Southern Europe, Alpha1 and Alpha2 encountered heterogeneous regulatory and capability barriers, including aggregator platform requirements, lengthy permitting procedures, and uneven installer competencies, which limited the replicability of standardized system architectures across markets. As a result, each deployment required localized adjustments in product configuration, delivery models, and operational support. These conditions intensified the tension between scope expansion and the firm's attempts to achieve speed and scale through standardized solutions.

The temporal overlap between Alpha1 and Alpha2 market entries, initiated before operational stability was consolidated in prior markets, increased pressures on managerial capacity and financial resources, illustrating how the simultaneous pursuit of speed, scale, and scope generated persistent tensions.

4.1.4 | Early Architectural Responses to the Speed–Scale–Scope Paradox: Modularity and Integrative Redesign

In Alpha0, product-service offerings required continuous adaptation as tender requirements varied across geography, particularly regarding supply-chain traceability, third-party environmental certification, and ESG compliance, creating a moving target for system design. These requirements often exceeded the capabilities of standardized product architectures, forcing iterative cycles of reconfiguration.

Procurement constraints for ESG-certified components further increased coordination complexity and project timelines, reinforcing a common pattern: Standardized product designs repeatedly confronted heterogeneous deployment conditions, triggering cycles of improvisation and redesign. As the VP of Alpha Group noted: "One of the advantages our divisions have been the time we had to acquire know-how through a learning process based on customer feedback and actual product usage. [...] This trial-and-error process, made of usage and improvement, proved crucial in developing turnkey solutions for all the business divisions."

To cope with these tensions while maintaining rapid market entry, the firm pursued parallel product and business development initiatives spanning low-carbon technology design and component integration, product architectures aligned with sustainability certification standards, and region-specific market-entry strategies and product adaptations required for Alpha0 and Alpha1.

Rather than converging on a single standardized architecture, the firm preserved flexibility through modular component design, region-specific regulatory adaptation, and rapid iteration routines. Unlike other tensions that remained localized, these episodes triggered integrative architectural responses: Modular design principles were codified and reused across business units, translating unresolved contradictions into structured heuristics. This sequence illustrates a top-down cascade dynamic: The response to the speed–scale–scope tension, recognized at the strategic level by the group CEO, was the definition of architectural principles, inspired by modular design and rapid iteration, that propagated into business-unit and operational domains, shaping how Alpha0 and Alpha1 structured their product development and market-entry strategies.

4.2 | Tension Between Product Orientation and System Integration

At the business (meso) level, the firm confronted a tension between developing standardized proprietary modules and maintaining its system-integration capability, which required continuous customization to meet heterogeneous customer and sustainability requirements. This produced a paradoxical dynamic in which the activities enabling differentiation (tailoring, integration, and adaptation) undermined attempts to standardize product components (B1). This tension manifested in the coordination between R&D and sales (O1–B1). These unresolved frictions, initially treated as project-level coordination frictions, were progressively brought to the attention of the head of product strategy and the group CEO, who began to address them at the level of business model architecture.

A prominent illustration emerged when Alpha0's EMS, originally engineered for large-scale storage optimization, was repurposed for Alpha1's distributed EV charging architecture, which required real-time dynamic load balancing across spatially distributed charging assets. This diversification required a re-engineering of shared components. The group CEO's expectations of cross-unit scale economies thus met practical limits: Anticipated profit margin improvements were delayed as the firm grappled with the technical heterogeneity of the markets it sought to enter simultaneously. As the CEO of Alpha1 recalled: "We had to significantly modify the EMS developed by Alpha0 to adapt it to the dynamic and interactive management needs of the charging stations. The control logic used for large-scale storage is not the same as the one needed to manage many distributed fast-charging points."

Although these adaptations initially constrained standardization, they progressively reinforced the firm's system-integration capability. Alpha1 and Alpha2 increasingly relied on Alpha0's technical expertise to adapt solutions across markets, transforming cross-unit knowledge exchange into a core organizational capability.

"We decided to adopt the best available technology and integrate it into our system, following the same approach used by Alpha0. Our background in system engineering helped us make strategic decisions which, although we're still assessing their long-term impact, have already shown positive short-term results" (CTO of Alpha1).

Rather than resolving the tension, the firm deliberately operated within it, continuously adapting modular components across

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business domains. Adaptation routines thus strengthened the firm's ability to orchestrate heterogeneous energy systems.

4.2.1 | Stability Versus Adaptiveness

At the R&D–engineering–commercial interface, business development prioritized market stability to sustain proprietary product lines and margin expectations, whereas engineering emphasized adaptiveness to address technological volatility and geographically differentiated sustainability requirements. These conflicting logics generated divergent development priorities: Commercial teams pursued emerging opportunities lacking a stable product configuration, while engineering resisted customizations that threatened the coherence of the product development plan.

Resource constraints amplified these dynamics. With only four global offices and a limited technical workforce shared across the business units, the firm struggled to allocate specialized personnel where needed. To address recurring misalignment, Alpha0 introduced "Strategic-Marketing Calls" in 2021, fortnightly cross-functional meetings led by the head of product strategy and bringing together R&D, marketing, business development, and sustainability representatives. These meetings made three classes of decisions: tender selection, based on technical fit and ESG eligibility; identification of the technological modules and value propositions that required adaptation, based on the trade-off between standardization returns and adaptation costs; and the allocation of engineering and commercial resources across competing project commitments. Over time, they became a collective sensemaking mechanism for managing tensions between standardization and customization, speed and robustness, and scalability and ESG requirements. As the head of product strategy explained, "We had to restructure how we worked," and the group CEO reinforced, "We had to redesign our business model and reallocate our know-how and patent portfolio to the energy and electric mobility sectors, which required continuous technology and value proposition adaptation."

4.2.2 | Global Aggregation Versus Local Adaptation

The second manifestation of the B1 tension (O2–B1) emerged most clearly in Alpha's cross-regional deployment. Although Alpha1's VPP scaling and Alpha0's modular architecture were designed for global replication, differences in grid standards, permitting procedures, and infrastructure conditions required recurring system adaptations, challenging the premise of a single global architecture. In some markets, standardized modules proved uncompetitive, while complex projects favored Alpha's system-integration capabilities. As a result, the firm shifted from a region-level to a project-level market entry strategy, relying on modular recombination rather than full architectural standardization. Over time, these adaptations expanded the firm's modular design repertoire and reinforced its integrative capabilities. As the VP of Alpha Group described, this architecture resembled a "Lego-Bricks approach," where modular components could be recombined across diverse contexts.

4.3 | Patient Capital Versus Scalability

An inflection point occurred in 2018 when a French energy utility acquired the majority stake in the group. Although the investment enhanced Alpha0's market reputation and enabled access to capital for large-scale renewable projects, the new shareholder prioritized short-term financial returns. This orientation conflicted with capital endowment, a critical success factor for Alpha1's market. This misfit (B2) delayed several strategic initiatives and revealed a paradoxical tension between patient capital and scalability. The top management was originally not able to generate an integrative response to this tension. Rather, the tension produced delays in strategic initiatives and eventually governance instability. The French utility later divested, and in 2021 a majority stake was acquired by an Asian industrial conglomerate seeking to decarbonize its operations. Despite recognizing Alpha's technological value, the new shareholder fully acquired and delisted the company in 2024, reflecting limited market appetite for scaling the distributed VPP model. This governance shift led to the group CEO and the VP of Alpha Group leaving the company. These events reflected a wider emerging operational tension (O3–B2) between the need for strategic flexibility in sustainability innovation and the preservation of the firm's collaborative organizational identity.

4.3.1 | Strategic Integration Versus Preserving Organizational Culture

A belonging tension emerged as Alpha's organizational identity was challenged by its inclusion in a new corporation. As the CEO of Alpha0 explained: "Their hierarchical structure and lack of communication are real challenges, issues we didn't face before. Investor's corporate culture reflects an Asian model, while we are at the opposite end of the spectrum, with a very open and teamwork-driven organizational model."

In response, management reinforced internal cultural anchors and talent-based mechanisms, that is, identity narratives, recurring cross-unit practices, advanced welfare programs, and retention incentives, to preserve agency in business strategy and prevent erosion of core system-integration capabilities. Over time, these efforts produced a generative renewal effect, as the firm developed a cultural-buffering capability: a bundle of HR practices, welfare programs, and identity narratives that buffer operational teams from governance turbulence and stabilize operational flexibility under corporate-level constraints. As the head of HR noted: "We leverage our position as a company committed to employee work-life balance, offering competitive salaries and being far more attractive to engineers compared to state-owned enterprises that operate in the domain of electrical transmission." This logic extended beyond recruitment. As the CEO of Alpha1 observed: "Talent retention through benefits and accountability is one of our main competitive advantages." These initiatives helped stabilize core engineering capabilities and limit employee turnover rate, preserving the firm's ability to orchestrate complex technological and market integrations.

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4.4 | Sustainability Mandates Versus Operational Efficiency

For Alpha Group, sustainability represented a necessary condition for competing in tenders. This type of market presented a tension between increasingly demanding environmental requirements and operational efficiency (B3).

4.4.1 | Sustainability Compliance Versus Technological Obsolescence

At the operational level, Alpha0 faced recurring misalignment between slow sustainability certification processes and the rapid evolution and deployment of its product modules (O4–B3). Specifically, completing LCA and environmental product declarations required lengthy verification procedures, often lagging behind ongoing product upgrades. As the head of sustainability explained: "The LCA certification took over a year, but the product had already moved to a new generation. We were certifying something we no longer sold."

As a system integrator, Alpha remained responsible for full sustainability disclosure, in terms of carbon footprint, material traceability, and regulatory compliance, while upstream suppliers operated under looser standards and were not required to provide equivalent transparency. As a result, teams frequently had to compensate for incomplete supplier information, increasing compliance costs and delaying tender preparation. As the head of sustainability noted, "Our clients demand full ESG transparency, but we lack the power to enforce those standards in our supply chain."

This tension did not escalate beyond the operational level: In the absence of sufficient supply chain authority and resource slack to invest in process redesign, recognition was absorbed through temporary workarounds—including project-level reprioritization and partial reuse of existing certifications—without producing a coordinated response across organizational levels. Consequently, the sustainability-efficiency tension became both more frequent and more difficult to manage.

4.4.2 | System Performance Versus ESG Traceability

At the operational level, engineers coped with trade-offs between system performance and ESG traceability (O5–B3): High-performing components sometimes lacked verified ESG documentation, while fully compliant suppliers involved higher costs or longer lead times. As the head of sustainability acknowledged, "The possibility of having to drop a noncompliant supplier raises the issue of the risk of not being able to meet demand."

To manage these situations, Alpha developed cross-functional evaluation routines involving sustainability, procurement, and R&D, allowing teams to assess trade-offs between ESG requirements, financial viability, and system performance on a project-by-project basis. In practice, this meant that engineering teams could no longer rely exclusively on technical performance criteria; they had to build new assessment methods to evaluate supplier ESG documentation, interpret evolving certification standards, and weigh environmental traceability against system-level design requirements. The firm soon adopted a guiding heuristic, "measure what matters most," which helped focus attention on the most relevant sustainability indicators in each tender.

Although the tension remained unresolved, repeated cycles of compliance, redesign, and supplier negotiation gradually produced a sustainability–performance reconciliation capability. This capability relied on cross-functional decision routines and supplier evaluation practices that strengthened coordination between engineering, procurement, and sustainability teams. These practices improved supplier screening and ESG transparency, enabling Alpha to meet rising sustainability requirements while maintaining system performance and supporting the scaling of integrated energy systems.

4.5 | The Multilevel Tensions and Their Impact on BMI Trajectories

The findings reveal three contrasting dynamics that structure the theoretical interpretation developed in the Discussion section: variation in the locus of first recognition, tensions that remain localized, and cumulative escalation toward double-loop reframing. The full cross-case mapping is reported in Appendix D.

First, the locus of first recognition varied: The B1 tension was initially sensed at the operational interface (R&D vs. commercial) and required escalation to the head of product strategy and the group CEO, who institutionalized cross-functional coordination routines (strategic-marketing calls) and codified modular design principles to address it. The B2 tension, by contrast, was recognized early at the strategic level by management, yet the investor's short-term return orientation prevented this recognition from translating into architectural change. This variation suggests that locus alone does not determine the enactment pathway: Organizational authority, resources, and governance configurations matter too.

Second, the episodes of nonescalation are informative precisely because of what did not happen. Several micro-level tensions, most notably O4–B3, the certification–product cycle misalignment, were clearly recognized at the operational level and repeatedly flagged, yet no cross-level escalation occurred and no architectural adjustment followed. Lacking supply chain authority and dedicated resource slack to invest in process redesign, the units absorbed the tension locally through temporary adjustments such as project-level prioritization and partial reuse of certifications. Escalation failed not because the tension went unnoticed, but because the actors who recognized it lacked the authority and resources to convert recognition into integrative framing, mirroring, at the operational level, the strategic-level blockage already noted for B2 and theorized in Section 5.1.2.

Third, and most consequentially for BMI trajectories, repeated single-loop adjustments accumulated over time until they reached a threshold sufficient to expose structural misalignment in the underlying value logic. In two cases, B1 and B3, this

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cumulative dynamic triggered a shift toward double-loop reframing: a redefinition of the organizing principles linking value creation, delivery, and capture, rather than incremental refinement of existing routines. Notably, several episodes exhibited transitional characteristics, combining elements of adaptation and reframing, before stabilizing into one dominant trajectory, indicating that the boundary between the two response patterns was crossed gradually rather than categorically. This pattern of local iterations accumulating into architectural reconfiguration is elaborated in Section 5.2.

5 | Discussion

Our findings suggest that BMI in sustainability-oriented industries cannot be fully understood by viewing paradoxical tensions as either cognitively framed at the strategic level or absorbed through operational adaptation. Building on paradox theory (Schad et al. 2016; Smith and Lewis 2011) and emerging research on multilevel mechanisms in sustainability transitions (Best et al. 2021; Carmine and De Marchi 2023), we address how paradoxes are enacted across organizational levels (RQ1, Section 5.1) and how this enactment process shapes distinct BMI trajectories (RQ2, Section 5.2).

Specifically, we identify a paradox-enactment process in which paradoxes have a locus of first recognition that shapes their initial encoding and the heuristics through which they are subsequently navigated (Section 5.1.1). This initial locus, in turn, conditions the cross-level pathway through which paradoxes are enacted, with managerial agency and resource slack influencing whether tensions escalate into integrative responses (Section 5.1.2). As paradoxes unfold across organizational levels, the enactment process also shapes whether firms respond through incremental refinement or more substantive business model innovation (Section 5.2).

5.1 | The Paradox-Enactment Process

Our case shows how the paradoxical tensions identified by Smith and Lewis (2011) are instantiated in sustainability-oriented industries. Strategic-level performing tensions cascade into organizing tensions at the business level and, at the operational level, manifest as belonging (O3–B2) and learning (O5–B3) tensions, consistent with the co-evolutionary patterns documented by Jarzabkowski et al. (2013). Building from these observations, we inductively derive a paradox-enactment process comprising two analytically distinct yet interrelated phases: paradox recognition (sensing and salience) and paradox integrative framing (heuristic translation and enactment).

5.1.1 | The Locus of First Recognition

The first phase, *paradox recognition*, unfolds through paradox sensing and paradox salience. Recognition typically emerges locally, through repeated breakdowns, regulatory frictions, and cross-team misalignments that accumulate in specific operational contexts rather than becoming immediately visible organization-wide.

We define *paradox sensing* as the process through which organizational members come to interpret recurring frictions as manifestations of persistent and interdependent contradictions, rather than as isolated operational problems (Berti and Cunha 2023; Hahn et al. 2018; Lewis 2000; Schad et al. 2016; Smith and Lewis 2011). Whereas prior work typically treats recognition as a single cognitive moment (Schad et al. 2016; Smith and Lewis 2011), distinguishing analytically between sensing and salience shows instead that recognizing a contradiction and elevating it to organizational consequence are separable processes. *Paradox salience* marks the point at which a sensed contradiction enters organizational decision-making as an object requiring response (Smith and Lewis 2011). This shift occurs when locally experienced tensions begin to affect broader organizational outcomes, such as market performance, regulatory compliance, or cross-unit coordination, turning them from localized concerns into strategic issues.

The second phase, *paradox integrative framing*, captures how recognized and salient tensions are translated into coordinated organizational action. Prior work shows that actors frame paradoxes to make them actionable (Berti and Cunha 2023; Berti and Simpson 2021; Lüscher and Lewis 2008; Smith and Lewis 2011). We extend this literature by showing that integrative framing is not only cognitive but organizational, unfolding through heuristic translation and heuristic enactment.

Heuristic translation refers to the articulation of simple rules of thumb that condense complex paradoxes into a small set of decision criteria (Bingham and Eisenhardt 2011). In doing so, they carry forward and sometimes revise the initial encoding of the tension as a local trade-off or a systemic contradiction, shaping the scope of the response. Rather than resolving the underlying contradiction, these heuristics render it actionable. Consistent with the ecological view of heuristics, their effectiveness depended on the fit between rule and environment (Marewski et al. 2024): The same modularity rule that enabled adaptation under fragmented regulatory regimes would likely have carried little value in a stable, homogeneous setting. *Heuristic enactment* captures how these heuristics are tested, refined, and embedded through cycles of product experimentation (Demil and Lecocq 2010; Sosna et al. 2010), stabilizing as repeatable responses within decision-making routines and product architectures.

Taken together, our data reveal a recurrent pattern through which organizations move from recognizing persistent contradictions to enacting them through heuristics embedded in experimentation and product architecture. The organizational locus at which tensions are first recognized shapes their subsequent enactment in two empirically observable ways. In some cases, heuristics emerge directly at the locus of recognition: The "measure what matters most" rule, for instance, was developed within the sustainability function where ESG–performance trade-offs were first experienced (O5–B3), leading to localized responses. In other cases, the character of operational frictions leads actors to encode tensions as systemic, prompting escalation and formalization at higher levels: The group CEO and VP's decision to adopt fully modular design principles responded to the B1 tension first encountered at the R&D–business development interface (O1–B1).

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Prior paradox theory, however, generally treats the organization as an undifferentiated site of recognition: Smith and Lewis (2011) and Berti and Cunha (2023) theorize how tensions become salient and are framed through both/and responses, while Schad et al. (2016) classify the forms that paradox responses can take. However, the organizational locus at which paradoxical tensions are first recognized remains comparatively underexplored. As a result, existing theory provides more limited insight into why the same structural contradiction may be interpreted differently and give rise to divergent heuristics and enactment trajectories within the same organization.

The locus of first recognition is also distinct from established accounts of where issues are noticed, interpreted, or attended to within organizations. The attention-based view explains how structural distributions of attention channel what decision-makers notice (Ocasio 1997); issue interpretation explains how noticed issues are categorized as threats or opportunities (Dutton and Jackson 1987); and sensemaking explains how actors construct plausible accounts of ambiguous cues (Weick 1995). The locus of first recognition addresses a different question: where within the organization a paradox first becomes organizationally actionable, that is, the location in which a tension is first translated from a perceived issue into an object of deliberate organizational response and first encoded as either a local trade-off or a systemic contradiction. This encoding carries consequences for the entire enactment pathway. Our contribution is therefore not to introduce another theory of organizational attention, but to specify how the organizational location of initial recognition conditions subsequent paradox enactment.

5.1.2 | Cross-Level Conditioning of Paradox Enactment

The pathway that enactment follows across levels takes the form of top-down cascade or bottom-up escalation. This distinction, however, reflects how paradox enactment unfolds across levels rather than whether it ultimately results in substantive business model change.

When tensions are recognized at the strategic level and organizational conditions permit, recognition and integrative framing tend to be tightly coupled. Because recognition occurs where resource allocation is concentrated and where actors can intervene in the configuration of the business model and product architecture, strategic actors can reinterpret operational frictions as manifestations of broader contradictions and initiate integrative responses (Hahn et al. 2014). Alpha0's strategic repositioning toward renewable-energy storage illustrates this cascade: The group CEO recognized the strategic-level speed–scale–scope tension at the corporate level and set the design rules for the group's products and systems that propagated into business and operational domains. In other cases, tensions are first recognized at the operational level where engineering, installation, and procurement teams encounter persistent frictions that resist local adjustment. Because these contradictions span regulatory, technological, and performance requirements, operational actors often lack the authority to address them directly (Berti and Cunha 2023). Enactment therefore requires escalation to levels where tensions can be reframed through broader architectural changes (Jarzabkowski et al. 2013).

However, our data also suggest that neither cascade nor escalation necessarily led to a transformative outcome. Rather, the translation of recognized tensions into integrative responses depends on the joint presence of managerial agency and resource slack. Agency is not merely a matter of willingness or formal position; it is enabled or curtailed by the prevailing governance configuration, which allocates decision rights and evaluation horizons. Agency thereby conditions whether recognized tensions can be translated into integrative framing. In B1, actors at the R&D–commercial interface lacked architectural authority, and the tension could have remained confined to project-level improvisation; it became strategic only after the head of product strategy and the group CEO reinterpreted these frictions as a strategic priority. By contrast, in B2, although the tension was recognized at the strategic level, a governance configuration oriented toward control and short-term returns curtailed actors' capacity to translate it into architectural change. During the preacquisition phase, greater tolerance for exploration and a longer-term orientation enabled comparable tensions to be addressed through integrative responses.

Resource slack, in turn, conditions the organization's capacity to convert recognition into structural change. The B3 case illustrates this clearly: Despite early and accurate recognition, thin margins constrained responses to temporary adjustments, preventing reconfiguration of the supply-chain logic. Only when cross-functional evaluation routines were introduced did partial integrative capability emerge. Consistent with Bourgeois (1981), slack operated not as generic resource abundance but as dedicated redesign capacity, the buffer that allows an organization to work through a recognized contradiction rather than absorb it locally. In our case, its role appeared to be threshold-like rather than linear: Below a minimal level of slack, recognition was unlikely to translate into integrative framing, echoing the contingent slack–adaptation relationship documented by Daniel et al. (2004).

Paradox enactment is therefore best understood as a conditioned process: If these conditions are absent, tensions, even when correctly recognized and escalated, are more likely to remain confined to local adjustments or produce incomplete responses.

These boundary conditions derived primarily from the negative episodes. Contrasting tensions that escalated into integrative responses with those that stalled (O4–B3) or remained blocked (B2), rather than the successful episodes alone, enabled us to identify managerial agency and resource slack as the conditions that distinguish escalation from local absorption, as reflected in Proposition 1.

More generally, this process should not be interpreted as a deterministic sequence, nor do we claim that it constitutes a universal causal mechanism. Episodes differed in timing, intensity, and directionality: Some tensions remained localized, others recurred across levels, and earlier responses, as in B2, were sometimes reinterpreted as conditions evolved. The two phases therefore represent an analytical abstraction of a recurrent empirical pattern, a plausible process model grounded in a single longitudinal setting, rather than a linear progression.

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We formalize these patterns as propositions: conjectures grounded in our empirical setting and open to comparative assessment, rather than claims of established regularity.

Proposition 1. *Locus-conditioned enactment of paradoxical tensions.*

In sustainability-oriented industries, the organizational locus at which a paradoxical tension is first recognized conditions how the tension is encoded, which heuristics are developed to navigate it, and whether enactment proceeds through top-down cascade or bottom-up escalation. The extent to which enactment results in integrative change depends, in turn, on the joint presence of managerial agency and resource slack.

5.2 | Tension-Conditioned BMI Trajectories

The process outlined in Proposition 1 has direct implications for BMI, extending process accounts of BMI (Foss and Saebi 2017; Spieth et al. 2025). We show that paradox enactment conditions both the direction and depth of business model change: whether tensions produce incremental adjustment or deeper architectural reconfiguration. Because sustainability-related tensions are cumulatively reinforced across institutional, technological, and regulatory domains, the transition from incremental adaptation to architectural reconfiguration becomes a recurrent outcome rather than an exceptional one.

In our case, single-loop adjustments operate within a given value logic, refining coordination routines, documentation practices, or evaluation criteria, whereas double-loop reframing entails a redefinition of at least one core element of this configuration by changing for whom value is created, what value is offered, or the activities through which it is delivered and monetized.

Applying the three analytical criteria introduced in Section 3.4 (nature of change, level of impact, and alteration of value logic), our data reveal two ideal-typical response patterns. When tensions are recognized but remain governable within the existing value logic, the organization relies on *single-loop adjustments*, refining activities, documentation, and cross-functional coordination without altering the underlying value logic (Berti and Cunha 2023). In these situations, paradox enactment stabilizes the existing business model architecture while allowing the organization to accommodate sustainability-related pressures.

By contrast, *double-loop reframing* emerges when repeated single-loop responses reveal a persistent misalignment between the prevailing value logic and evolving sustainability-oriented market conditions. In these cases, paradox enactment exposes contradictions that cannot be addressed through additional coordination or process refinement, prompting the organization to reconsider core assumptions about what customers value, what must be delivered, and how returns can be captured. Business model innovation therefore occurs when paradox enactment shifts the object of change from organizational activities to the underlying value logic itself (Boons et al. 2013; Evans et al. 2017; Geissdoerfer et al. 2018).

In Alpha's case, this transformation unfolded across all three dimensions. In value creation, sustainability and system complexity shifted from downstream constraints to central elements of the value proposition, with ESG traceability and dynamic load-management capabilities becoming integral to system design. In value delivery, cross-functional evaluation routines, supplier assessment practices, and modular component recombination reshaped how solutions were brought to market. Value capture also evolved toward more differentiated, sustainability-oriented revenue configurations, although this transition remained ongoing, consistent with the processual and nonlinear nature of BMI under sustainability transition conditions.

We treat single-loop adjustment and double-loop reframing as analytically distinct ideal types rather than rigid empirical categories. Several episodes combined adaptive and reframing elements or shifted progressively from one form toward the other as tensions were repeatedly enacted. We interpret these intermediate responses as reflecting the recursive nature of paradox enactment, in which organizations may move from adaptive adjustment toward deeper reframing as their understanding of the underlying contradiction evolves. The distinction nevertheless remains analytically useful because it captures the dominant logic through which the organization responded.

Existing accounts emphasize search processes through trial and error (Frankenberger et al. 2013; Massa et al. 2017; Sosna et al. 2010). In sustainability-oriented industries, however, our findings suggest that the search space itself is structured by how organizations recognize and escalate underlying contradictions. Experimentation does not occur in a neutral field, but within corridors defined by which tensions are made salient, which heuristics are developed to navigate them, and which actors hold authority over architectural choices.

This perspective helps explain why iterative BMI processes (Bachmann and Jodlbauer 2023; Demil and Lecocq 2010) sometimes result in incremental refinement and, in other cases, in deeper reconfiguration. Paradox enactment thus provides a process explanation linking the recognition of sustainability-related tensions to divergent BMI trajectories.

Proposition 2. *Tension-conditioned BMI trajectories.*

Paradox enactment conditions BMI trajectories: When sustainability-related tensions remain governable within an existing value logic, firms pursue incremental adaptation; when tensions expose persistent misalignment, they are more likely to trigger an architectural reconfiguration of value creation, delivery, and capture.

6 | Conclusions

Our study repositions paradox enactment from a reactive process of managing tensions to a generative process shaping how organizations evolve their business models over time. Rather than treating paradoxes as constraints to be resolved, we highlight their role in structuring the direction, depth, and cumulative pattern of business model change under sustainability transition conditions.

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6.1 | Theoretical Contributions

This study extends research on sustainability-oriented BMI by showing how sustainability-related paradoxes become consequential for organizational action, positioning sustainability not as mere context but as a theorized condition that systematically conditions paradox enactment (Best et al. 2021; Carmine and De Marchi 2023).

First, the study contributes to paradox theory by highlighting the importance of a multilevel enactment process in sustainability settings. Prior research conceptualizes paradox responses in broad terms, dynamic equilibrium, both/and approaches (Schad et al. 2016; Smith and Lewis 2022), and abstracts away from where tensions are first recognized within the organization. Specifically, we introduce the organizational locus of first recognition together with a two-phase enactment process linking recognition to integrative framing, which together help explain why structurally similar tensions may produce divergent enactment outcomes within the same organization. This provides a more operational account of paradox management and bridges paradox theory with process perspectives on BMI (Demil and Lecocq 2010; Frankenberger et al. 2013; Spieth et al. 2025).

Second, the study specifies the conditions under which sustainability-related tensions produce deeper forms of business model change. Existing research distinguishes single-loop and double-loop responses at a conceptual level (Berti and Simpson 2021; Schad et al. 2016) but provides limited insight into when one prevails. Our findings suggest that the depth of the response is tension-conditioned: Local adjustments often displace rather than eliminate tensions, and when their accumulation can no longer be accommodated within the existing value logic, organizations are more likely to reconfigure their business model rather than refine existing activity systems. This contributes to research on sustainable BMI as iterative reconfiguration (Foss and Saebi 2017; Geissdoerfer et al. 2018) and refines accounts of emergent strategy by incorporating tension recognition and escalation as antecedent conditions alongside experimentation and pivoting.

Together, these contributions refine research on both paradox theory and BMI. Taken together, our findings suggest that *where* a paradoxical tension is first recognized within the organization conditions *how* it is encoded, *which* pathway its enactment follows, and *how deep* the resulting business model response runs. In doing so, we provide a process explanation for how firms respond to sustainability-related tensions and how these responses may progressively reshape the architecture of value creation, delivery, and capture.

6.2 | Managerial Implications

The findings provide guidance on how organizations can structure processes and decision-making to leverage, rather than suppress, sustainability-related tensions.

Our findings suggest three complementary managerial capabilities. First, managers may improve early detection of emerging paradoxes by monitoring the organizational units most exposed to ecosystem interdependencies: In our case, engineering, procurement, and after-sales functions encountered tensions well before they became visible at the strategic level. Rather than relying solely on performance indicators, organizations should institutionalize reviews of recurring operational anomalies, repeated cross-functional disagreements, and local workarounds: In Alpha Group, postproject reviews and documentation of recurring certification frictions served precisely this signaling function. Second, early recognition creates value only when local insights reach actors who can act on the business model itself. Structured escalation pathways allow locally identified frictions to be interpreted collectively, and their systemic implications recognized before responses fragment across functions. Third, organizations should periodically assess whether escalated tensions can be accommodated within the current business model or call for more fundamental reframing, a judgment that, in our case, separated the tensions absorbed through single-loop adjustment from those that eventually triggered business model change. Doing so requires not only distributed decision authority but also shared interpretive frameworks that enable similar tensions to be interpreted consistently across functions.

At the middle and operational levels, the emphasis shifts to translating tensions into actionable form. Middle managers play an important role in developing simple decision heuristics and in ensuring that tensions identified in one domain inform decisions in others. In settings characterized by heterogeneous regulatory and market requirements, modular and flexible architectures can support this translation, enabling local adaptation and experimentation while containing the risk of system-wide fragmentation.

A complementary lever concerns governance design. Because governance shapes decision rights and evaluation horizons within which managerial agency is exercised, integrative responses become possible when governance arrangements connect diverse organizational perspectives during strategic decision-making, through shared decision rights, joint evaluation criteria that weigh economic and sustainability outcomes simultaneously, and tolerance for longer payback horizons. Conversely, governance configurations oriented toward tight control and short-term returns can block the translation of correctly recognized tensions into architectural change. Designing governance for integration therefore involves protecting resources for experimentation and redesign while extending evaluation horizons, reducing the risk that sustainability-related tensions are resolved primarily in favor of short-term efficiency.

6.3 | Limitations and Avenues for Future Research

This study has several limitations that open avenues for future research. First, the analysis is grounded in a single corporate group operating in a sustainability-oriented industry characterized by high technological interdependence and fragmented regulatory regimes. The generalizability of the findings is therefore bounded by these contextual characteristics. While many sustainability transitions share similar tensions,

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they differ in how these are configured across technological architectures, supply chains, and institutional environments. Accordingly, we suggest that the core process logic, the conditioning role of the locus of first recognition, the cross-level dynamics of cascade and escalation, and their moderation by managerial agency and resource slack may be applicable across sustainability transitions in which tensions are persistent and span organizational levels. By contrast, the prominence of architectural and modular responses observed in our case may be specific to settings, such as energy and electric mobility, marked by tight technological coupling and infrastructure dependence; sustainability contexts with looser interdependence may express the same underlying process through different response repertoires. Future work could therefore examine whether the paradox-enactment process unfolds similarly across sustainability settings characterized by different configurations—as illustrated by the electrification of the automotive industry in Europe and North America, where firms must balance scale, regulatory compliance, and infrastructure constraints. Comparative and longitudinal designs would be particularly valuable in assessing how these dynamics vary across settings.

Second, the study focuses primarily on internal organizational processes and thus captures only indirectly the role of external actors, such as regulators, certification bodies, suppliers, and infrastructure partners, in shaping paradox enactment. Further research could investigate how interorganizational governance arrangements influence the timing, encoding, and escalation of tensions in ecosystems where compliance, technological interdependence, and market access depend on actors beyond the focal firm.

Third, the reliance on qualitative and partly retrospective data limits the ability to trace the micro-temporal emergence of frictions and the real-time development of heuristics. Ethnographic approaches, digital trace data, or real-time process methods could provide finer-grained insights into how tensions are recognized and translated into action as they unfold.

Finally, while the study examines cross-level dynamics within a single organization, sustainability transitions often unfold across interorganizational configurations—such as standard-setting consortia, public-private partnerships, or supply-chain alliances. Future research could explore how paradox dynamics evolve when agency and resources are distributed across multiple organizations, and how the dynamics identified here interact with collective coordination structures and shared innovation efforts.

Author Contributions

Pietro Rombolà: conceptualization, investigation, writing – original draft, methodology, validation, visualization, writing – review and editing, formal analysis, data curation. **Paolo Neirotti:** conceptualization, investigation, writing – original draft, methodology, validation, visualization, writing – review and editing, formal analysis, data curation, supervision, resources. **Claudia Franzè:** conceptualization, investigation, writing – original draft, methodology, validation, visualization, writing – review and editing, formal analysis, data curation, supervision.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Appendix S1:** Supplementary Information.

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