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Research article

The role of digital service innovation for value proposition co-creation in emerging sustainable platform ecosystems

Syed Wajahat Ali *, Rodrigo Rabetino, Jahanzaib Shahzad

School of Management, University of Vaasa, Wolffintie 32, Vaasa, 65200, Finland

A B S T R A C T

This study aims to explore how value propositions emerge during the early stages of sustainability-focused B2B digital platform ecosystems. It examines the role of Digital Service Innovation (DSI) in supporting collaborative practices that address regulatory uncertainty, infrastructural fragmentation, and environmental challenges. An exploratory single-case study was conducted, focusing on the development of a regional biogas platform ecosystem in Finland. Data were collected through 20 semi-structured interviews and three collaborative workshops with sector-specific stakeholders. A process-oriented framework was developed to explain the emergence of value propositions within the platform ecosystem. The results reveal that value propositions emerge through repeated, stakeholder-driven co-creation practices influenced by external factors such as policy uncertainty and market thinness, which act as catalysts for collaboration. The concept of value-in-risk-mitigation is introduced, illustrating how stakeholders co-create value by managing shared vulnerabilities. Digital Service Innovation-enabled services were found to reduce coordination challenges while enhancing environmental performance through integration of digital tools to support emission traceability, circular resource flows, and compliance support. The study demonstrates the role of Digital Service Innovation (DSI) in helping firms and policymakers build trust, develop neutral governance models, and establish digital infrastructure that promotes both competitiveness and sustainability. It also expands service-dominant logic literature by introducing value-in-risk-mitigation as a new driver for initiating value co-creation. It bridges digital servitization and sustainability research by showing that Digital Service Innovation (DSI) strengthens both economic viability and ecological resilience in emerging ecosystems. The research is limited to a single regional case, which may limit the applicability of the findings. Future studies should compare different sectors and include quantitative measures of environmental performance enabled by Digital Service Innovation(DSI).

1. Introduction

Digital platforms are technology-enabled infrastructures that enable interactions between diverse but interdependent user groups by providing a common space for value co-creation and value exchange (Gawer and Cusumano, 2014; Parker et al., 2016). A defining trait of digital platforms is their capacity to generate network effects, meaning the platform's value grows as its user base expands (Parker et al., 2016). Platform ecosystems surround these platforms as dynamic networks of firms, technologies, and users that co-evolve through complementarities and modular innovation (Jacobides et al., 2018; Tiwana, 2014). Governance mechanisms such as rules, standards, and access controls further influence actors' engagement and competition within these ecosystems (Gawer and Cusumano, 2014; Mukhopadhyay and Bouwman, 2019). With the development of advanced digital technologies, platform ecosystems have evolved into socio-technical systems. Their development is driven by complementarities, governance arrangements, and network effects. These factors enable platform ecosystems to adapt continuously to changing environmental and institutional requirements (Adner, 2017; Coskun-Setirek et al., 2024; Kapoor et al., 2021).

With increasing environmental pressures, digital platforms have evolved into digital marketplaces and socio-technical infrastructures that facilitate the coordination of diverse actors in sustainability transitions (Andersen et al., 2021). This coordination is particularly important in transitioning sectors characterized by fragmented or underdeveloped supply chains, distributed production, uncertain demand, and ongoing market formation. In such contexts, aligning diverse stakeholders is both essential and challenging (Köhler et al., 2019; Musiolik et al., 2012).

In such cases, platforms play a market-shaping role by enabling shared rules and practices, and aligning ecosystem actors (Baker et al., 2019; Storbacka and Nenonen, 2011). In sustainability-oriented contexts, digital platforms and their value propositions are designed to support marketplace activities. They also help achieve broader societal and environmental goals (Hellemans et al., 2022; Kolk and Ciulli, 2020).

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* Corresponding author.
E-mail address: Wajahat.ali@uwasa.fi (S.W. Ali).

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These dual requirements of economic coordination and sustainability performance introduce new complexities into platform ecosystems' value creation and delivery (Ninan et al., 2026).

A fundamental aspect for the emergence of platforms is defining their value proposition, which is essential to express what the platform offers to various participating parties and why they should engage with the platform (Parker et al., 2016). A single entity on complex digital platforms rarely creates value. Instead, it is shaped through complementarities, feedback loops, and interaction among different stakeholders (Evans and Schmalensee, 2016). Thus, value is not based on predefined features but is built upon actor interactions and experiences (Vargo and Lusch, 2016). Therefore, a digital platform's role is not just to provide technological infrastructure but also to manage relationships, align its participants, and encourage them to contribute to a complex, multi-dimensional value proposition.

In this context, Digital Service Innovation (DSI) plays an important role in enabling firms and ecosystems to create and transform their value propositions and business models by providing digital infrastructure, data-driven services, and innovative governance resources. Scholars such as Opazo Basáez et al. (2024) and Rabetino et al., 2024 emphasize that DSI is not merely a technical or managerial construct, but an interdisciplinary phenomenon that encompasses technological, organizational, and societal dimensions. Thus, DSI provides the technological and organizational resources necessary to meet environmental standards and develop innovative, service-driven value propositions that promote circularity (Paiola et al., 2021), energy efficiency, and decarbonization. Moreover, recent empirical evidence shows that digitalization enables servitization, thereby promoting environmental practices, highlighting Digital Service Innovation's role in sustainable industrial transformation (Seclen-Luna et al., 2026). These studies provide important evidence that digitalization can contribute to environmental management and sustainability transitions. Especially in highly regulated sectors, DSI can enhance economic competitiveness by leveraging digital affordance and achieving environmentally friendly outcomes. However, research shows that digital technologies can support circular economy practices, but their implementation is shaped by multi-level barriers (Trevisan et al., 2023).

Existing research has examined the scaling of mature platforms through different architectural and governance choices (Jovanovic et al., 2022). Additionally, research suggests that digital platforms have become a dominant organizational form for value co-creation across various industries nowadays (Gawer, 2021). Still, the key question about the early stages of platform ecosystem formation remains unanswered, especially in sustainability-sensitive sectors and concerning the value proposition (co)creation. Existing literature has examined the operation of value co-creation within established platforms (Chávez et al., 2023; Prisco et al., 2026), but it has paid less attention to the pre-development phase of the emerging platform ecosystem (Abed Alghani et al., 2026). Emerging research indicates that value proposition development in such contexts is inherently uncertain and processual. Studies show that actors often struggle to define value propositions when both the ecosystem structure and the offering remain indeterminate (Dattée et al., 2018). The concept of value idea emergence highlights that actors initially recognize potential value before formal value co-creation processes are established (Rustholkarhu et al., 2021). However, existing studies do not fully explain how these early value ideas evolve into shared, credible value propositions through multi-actor co-creation.

To address this gap, this study examines how value propositions emerge during the initiation phase of sustainability-oriented B2B digital platform ecosystems. In particular, the study explores what triggers stakeholders to search for new value in emerging sustainability-oriented ecosystems. It examines how value propositions are co-created before a digital platform is fully developed. It also identifies the factors that support or constrain value proposition emergence in Digital Service Innovation (DSI) contexts. Specifically, the paper addresses the following research questions: *How do value propositions emerge in the pre-development phase of a sustainability-oriented B2B digital platform ecosystem?* In doing so, the study examines the process through which stakeholders move from fragmented needs, uncertainties, and sectoral challenges toward a shared platform value proposition. Especially, detailed process descriptions of how stakeholders cooperate to achieve shared environmental and economic goals are lacking in the existing literature. At the same time, some studies address stakeholder collaboration for environmental and economic goals in specific contexts (Siswanto and Rosdaniah, 2023). Comprehensive understanding of how digital features are utilized before platforms start up and grow, and how institutional players influence value co-creation through soft enablement mechanisms, remains underdeveloped. These gaps are especially significant in sustainability-focused industries, such as renewable energy, where emerging digital platforms can promote innovation, help remain competitive, and mitigate environmental risks by adapting to changing environmental conditions (Florek-Paszkowska, 2025). To address these gaps, the primary objective of this study is to develop a processual conceptual framework that explains the emergence of value propositions in the pre-development phase of sustainability-oriented digital platform ecosystems.

The contributions of this study are threefold. First, it contributes to digital platform ecosystem research by developing a processual explanation of value proposition emergence before platform architecture, governance structures, and actor roles become stabilized. While previous work has studied platform ecosystem emergence (Thomas et al., 2022), examined the capabilities through which platform owners enable value co-creation and value capture in emergent ecosystems (Schreieck et al., 2021), and platform development in nascent industries (Shi et al., 2021). However, they offer limited insight into the micro-level interactions integrated with macro-level institutional forces through which actors negotiate and shape shared value propositions under uncertainty. By tracing this overall emergence process, this study extends platform ecosystem research beyond established or mature ecosystems (Thomas et al., 2022; Tiwana, 2014). Second, it extends the Service-Dominant Logic (SDL) literature by introducing the concept of "value-in-risk-mitigation" as a new pathway for co-creating the platform's value proposition. SDL explains that value is co-created through resource integration among multiple actors and coordinated through institutions and institutional arrangements (Vargo and Lusch, 2016). Building on this view, this study highlights that stakeholder perception and willingness are often motivated by the need to manage shared vulnerabilities, such as regulatory volatility or infrastructural gaps, rather than being purely driven by economic benefits (Vargo and Lusch, 2017). This shifts the emphasis from managing uncertainty to leveraging it as a basis for coordinated action and innovation (Latinovic and Chatterjee, 2024). Third, the study contributes to Digital Service Innovation (DSI) and sustainability-oriented platform ecosystem research by demonstrating the role of digital services in simultaneously supporting economic coordination and environmental management (Kolk and Ciulli, 2020; Paiola et al., 2021; Siswanto and Rosdaniah, 2023).

2. Conceptual background

2.1. Digital platform ecosystems: foundation and dynamics

Digital platform ecosystems are now increasingly understood as social-technical systems, where a digital infrastructure connects multiple actors (owners, complementors, users, regulators) in various configurations that add value to the ecosystem (Kapoor et al., 2021; Jacobides et al., 2018). At the same time, Adner (2017) defines an ecosystem as an alignment structure of interconnected activities necessary for a value proposition to come into existence. Different paradigms have been discussed in the literature of the digital platform ecosystem over the past few years, including technical (Tiwana, 2015), social (De Reuver et al., 2018), economic (Rochet and Tirole, 2006), and

business perspectives (Gawer and Cusumano, 2014). The integration between these perspectives typically shapes the platform's value and ecosystem outcomes (Hein et al., 2019). Digital platforms usually create digital spaces where multiple actors can co-integrate, co-create, and co-design value. Digital platforms also help to enable complementarities, initiate coordination, and generate network effects that contribute to the platform's overall value proposition. It is important to understand their distinct and hybrid organizational structure before in order to fully conceptualize the platform ecosystem dynamics. Kretschmer et al. (2022) conceptualizes this in their research and calls platforms "meta organization" because their dynamics, governance structure, and source of power are fundamentally different from traditional business models.

The digital platform ecosystem comprises distinct sets of actors (complementors, users/consumers, platform sponsors/producers, and enabling actors), each with a specific role in value co-creation and value exchange. One of the important factors for value co-creation lies in the technological maturity of platforms. Digitally mature firms can more effectively leverage platform resources, whereas less mature firms may face participation barriers, thereby limiting overall ecosystem performance. The Platform ecosystem facilitates value creation through two primary mechanisms: transaction (matching supply and demand, leveraging cross-side network effects) (Bonina et al., 2021) and innovation (providing digital affordances and boundary resources for complementors to develop new innovations) (Hein et al., 2019). The platform has different technical architectures and governance structures for both mechanisms. Yiling et al. (2019) stated that the digital platform ecosystem evolves through the development of IT architecture and an accompanying governance regime, both of which are essential for their sustainability and adaptation.

The interaction between architecture, governance, and actor relationships strongly shapes the evolution of digital platform ecosystems. While, modular architecture with stable interfaces controls the platform evolution (Baldwin and Woodard, 2008). At the same time, Wareham et al. (2014) highlighted that governance mechanisms orchestrate the diverse contributions of different actors and balance the tension between stability and variability. However, recent literature challenges the view that platform owners alone orchestrate ecosystem resources. In B2B platform creation, this orchestration also requires firms and ecosystem actors to redefine roles, power relations, capabilities, and governance responsibilities. Abed Alghani et al. (2026) describe this as a shift in organizational boundaries related to identity, power, competence, and efficiency. Orchestration is increasingly seen as distributed, involving multiple governance mechanisms with different levels of centrality (Jacobides et al., 2018; Wareham et al., 2014). This multi-governance is responsible for the varying levels of centrality and intensity of actor engagement. Highly central actors such as complementors can influence standards, data flows, and value capture, creating power asymmetries. At the same time, greater intensity and interdependence among actors increase ecosystem risks, exposing participants to systemic dependencies, lock-in effects, and opportunistic behavior (Cusumano et al., 2019). Moreover, the tension between modularity and generativity persists in platform ecosystems. A successful platform manages this tension by maintaining a strict, controlled core (modularity) while enabling high generativity through well-defined boundary resources, such as APIs and SDKs (Isckia et al., 2018). As digital platform ecosystems evolve from nascent platforms into larger ecosystems, they change capabilities, competition, and governance (Nerbel and Kreutzer, 2023). Their dynamics are therefore best understood as coevolutionary, as platforms must continuously update technical affordances and relational capabilities to remain attractive to complementors (Schreieck et al., 2021). Emerging platforms face not only technical and governance challenges but also the need to attract users and complementors, build trust, and compete against larger, established platforms (Sun et al., 2025).

2.2. Mechanisms of value proposition emergence in platform ecosystems

The value proposition of a platform emerges through the interplay between micro-level interactions and macro-level network dynamics. Most previous research on a platform's value is based on the fundamental concept of value co-creation (Vargo et al., 2008; Vargo and Lusch, 2017). Peng et al. (2023) draw an important distinction to address the need to step away from a traditional focus on "who creates value". He argued that the platform ecosystem constitutes a complex process of value emergence that incorporates multiple actors and multi-level systems. At the foundation of this process is the concept of network effects, where a platform's value increases exponentially with the number of participants added to the network (Eisenmann et al., 2011; Katz and Shapiro, 1985). These network effects can be direct (e.g., the value of a communication network increases with the addition of new users) or indirect (e.g., more app developers are attracted to a platform, leading to more users being attracted to the same platform, which adds value for both parties). Platforms intentionally enhance these network effects through their strategic design. They also leverage their boundary resources, such as APIs and SDKs, to strengthen the capacity of complementors to make contributions that extend the platform's overall core structure (Baldwin and Woodard, 2008; Mukhopadhyay and Bouwman, 2019).

These network effects are closely dependent on the engagement of actors within the platform. Brodie et al. (2019) conceptualizes engagement as cognitive, emotional, and behavioral investments in networked exchanges. This engagement serves as a central mechanism for value creation, where actors actively contribute their resources through disposition and connectedness, thereby setting the stage for broader system evolution (Ekman et al., 2021; Storbacka, 2019). This deeper level of engagement gives rise to a pre-creation stage, referred to as "value idea emergence," where actors first become aware of a potential benefit to be pursued within the ecosystem (Rusthollkarhu et al., 2021). Such engagement-driven interactions are key to enabling collective value creation across ecosystems (Rahman et al., 2025). Formal governance is also necessary to resolve conflicts that arise from the diverse engagements of stakeholders. To manage the control and openness dilemma present in the platform ecosystem, a platform owner should enforce clear roles for participation, access, and data access (Gawer and Cusumano, 2008). While doing so, it is essential to consider the concept of "reverse-value effects," where the increased power of a platform owner can lead to value dilution or even value destruction for other stakeholders (Latinovic and Chatterjee, 2024; Yrjölä et al., 2023). Schreieck et al. (2021) identifies the set of platform owner capabilities that can contribute to maintaining the balance between value co-creation and value capture in emerging platform ecosystems.

The concept of DSI provides a powerful lens for understanding how value propositions emerge in platform ecosystems, especially when collaborative problem-solving and societal objectives are involved. DSI is essential for leveraging digital infrastructure and developing digital services that enhance the platform's value proposition (Rabetino et al., 2024). Häikiö and Koivumäki (2016) argue that DSI is a thoroughly collaborative process, where value creation relies on the active participation of multiple actors. On the other hand, Smith et al. (2016) emphasizes that value propositions should focus on technology and data, as digital tools play a significant role in shaping value creation and delivery within ecosystems. However, Skålén et al. (2015) sees value propositions as socially constructed, negotiated through interaction and realized through both firm-led and mutual co-creation. DSI acts as a catalyst for creating value by mixing social factors, technological skills, and ecosystem collaboration within the platform design. This allows contributions from multiple actors, which lead to broader system impacts.

2.3. Value proposition Co-creation in sustainability-oriented B2B platforms

In sustainability-oriented B2B platforms, the mechanisms of value proposition (VP) co-creation are quite complex. It is co-designed to meet the diverse needs of stakeholders who aim to achieve sustainable targets, which, in turn, provide economic benefits. Such platforms serve as digital intermediaries, helping businesses (e.g., manufacturers, suppliers, and customers) adopt sustainable practices and facilitating interaction between participants through platform services. Petrik et al. (2025) suggest that digital platforms can effectively function as meta-organizations, promoting collaboration and resource circularity, thereby acting as dynamic facilitators of a circular economy.

Empirical evidence increasingly highlights how these digital ecosystems operate in practice. For instance, recent empirical studies on manufacturing firms demonstrate that digital tracking systems and IoT integrations can reduce material waste and optimize resource circularity in production systems (S.Yin et al., 2024). Furthermore, empirical cases in agricultural and manufacturing supply chains show that platforms utilizing blockchain technology significantly enhance trust and verify carbon emission claims, moving sustainability from a theoretical goal to a measurable, data-driven outcome. So, by leveraging digital tools, these platforms enhance resource efficiency, track product lifecycles, and ensure transparency throughout the supply chain. This level of transparency is essential for verifying sustainability claims and building trust among stakeholders. Trust plays an important role in driving the value proposition of a platform, especially its Stakeholder Value Proposition (SVP). The SVP must deliver value not only to its direct users and providers but also to larger urbanecosystems to build legitimacy (Carrasco-Farré et al., 2022). Large corporations often collaborate to create a shared understanding of "sustainability" and achieve common goals, thereby creating value (Mihailova et al., 2022). Building on this principle, digital platforms can encourage cooperation by providing practical tools for circular-economy activities (Petrik et al., 2025).

However, institutional rules and regulatory conditions, such as carbon-emission requirements or the EU Green Deal, sometimes shape platform legitimacy and adoption. The governance models (centralized, decentralized, or cooperative) determine how trust, control, and value are distributed among participants in the platform ecosystem. These governance choices on sustainability-oriented platforms are selected based on the digital services and offerings that the platform provides. These digital affordances further complement the technological layer of the platform that simulates and optimizes circular strategies (Florek-Paszkowska, 2025). However, these technological capabilities are closely tied to business model innovation, including product-as-a-service, servitization, and platform-enabled platform economy models (Koilo, 2025). It clarifies the operation of platform to encourage actor participation and motivate them to innovate the platform value proposition over time. Socio-technical transitions, service-dominant logic, and stakeholder theory provide important frameworks that emphasize the role of sustainability-focused platforms in coordinating resource sharing, collaboration, and addressing the tensions between sustainability and other profit goals. Consequently, co-creating value propositions in B2B ecosystems is influenced not just by technology but also by the combined evolution of institutions, politics, and society.

Past research converges on a shared mechanism that drives value proposition development of sustainability-oriented B2B platform ecosystems. Shared vulnerabilities are first identified through contextual pressures such as environmental challenges, regulatory requirements, and sector-wide uncertainty. These vulnerabilities are then prioritized based on early sponsor decisions about ecosystem scope, governance structures, and actor engagement, which shape the range of co-creation opportunities (Adner, 2017; Murthy and Madhok, 2020, 2021). Next, the resulting priorities are then converted into co-creation practices as ecosystem actors combine complementary resources, coordinate governance arrangements, and manage interdependencies essential for joint value creation (Hein et al., 2019; Jacobides et al., 2018). Ultimately, these interactions are incorporated into a developing platform value proposition that continues to be shaped through ongoing negotiations among stakeholder interests, sustainability goals, and economic (Bustamante, 2023; Frow and Payne, 2011).

From a Service-Dominant logic (SDL) perspective, this process reflects the premise that value propositions emerge through the integration of resources and collaborative efforts among multiple ecosystem actors rather than through unilateral firm action (Vargo et al., 2008; Vargo and Lusch, 2004). The analytical framework presented below operationalizes these dynamics across three empirically observable stages.

2.4. Analytical framework

Based on prior studies of platform ecosystem emergence, a preliminary analytical framework for value proposition co-creation was developed, as shown in Fig. 1. The analytical framework consists of three main stages. The first stage of the analytical framework represents the contextual triggers and vulnerabilities, which capture the external pressures that initiate the emergence of sustainability-oriented B2B platform ecosystems. Bustamante (2023) explains that agricultural platform ecosystems can emerge under conditions of financial, environmental, and societal stress, where actors attempt to respond collectively to vulnerabilities such as fragmented data infrastructures, sustainability reporting requirements, and sector-wide uncertainty. Similarly, Thomas et al. (2022) argues that ecosystem emergence is shaped through processes of value discovery, collective governance, platform resourcing, and contextual embedding, suggesting that instability in the external environment creates the conditions for ecosystem formation. Murthy and Madhok (2020, 2021) further demonstrate that early platform sponsor decisions regarding ecosystem scope and problem framing strongly influence actor mobilization and future value co-creation opportunities.

The second stage of this framework builds on stakeholder activation, co-development practices, and governance, focusing on multiple actors align around a shared platform vision. Drawing on service-dominant logic, Vargo and Lusch (2004) conceptualize value as co-created through the integration of resources, knowledge, and competences among multiple actors rather than delivered separately by a firm. In sustainability-oriented B2B ecosystems, this process becomes more complex because firms must negotiate data ownership, trust, governance structures, and technological interdependence before ecosystem participation can stabilize. Hein et al. (2019) identifies complementary asset integration, platform readiness, and servitization as central practices supporting value co-creation within B2B platform ecosystems, while Lavikka et al. (2017) shows that temporary governance arrangements and co-creative workshops help align stakeholder motivations. Abed Alghani et al. (2026) further strengthen this stage by showing that B2B platform creation is not a single strategic leap but a staged co-development process in which firms redefine organizational boundaries across identity, power, competence, and efficiency while moving from a pipeline model toward ecosystem orchestration. Their study also demonstrates that supplier engagement, manufacturer–supplier interaction, governance mechanisms, and milestone-driven flexibility are central to platform co-development in the pre-launch phase.

The final stage of the analytical framework is the value-defining mechanism and the emergence of the value proposition, which explains early negotiations and interactions gradually merge into a credible ecosystem value proposition. Frow and Payne (2011) argue that stakeholder value propositions emerge through an iterative process involving stakeholder identification, dialogue facilitation, opportunity recognition, and collaborative value proposition development. This perspective of scholars positions the value propositions as a reciprocal, socially constructed mechanism rather than as static, firm-generated

Fig. 1. Analytical framework.

offerings. Thomas et al. (2022) further suggests that ecosystem emergence is highly distinctive because governance decisions and actor relationships established during the early stages create path-dependent effects on subsequent ecosystem development. Bustamante (2023) similarly demonstrates that sustainability-oriented ecosystems often experience tensions between "common-good" sustainability objectives and pressures for measurable economic returns, particularly when external funding and commercialization become necessary. As a result, the meaning of value within the ecosystem is continuously negotiated and redefined throughout the emergence process.

3. Methodology

3.1. Research strategy and design

The present case study aims to develop theoretical insights into how value propositions emerge through co-creation processes in early-stage B2B platform ecosystems and how DSI processes unfold during the pre-development phase of such ecosystems. In doing so, this study adopts a single holistic case study design, which is appropriate for investigating complex and evolving socio-technical phenomena (Eisenhardt, 1989; Yin, 2018). A case study design enables an understanding of the situation within its real context, where the boundaries between the phenomenon and the context are not clearly visible (Yin, 2018). Moreover, case studies are valuable for generating contextually grounded insights and inspiring new theoretical ideas (Siggelkow, 2007).

In our holistic case study design, the primary unit of analysis is the formative process of value proposition co-creation within the focal platform ecosystem emergence. While stakeholders and the platform constitute interconnected elements through which the focal process becomes observable. This holistic approach enables analysis of key mechanisms and contextual conditions, including triggering uncertainties, stakeholder perceptions and willingness, value-creation mechanisms, external enablers, and evolved platform configurations. This analysis explains ecosystem-level outcomes by examining how these mechanisms interact within the overall ecosystem configuration, contributing to an understanding of the process-configuration perspective. Aligning the unit of analysis with the processual and ecosystem-level nature of the phenomenon supports analytical coherence and internal consistency of the research design.

Thus, building on existing platform-ecosystem literature by examining an empirical case study of the emerging Finnish biogas ecosystem. The case serves as a basis for explaining and conceptualizing the processual dynamics of an emerging B2B platform ecosystem through which stakeholders co-create, negotiate, and refine value propositions under conditions of regulatory uncertainty and infrastructural fragmentation. The study adopts an abductive approach, which systematically relates empirical observations to theoretical concepts (Timmermans and Tavory, 2012). This approach is particularly valuable in studies where existing theory offers guiding concepts but requires refinement through emerging empirical findings (Dubois and Gadde, 2002). Throughout this study, empirical insights were continuously compared with the literature from service-dominant logic (Vargo and Lusch, 2004, 2011) and ecosystem and governance perspectives on platform dynamics (Hein et al., 2019; Jacobides et al., 2018).

3.2. Case selection and context

The case was selected for its potential to reveal insights into the phenomenon of value proposition co-creation in an emerging platform ecosystem. The biogas industry is positioned at the intersection of agriculture, transportation, waste valorization, and energy policy. Despite its strategic importance in Finland's circular economy, no established digital marketplace currently exists in Finland's various regions. This pre-development phase offers a unique chance to observe how participants negotiate shared value under regulatory uncertainty and infrastructural fragmentation. The unit of observation is the emerging biogas platform ecosystem initiative. It is conceptualized as an evolving configuration of organizational stakeholders, including farmers, municipalities, producers, distributors, service providers, and industrial users, working together toward shared value creation.

3.3. Data sources and data collection

A diverse group of stakeholders with experience in the biogas industry and related fields operating across three Finnish regions was selected using purposeful sampling (Suri, 2011) to represent the ecosystem's diversity. The purpose of selecting these diverse participants was to fully capture the broad experiences and varied viewpoints relevant within the biogas industry ecosystem. More specifically, participants selected were either directly involved in conducting business in biogas-related markets or directly impacted by the development of a biogas-focused platform ecosystem.

The criteria for sample selection were to include at least one key representative from every stage of the biogas value chain who can offer meaningful, diverse insights necessary to understand the complexities and dynamics of the whole ecosystem. The participants' sample included raw material providers such as farmers and agricultural producers operating biogas plants, representatives from large food processing companies, biogas producers from both SMEs and large industries, municipal and city council representatives engaged in rural development and strategic planning, as well as service providers, technology firms, and project developers. In addition, biogas experts, specialists, and industrial users were also included to enrich the contextual understanding of this industry dynamics. Table 1 presents detailed information on the participants.

Twenty semi-structured interviews were conducted to gather insightful data and comprehensive perspectives from each stakeholder. These interviews were mainly conducted online from May to October 2024. Each interview session was scheduled based on the participant's availability and convenience, and lasted approximately 40–60 min in total. Participants were asked 6 to 10 open-ended core questions and were encouraged to share their experiences and opinions freely. Follow-up questions were introduced to deepen the discussion, which allowed for a more detailed expression of their viewpoint. Participants were given the option to choose whether the interview would be conducted in Finnish or English to minimize language barrier issues.

The interview questions were designed to gather comprehensive insights by combining limited quantitative data, such as industry scales, industry size, and market estimates (including supply and demand), with exploratory qualitative insights on specific points. An interview questionnaire framework, illustrated in Table 2, was developed based on the research questions. These interviews were designed to collect valuable insights. It primarily focused on topics such as the experiences and expectations of stakeholders regarding the development of the biogas

Table 1
Participant details.

Interviewee code	Ecosystem role - Types of organization	Regional representation	Position/Job title	Duration (min)
P1	Biogas producer - Municipal Waste Management	Ostrobothnia	Development Engineer	35
P2	Biogas producer - Industrial and Agricultural Waste Management	Ostrobothnia	VD/CEO	45
P3	Biogas producer - Dairy farm	Central Ostrobothnia	Farm Owner	30
U1	Biogas user - Large Enterprises and Industrial Parks	Ostrobothnia	Senior Advisor	60
U2	Biogas user - Large Enterprise and Energy Utility	Ostrobothnia	Head of Business Intelligence	28
U3	Biogas user - Large Global Enterprise	Ostrobothnia	General Manager	47
U4	Biogas user - Municipal Utility	Central Ostrobothnia	Business Area Director	38
U5	Biogas user - Technology Firm/Startup	Central Ostrobothnia	Technology Concept Director	44
U6	Biogas user - Large Global Enterprise	Central Ostrobothnia	Plant Manager	33
D1	Biogas distributor - SME (Local Distributor)	Ostrobothnia	Development Manager	31
T1	Technology provider -Technology Firm/Consultancy	South Ostrobothnia	Director, Projects	43
T2	Technology provider - Joint Venture	Central Ostrobothnia	Director of Sustainable Business Development	38
RM1	Raw material provider - Food Processors	South Ostrobothnia	Sustainability Manager	47
RM2	Raw material provider – Farm/SME	South Ostrobothnia	Agricultural Entrepreneur	25
RM3	Raw material provider - Farm	SouthOstrobothnia	Farm Manager/Co-owner	32
A1	Rural Manager - Municipal body	South Ostrobothnia	Rural Manager	38
A2	Climate Specialist -Municipal Body	Central Ostrobothnia	Climate Specialist	41
A3	Director of Economic Development - Municipal Body	Central Ostrobothnia	Development Director	52
A4	Regional Developer -Regional Body	Central Ostrobothnia	Regional Developer	48
A5	Regional Development Coordinator - Regional Body	Ostrobothnia	Regional Development Coordinator	36

Table 2
Questionnaire framework.

BioGas Producers	BioGas User	BioGas Distributor	Service Providers	Raw Material Supplier
Scalability -Stakeholder Engagement	Scalability -Stakeholder Engagement	Scalability -Stakeholder Engagement	Scalability -Stakeholder Engagement	Scalability
Value Proposition- Business Opportunities-Core Interaction	Value Proposition- Business Opportunities-Core Interaction	Value proposition- Services	Value proposition- Services	Value proposition- Core Interaction
Ownership Choices	Ownership Choices	-	Ownership Choices	-
Revenue Model -Monetization-Model Preferences	Revenue Model -Monetization-Model Preferences	Revenue Model- Monetization-Operational Complexity	Revenue Model- Monetization-Operational Complexity	Monetization
Compliance Strategies - Regulatory Challenges	Compliance Strategies - Regulatory Challenges	Compliance Strategies - Regulatory Challenges	Technical Aspect- Platform Challenges	-

platform. The specific needs and challenges faced by stakeholders in the biogas industry are shaped by political and environmental policies. They are also influenced by how stakeholders collaborate and conduct business within the highly regulated industry environment. How can different digital services help them achieve their goals and minimize the risks associated with these external environmental and regulatory factors? Lastly, the impact of external forces, such as policy, regulation, and technological changes, on the emerging biogas ecosystem.

In addition to the interviews, three workshops (one per region) were organized to facilitate enhanced collaboration, visualize the shared challenges, and validate emerging trends in the Biogas industry. These workshops were organized after the interview phase, and each lasted approximately 3–4 h, involving 5–10 participants. Participants were purposively selected to ensure full representation of the main key stakeholder groups relevant to the biogas industry. The selection was also made based on their level of expertise, their professional experience, and their willingness to participate in a collaborative discussion. The Workshops functioned as a second round for data validation in this study. These workshops enable participants to integrate multiple viewpoints, thereby participating in brainstorming activities (collective vision, impactful digital services) that are meaningful to all industry stakeholders. These collective contributions were then used as sense-making tools to enrich the interview material, which further helped to analyze the data gathered from the interviews.

3.4. Data analysis

The qualitative data were analyzed using a thematic analysis approach, which provides theoretically flexible ways to identify and analyze patterns within a dataset (Braun and Clarke, 2006). To ensure a clear and grounded interpretation of the empirical data. The analysis was structured following Gioia et al. (2013), which provides a systematic inductive approach to develop concepts from qualitative data. The analysis also followed an iterative, comparative process of analyzing the empirical data alongside emerging concepts, so that developed research insights can be related to existing literature (Alvesson and Sandberg, 2011). Thus, first-order concepts were first generated through inductive coding while preserving and highlighting key expressions from participants' original quotes, such as "policy volatility," "side-stream reuse," "trust through certification," and "neutral governance".

First-order concepts were then grouped into second-order themes. These conceptual categories were refined through continuous comparison and abductive reasoning (Magnani and Gioia, 2023) so that they reflect theoretical insights drawn from the existing literature (Corbin and Strauss, 2015). In this study, these second-order themes reflect broader conceptual patterns, such as regulatory and policy barriers, collaborative resource utilization, strategic alignment, platform governance design, and multi-vector energy synergies.

Finally, these second-order themes were clustered into final aggregate dimensions to structure the overall findings (Gioia et al., 2013). As a result of this iterative process, four final aggregated dimensions were established that include: (1) triggers of value search and discovery, (2) value-proposition co-creation, (3) platform value proposition, and (4) external enablers supporting value emergence. The findings from this data analysis are summarized in Fig. 2.

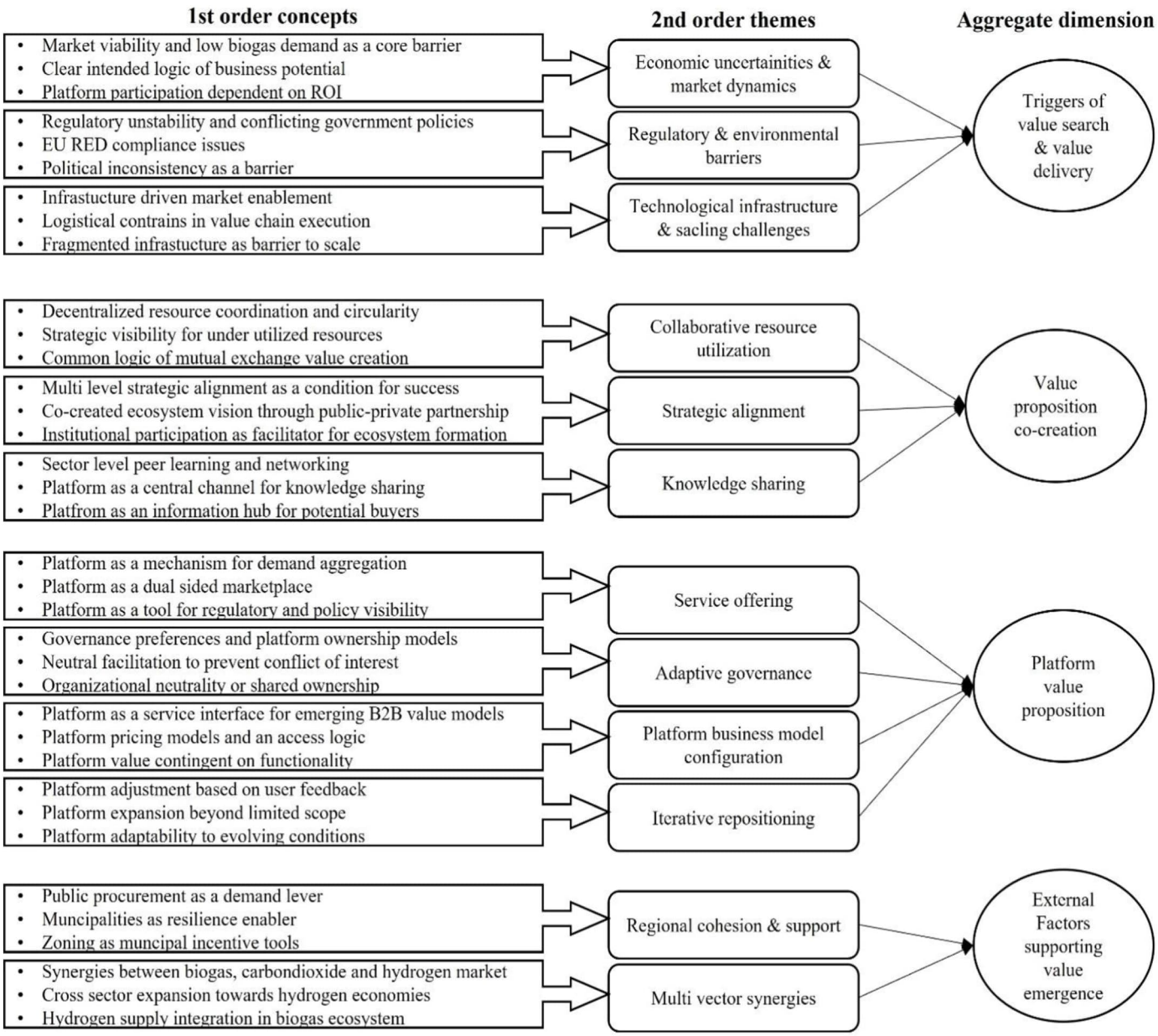

Fig. 2. Data structure.

3.5. *Methodological rigor and trustworthiness*

Several measures were taken to enhance methodological rigor and trustworthiness of this qualitative case study (Yin, 2018). The research design utilized multiple methods to provide a strong foundation for the findings and to ensure the overall quality of the study. Reliability was prioritized by adopting a formal case study procedure described by Rabetino et al. (2025), which ensured systematic consistency throughout the data collection. Multiple sources of evidence, including semi-structured interviews and workshop findings, were compared and cross-checked through data triangulation (Yin, 2018). To maintain a clear chain of evidence, all interview guides, workshop procedures, the coding processes, and speaker notes were documented, allowing findings to be traced directly from empirical material to the final interpretation. While a consistent interview structure was used for all participants, researchers maintained the flexibility to include follow-up questions during workshop sessions to ensure accurate interpretation. Finally, the primary questionnaire was validated through a pilot interview with a subject-matter expert and refined based on their feedback before formal data collection began.

However, as qualitative case study research is context-dependent, the study does not aim for statistical generalization. Instead, external validity was supported through analytical generalization by providing a transparent description of the research context, participants, and analytical procedures. The analysis was further strengthened through abductive systematic coding to continuously compare the empirical data with emerging themes (Gioia et al., 2013). Furthermore, the study followed ethical guidelines for qualitative research (Tracy, 2010). Participation was voluntary, and informed consent was obtained from all interviewees. Participants were informed about their rights, including the ability to review and withdraw their data at any time. Interviewees were anonymized (e.g., P1, U2, A3) to protect their identities. All interview transcripts and workshop data were securely stored in compliance with GDPR data-handling standards. Finally, reflexive awareness was maintained to ensure that the researcher's involvement in the broader biogas project did not bias the interpretation of the data.

4. Findings

This section presents the empirical findings derived from qualitative data. This section is structured around four final aggregated dimensions derived from abductive interpretivism: Triggers/Enablers of Value, Search and Discovery, Processes of Value Co-creation, and Emergent Platform Value Proposition, as well as external enablers ot constraints that affect the dynamics of value emergence.

4.1. Triggers of value search and discovery

This dimension includes both macro- and micro-level trigger factors, such as regulatory uncertainty, environmental constraints, economic conditions, market dynamics, and scaling challenges. These factors influence stakeholders' initial willingness to engage in value co-creation activities. This dimension also explains how different stakeholders perceive and assess the potential value of the emerging platform during the pre-development phase. It highlights that the perceived value aligns with the varying needs, challenges, and opportunities of multiple stakeholders. Each factor of this dimension serves as a trigger condition that determines whether and why it is the cause of value creation in platform value proposition development.

The study finds that regulatory volatility and environmental barriers are key triggers for the search for new value, particularly in the renewable energy sector, such as biogas. Short political cycles and rapidly changing policy priorities increase uncertainty and highlight the need for long-term stability and assurance. As one stakeholder noted, the primary challenge posed by this political instability is the potential for unforeseen taxes that could further impact their operations.

> *"… if you look at the politics and the four years, it always comes new laws, and the next group of politics, they change the laws, and so that should be more long-term regulations."* (P2)

> *"The biggest challenge in maintaining biogas operations is based on societal actions. Unexpected taxes may be imposed on biogas operations, which can discourage maintaining them. There is little trust that the government, which changes every four years, will provide support for growing or maintaining operations. Therefore, there are clear risks in the development of operations."* (P3)

While one stakeholder stated that these highly sensitive and rapidly changing regulations are a driver of significant development in the sector, and sustainability-driven environmental rules vary across different domains of this industry, which makes the operation a challenge.

> *"… it is a very regulated sector and the operating environment of the time such a change-sensitive, that they are perhaps then probably the biggest development phase things always follow the way it is the regulatory change, which takes place in so many different fields, starting from the transport sector and the agricultural sector and environmental legislation and sustainability legislation and so on, that here is a lot of different entities, so it is probably here is its challenge and especially now in recent years, so the rapid changes in the operating environment has occurred."* (T2)

> "… *what has caused some concern is this EU Renewable Energy Directive two and three, and specifically whether, in a certain sense, for example, harvested from peat fields, so under what conditions it can be used, for example, as transport fuel so that sustainability criteria are met."* (A4)

These quotes clearly reflect how these political dynamics and frequent policy changes create uncertainty, affecting stakeholder perceptions of participating in the platform unless concrete commitments with clear rules and long-term assurances are made. The complexity of overlapping environmental, agricultural, transportation, and sustainability regulations further reinforces this reluctance, making it difficult for stakeholders to trust the stability of the future market fully.

These conflicting policies have given rise to economic volatility, which in turn has led to the exploration of new business opportunities. The decision to participate in these emerging markets depended on the market potential and the clear financial benefits that stakeholders expected from the platform. Stakeholders also described market thinness and price pressure as core economic barriers to platform participation, in addition to the potential of this industry.

> *"The biggest challenge at the moment is the market … Biogas is more of a hobby than a business if there is no demand and fossil fuel is so cheap."* (T1)

> "… *but right now the market is still so small, even though we know that there is much demand and there is a lot of production potential, these are not yet at the right level and the right quality of balance, so that right now that is perhaps what most shadows in my opinion …"* (A4)

Especially from a biogas perspective, stakeholders are hesitant to switch unless they have a clear understanding of the business potential. The acquisition of tangible economic and commercial benefits, along with market potential, is also considered a prerequisite for stakeholder participation. Some stakeholders explicitly determine the condition of participation based on ROI and Guarantees.

> *"We are willing to pay a platform fee if the ratio between fees and income is reasonable … There should also be a guarantee that the platform provides benefits for maintaining production."* (P3)

However, these regulatory and economic fit factors are not the only enablers of new value search. Specific scaling challenges initiate stakeholders' vision towards a newly emerging ecosystem. These include the infrastructural barriers, as well as capacity limitations. Specifically, from a biogas perspective, limited storage, small-scale production units, and the non-existence of liquefaction facilities were described as significant structural constraints that restrict the sector's ability to expand beyond its niche.

> *"… the industry is still too small-scale, and the challenge comes especially when developing the infrastructure to liquefy biogas for heavy-duty and the maritime sector, because that is what is needed if we want to scale up in those markets."* (P1)

However, scaling up the production facilities' infrastructure does not meet the practical needs of this biogas sector. Logistics and storage limitations also impact this infrastructural scaling, as one stakeholder noted, highlighting the interdependent nature of the dependency.

> *"… but it is highly dependent on the storage capacities, and if we have a network available, then we can have a liquefied system alternative that could be workable, especially for longer-range transport … It may make sense to integrate hydrogen storage with methane and approach infrastructure and storage in a unified manner. However, it is challenging in places like Finland, where there is not a significant gas network."* (U2)

As the industry is so small, the isolated nature of current production further complicates the integration of Infrastructure and logistics. One stakeholder raised this question and proposed a solution as well.

> *"… it is the biggest obstacle there is, the transportation. It is, in fact, quite possible to have local production or purchase gas in various locations. However, how can it be transported forward, and how can the necessary infrastructure, such as pipelines or trucks, be established to transport it to consumers? Perhaps you can transport it as CNG somewhere, but that would be a place offload, where you can offload your compressed gas, and then you liquify it there and get it forward in the chain."* (U3)

These scaling challenges demonstrate how infrastructure and logistical limitations impact the straight market take-off and encourage stakeholders to consider new collaboration arrangements in the form of a digital platform, which can resolve these issues through coordination and facilitation using shared infrastructures. This also gives rise to the

search for new innovative solutions that form the basis of creating an integrated digital ecosystem.

4.2. Value proposition co-creation context

This second aggregated dimension illustrates how stakeholders actively responded to the triggers mentioned earlier by engaging in co-creation practices that laid the early foundation for the emerging platform. Notably, in the absence of a fully developed platform, stakeholders develop collaboration arrangements, such as resource utilization, strategic alignments, and knowledge-sharing mechanisms, to co-create value. These practices not only envision the potential for distributed and mutual value exchange but also establish a basis upon which the digital platform's value proposition will be built.

A primary precondition for the emergence of value co-creation in the biogas platform was strategic alignment, where different stakeholders emphasized that realizing shared value requires collaboration beyond organizational and territorial boundaries. Stakeholders emphasized that success necessitated coordination across multiple levels of governance and among diverse actors. One industrial user emphasized the multi-nature of this alignment as follows:

> *"Strategic planning is happening on multiple levels. Municipal, regional, and EU regulations are all affecting company steps. It is not enough to act locally."* (U3)

> *"If we do not have feedstock and off-taker contracts locked, no plant will be built. It is the same with infrastructure and public partners. Everyone must be aligned."* (U1)

As a basic condition for platform development, these alignments are essential to connect actors to legitimate collaboration initiatives. Stakeholders also emphasized the importance of public-private collaboration as a factor in collective visions. From a case study perspective, stakeholders identified the municipality's role as a network creator, initiating active connections between diverse groups, and envisioning this proactive approach as focused on collaborative rather than control. As one stakeholder stated:

> *"… our role as a sub-region … is the role of network creators, that we keep our eyes and ears open when we notice such signals coming from different directions, so [we] pull them together."* (A5)

> *"We are already discussing at the regional level with others. We are not competing. It is about a shared potential; better to work together."* (A3)

These strategic alignments are incomplete without institutional facilitation. These institutional assistances serve as a tool to shape the entire value landscape, especially as shown in the case study, where municipal facilitation, even without direct ownership, influences the formation of these ecosystem networks.

> *"The city helped legitimize the platform idea. Even if they do not run it, their support sent a message to industry actors that this was serious."* (RM3).

> *"Municipalities cannot own the platform, but they can support a regional biogas network or energy company. That would be more efficient and long-term."* (A1).

These strategic formations are ineffective until they initiate more co-creation practices within the ecosystem. Stakeholder-driven co-creation practices also include the collaborative utilization of distributed and underutilized resources. These collaborative utilization efforts encourage the concept of side-stream circularity, where the waste of one stakeholder becomes a valuable product for another stakeholder. A distributor stated it as follows:

> *"… it is like a circular economy; they provide the raw material for the gas production, and instead, they get fertilizer from the reject from the biogas plant. So it is like a win-win situation with a very good circular economy."* (D1)

Municipal stakeholders linked the circular flow of by-products from side streams to broader community benefits, aiming to enhance local energy resilience and self-sufficiency.

> *"We have arable land, animals, and food processors utilizing side streams for energy use, which is one part of developing energy self-sufficiency."* (A1)

This decentralized resource coordination and the logic of circularity create practical efficiencies and foster a common understanding of mutual benefits that will later support the platform's value proposition. However, some stakeholders still believe that these practices will have a limited impact without clear strategic visibility and coordination. As one expert noted:

> *"… there would be a huge potential of farmers that would like to connect and have some material that is now going to waste … Instead, they could sell it for … biogas production."* (U3)

This highlights the need for a structured mechanism to ensure strategic alignment, thereby synchronizing the flow and reducing uncertainty. This alignment and collaboration build trust among actors, function as sector-level peer learning, which in turn establishes the value development and conceptual foundation for the future digital platform. As one stakeholder stated, this phenomenon is

> *"There is no special strategy, but we have seen the value in keeping in touch with actors, hearing what they have to say, and keeping them informed of developments."* (A5).

This kind of multi-level interaction builds trust within the Actor-to-Actor (A2A) network, which in turn evolves into collective vision sharing. However, the farmer demanded a more effective networking of stakeholders that would initiate the knowledge-sharing mechanism. A platform can help as a central channel for managing these sharing mechanisms. Stakeholders further emphasized that the platform could serve as an information hub for accessing up-to-date knowledge and information.

> *"We need biogas evenings where people sit and talk. Ideas do not develop alone; they grow through discussion. But farmers do not have time, so networking needs to be enabled."* (RM2)

> *"… if interested parties can get up-to-date data from one place, that would be a good thing."* (T1)

In addition to facilitating early alignment and coordination among diverse stakeholders, trust and knowledge sharing also help identify specific platform roles and functions that direct the emergence of the platform-enabled value proposition.

4.3. Platform value proposition

This third aggregated dimension captures what aspects the stakeholders envisioned in the emergent value proposition of the digital platforms. Four interrelated aspects are discussed in this dimension, starting with the expected service offerings, the governance principles that are adaptable for all stakeholders, the business model configurations that shape participation, and finally, the continuous adjustment of the platform's value proposition, which ensures its long-term relevance. These essential components of the digital platform illustrate how the platform was envisioned not only as a technical intermediary but also as a socio-technical infrastructure that balances market, institutional, and community needs. As different stakeholders stated, some suggested that the platform should serve as a mechanism for demand aggregation, while others envisioned it as a dual-sided marketplace, and still others viewed it as a tool for enhancing policy and regulatory visibility.

"I think the platform could serve some purpose, but I see it more as a mass balancing system." (P1)

"… a marketplace that would bring together the gas producers." (U4)

"We would be interested in a platform that lists producers and lets us advertise our products. It could function as a full marketplace on both sides." (U5)

"As an end-user, we need to report and validate that the gas we have acquired is sustainable according to different regulations. Ensuring that the feedstock is acceptable is also important, and this may vary depending on the operator. So, a platform could actually bring significant benefits in this area." (U2)

However, these comprehensive service layers of the platform must be legitimized by the governance practices adopted by the platform.

"… If there is a clear earning logic, it could be run as a business. However, if it is more about softer values, a cooperative model makes sense." (A5)

"It could be a non-profit or cooperative maintained for shared value." (A4)

However, some stakeholders expressed their concerns about the neutral ownership, while one proposed a hybrid facilitation as a solution to avoid over-politicization of governance issues.

"… it needs private companies involved. Otherwise, it goes political. It must be aligned with economic logic, not just public sector processes." (A1)

"I have seen this work well—shared ownership with a third-party provider running the service … you avoid politicization and ensure good support." (U5)

These statements highlight the stakeholder choices for adaptive governance, aiming to strike a balance between neutrality and ensuring platform credibility. Moreover, the willingness of stakeholders to participate in platform-enabled services not only depends on the expected digital services and governance models but also relies on the platform's clear, fair pricing and access logic. Some stakeholders requested guaranteed benefits as a return on their platform payment fees, while others prefer subscription-based platform fee models over transactional fees.

"We are willing to pay a platform fee if the ratio between fees and income is reasonable … There should also be a guarantee that the platform provides benefits for maintaining production." (P3)

"A yearly subscription would be better than a transaction-based one … we would pay a premium for early access to offers." (U3)

Apart from the pricing, stakeholders emphasized that the platform's business model should be flexible to allow for technical and system integration through direct APIs, thereby increasing the digital functionalities of the platform. However, this integration requires the platform to evolve continuously rather than emerge fully formed. A stakeholder wished this initiative to develop further and reposition itself accordingly.

"The platform must evolve beyond the project phase … adjusted along the way based on what works and what does not …" (T1)

"… genuinely permanent and evolving so that it does not remain as a project that becomes outdated." (T2)

Stakeholders also emphasized that the platform must adopt iterative repositioning, where the scope of platform governance and services must be continuously adjusted in response to changing user needs, feedback, and evolving conditions.

Although stakeholders envisioned different platform functions, their expectations reflected a common concern with reducing uncertainties associated with participation in the emerging biogas ecosystem. Producers emphasized market balancing, predictable demand, and economic viability, while users focused on marketplace functionality, traceability, and compliance with sustainability requirements. Public actors highlighted governance arrangements that could ensure legitimacy, neutrality, and long-term continuity, whereas technology-oriented stakeholders emphasized adaptability and continuous platform development. These differences in the viewpoints demonstrate that stakeholder-specific vulnerabilities and priorities shape the overall platform value proposition. At the same time, all stakeholder groups viewed platform participation as a way to improve coordination, transparency, and predictability. This suggests that the perceived value of the platform emerges from its ability to reduce market, operational, and institutional uncertainties.

4.4. External enablers or constraints supporting value emergence

In addition to triggers, co-creation practices, and the envisioned platform functions, interviewees highlighted a set of moderating conditions that explain how these factors can fully enhance the emergence of the platform's value proposition. These external enablers or constraints operate beyond the platform's specific design, reflecting the broader institutional and technical context in which the ecosystem exists.

Local and regional governments were often cited as important facilitators, although not because they owned or ran the platforms, but instead because they created conducive environments. Through zoning, procurement, and symbolic backing, municipalities were perceived as providing legitimacy and promoting demand.

"The municipality can influence its own procurement so that it awards even better points to the operator who uses biogas as a transport fuel for school transport." (A5)

"The city cannot hand out any money directly, but through zoning and land-use policy." (A2)

"The city helped legitimize the platform concept. Even if they do not run it, their support conveyed the message across industry players that this was serious." (RM3)

However, the interviewees were firm that municipalities should avoid direct proprietorship. Finally, it was believed that national policy determined the platform's scale of demand.

"Local authorities cannot own the platform, but they could support some regional biogas network or energy company. That is more efficient and long-term." (A1)

"Scaling up will occur after enough demand. Demand has to follow from national political decisions. Otherwise, it is hard to scale regardless of how ready the region is …" (A1)

Regional coherence and beneficial public acts moderate platform viability by creating a fertile ground for growth. The ability to capitalize on multi-vector synergy further enhances this advantage. With the help of current regional cooperation, the platform may be able to incorporate new energy technologies more quickly, such as linking biogas production to hydrogen and carbon dioxide utilization. This strategy offers both a structural lever (the technological capacity to connect systems) and symbolic rationality (demonstrating a commitment to larger regional objectives), making the platform more resilient and appealing to a wider variety of stakeholders. Stakeholders described these synergies as an essential part of future scalability and competitiveness.

"Hydrogen links to biogas production through CO_2… a good opportunity to increase biogas production and make use of green CO_2." (P1)

"We would be interested in a platform that lists producers and lets us advertise our hydrogen, maybe even carbon." (U6)

The platform could extend beyond acting as a niche intermediary

marketplace and position itself as a cross-sector energy hub in the future by integrating these new markets, which will unlock broader value creation and help stakeholders' practices comply with national decarbonization goals.

Stakeholders linked the future success of the platform ecosystem to external conditions extending beyond the platform itself. Municipal actors emphasized the importance of regional coordination, policy support, and demand creation, while industry actors highlighted the availability of infrastructure and opportunities for technological integration as key enablers. Producers and users viewed these external conditions as important for strengthening confidence in long-term investments and market development. Across stakeholder groups, regional support mechanisms and cross-sector energy synergies were seen as the most important drivers for increasing confidence in future opportunities, scalability, and ecosystem growth. These findings suggest that external conditions support value emergence by reducing uncertainty in investment decisions, market development, and long-term participation in the ecosystem.

5. Discussion

The findings presented above illustrate how VP is perceived, co-created, and repositioned during the inception phase of an emerging digital platform ecosystem. Based on empirical insights, we developed a processual conceptual framework. As shown in Fig. 3, the framework consists of four interrelated dimensions of value co-creation: 1) Triggers of value search and discovery; 2) Stakeholder-driven VP co-creation; 3) Platform value proposition elements, and 4) Contextual Enablers supporting value emergence.

The framework suggests how external triggers can shape stakeholder-driven participation, enabling the emergence of a platform value proposition through collaborative co-creation. It also emphasizes the importance of stakeholders' willingness in advancing co-creation activities for platform value proposition development through different sharing mechanisms. Co-innovative value in emerging B2B digital platforms advances dynamically across several contextual factors, including institutional frameworks, infrastructural capabilities, and market-driven circumstances, which in turn become the basis of a new emerging value proposition. Next, we elaborate on these processes in detail.

5.1. Triggers as a catalyst for value exploration

Prior research on platform ecosystems has largely explained participation as an opportunity-driven process shaped by complementarity, network effects, and platform openness (Eisenmann et al., 2008; Gawer and Cusumano, 2014; Jacobides et al., 2018). However, how this logic of participation operates in highly regulated sectors remains underexplored. Our findings indicate that the stakeholders' willingness to engage in new value exploration in the highly regulated sector is primarily driven by external factors and uncertainties. These findings align with recent research on platform ecosystem emergence, which suggests that ecosystem formation is often triggered by external pull and uncertainty (Dattée et al., 2018). Villa et al. (2026) argue that institutional pressures, regulatory frameworks, and established technical architectures can initiate and drive platform ecosystem formation before the emergence of clearly defined actor-level value propositions. These external triggers strongly shape how stakeholders perceive and prioritize the platform's potential value (Bustamante, 2023).

Also, our findings further explain stakeholders' motivation and willingness to explore new collaborative solutions are significantly influenced by external triggers, including economic uncertainty, regulatory and environmental barriers, and technological and infrastructural scaling challenges. These factors function simultaneously as constraints and catalysts, shaping both the need and the direction for value discovery and ecosystem emergence. While Thomas et al. (2022) identify value discovery as a central process in ecosystem emergence, our findings provide insight into the conditions that initiate this emergence process before concrete value propositions are fully established.

The findings also show unpredictable energy policy, regulation, and directive at both national and European levels, such as EU RED II (Directive, 2018), European Green Deal(European Commission, 2019)

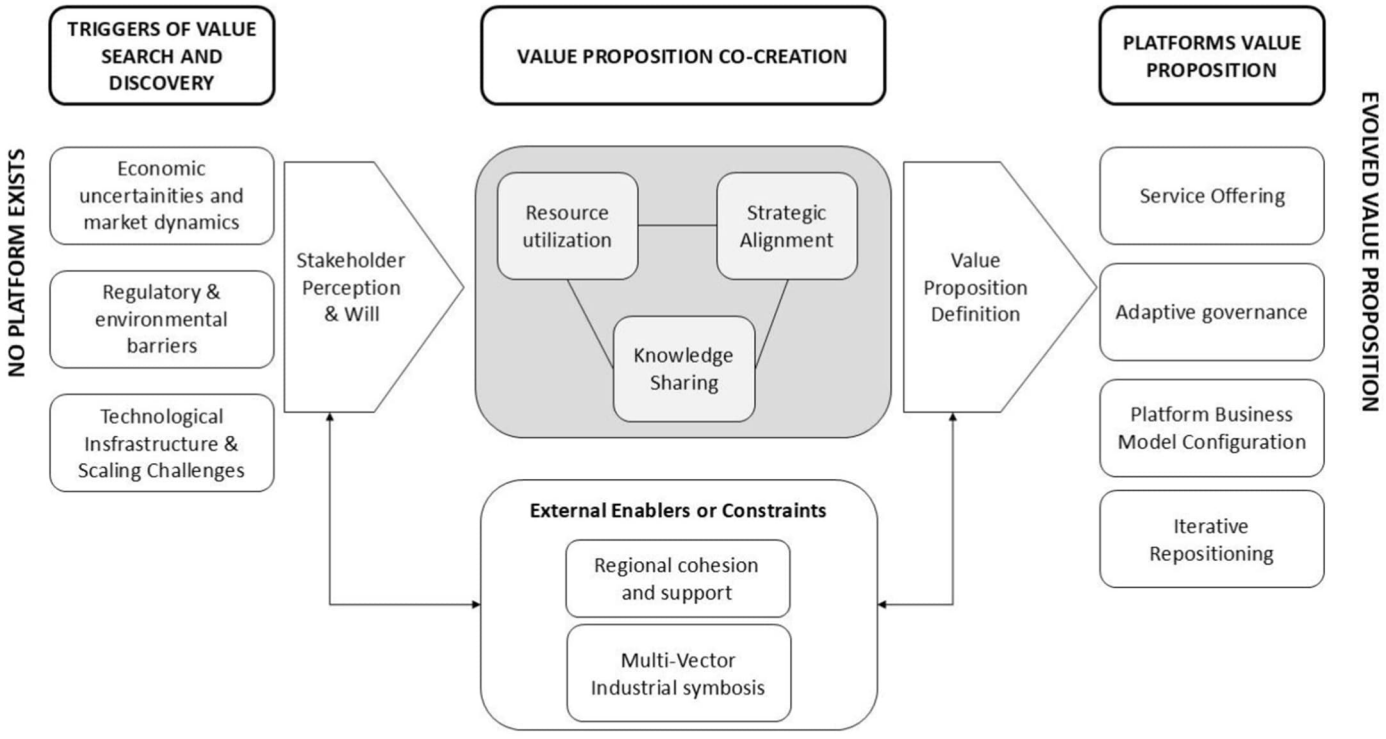

Fig. 3. Value proposition emergence through value co-creation.

and EU Net Zero Industrial Act (Regulation, 2024) create a risky environment for stakeholders, forcing them to search for mechanisms that could provide long-term stability and predictability for investment and decision-making. This shift in regulatory dynamics aligns with previous academic research on ecosystems in highly regulated sectors, where institutional policies and technical standards shape ecosystem formation and require ecosystem actors to actively coordinate different mechanisms to enable value co-creation (Spagnoletti et al., 2024). Hawlitschek and Hodapp (2024) show that nascent platform ecosystems face significant challenges, especially under conditions of uncertainty. They argue that overcoming these barriers is necessary to enable effective value co-creation during the early stages of platform development. Our study supports this perspective by showing that ecosystem participation can serve as a risk-sharing mechanism, allowing stakeholders to address uncertainties that would be difficult to manage individually or collectively.

Beyond regulatory and environmental pressures, economic uncertainty also significantly shapes stakeholders' participation decisions. The findings indicate that stakeholders view ecosystem participation as a means of jointly creating new revenue opportunities while reducing exposure to market risks. This resonates with the previous research suggesting that participation in platform ecosystems can improve complementors' business performance through value co-creation and access to new opportunities (Ceccagnoli et al., 2012). At the same time, Murthy and Madhok (2020) argue that platform ecosystems often emerge by overcoming early-stage uncertainty through alignment between an emerging problem and the platform's scope. Building on this argument, our findings show that in highly regulated environments, such alignment is driven not only by the pursuit of opportunities but also by the need to collectively mitigate regulatory, technological, and market uncertainties. Moreover, the initial “value search” is often driven less by opportunity maximization and more by collective risk mitigation. This shifts the explanation of ecosystem emergence from an opportunity-driven view to one focused on managing shared vulnerabilities and uncertainties, particularly in highly regulated environments.

5.2. Stakeholder-driven value proposition Co-creation initiative

The identified triggers shape stakeholders' perceptions of the emerging platform and influence their willingness to participate in co-creating its value proposition. These conditions establish the foundation for ecosystem development, even in the absence of a fully developed platform. This finding is consistent with prior research highlighting the importance of early-stage ecosystem processes such as value discovery and collective alignment (Thomas et al., 2022). However, our findings extend this perspective by showing that perceptions of value are actively constructed through stakeholder interactions prior to the establishment of formal platform structures. Stakeholders create mutual value through collaboration, including strategic alignment, resource integration, and knowledge sharing. These value exchanges form the foundation of the platform's future value proposition.

This study also reveals that the value proposition (VP) emerges from stakeholder-driven planning and decentralized resource integration. Stakeholders share their physical assets, capabilities, and interorganizational relationships to create a shared collaborative space. This process aligns with Storbacka et al. (2016, p. 3008), who state that “actor engagement is conceptualized as a microfoundation for value co-creation”. This also aligns with the service-dominant logic research, which suggests that value does not reside in outputs themselves but emerges through resource integration among multiple actors (Vargo et al., 2008). Our findings support this view by demonstrating that the stakeholders collectively combine resources and capabilities to shape the platform's emerging value proposition.

From our case study perspective, stakeholder engagement supports the development of a shared vision. This occurs through resource exchanges, collaborative goal setting, and the joint exploration of solutions to diverse stakeholder needs. These joint activities help to transform intentions into concrete co-creation practices and help align stakeholders around a common value idea. This observation is consistent with Rusthollkarhu et al. (2021), who argue that value idea emergence (VIE) makes potential benefits visible and hence supports value co-creation within platform ecosystems. On B2B platforms, participants sometimes hesitate to engage, and these hesitations shape the emergence and extent of engagement (Benz et al., 2021). Consistent with this, our findings show that hesitation represents a structural characteristic of early-stage ecosystems. Mechanisms such as peer learning, shared problem-solving, and continuous dialogue help reduce uncertainty and gradually enable stakeholder participation. Taken together, these processes enable stakeholders to collectively define a shared value proposition before the platform ecosystem is formally established. This value proposition reflects a common understanding of the platform's purpose, expected benefits, and future direction. Our findings extend existing research by showing that value propositions emerge through stakeholder interactions during ecosystem formation. These interactions provide the foundation for future service development, governance arrangements, and business model develpoment.

5.3. Envisioning the Platform's value proposition

As stakeholders collaborated through various interactive mechanisms, a clearer vision of the digital platform's value proposition began to emerge. In our case, stakeholders expressed diverse expectations regarding the platform's service offerings, reflecting their varying roles and needs within the ecosystem. The platform was envisioned as more than a transactional marketplace. It was conceptualized as a multifunctional socio-technical infrastructure that supports different forms of interaction and coordination among ecosystem stakeholders. This conceptualization resonates with previous research arguing that platforms organize economic processes while coordinating and regulating broader societal contexts (Dolata and Schrape, 2025). Spagnoletti et al. (2015) argues that digital platform architecture should support the social interaction structures of the communities it serves, including information sharing, collaboration, and collective action. Consistent with prior research (Carrasco-Farré et al., 2022; Frow and Payne, 2011; Wang et al., 2024), our findings support that platform value propositions emerge through the alignment of interaction structures and stakeholder needs. However, we extend this perspective by showing how such alignment develops iteratively during the early stages of ecosystem formation under conditions of uncertainty.

Our findings also indicate that the emerging value proposition must include a range of digitally enabled service offerings designed to support both economic and sustainability objectives. This aligns with previous research showing that multi-sided platforms create value by connecting diverse stakeholder groups. They also enable service offerings that address the different needs of these stakeholders (Heikinheimo et al., 2025). In addition, the findings show that stakeholders emphasized the importance of services that support policy visibility, sustainability reporting, feedstock validation, and regulatory compliance. These findings are consistent with prior studies highlighting the role of digital platforms in enabling transparency and sustainability-oriented coordination across ecosystem actors (Ninan et al., 2026).

The findings further indicate that the realization of these service offerings depends on appropriate governance arrangements and business model configurations. Prior research suggests that ownership structures, value creation mechanisms, and complementor autonomy represent key dimensions through which platform ecosystems are differentiated (Hein et al., 2020). In line with these perspectives, our findings show that stakeholders consider governance mechanisms, particularly ownership structures, as decisive factors influencing future participation and adoption of platform services. This concern for governance is also evident in the literature that highlights the importance of perceived fairness and trust in platform-based ecosystems

(Tiwana, 2014). While digital platforms are often assumed to facilitate trust, coordination, and collaborative value creation, emerging research increasingly suggests that digitalization may simultaneously weaken richer forms of human-to-human interaction and interorganizational learning (Gomes et al., 2026). Our findings clearly show that stakeholders in sustainability-focused markets prefer a neutral or hybrid platform ownership model (such as a consortium or cooperative). This preference aims to prevent the platform from being politicized and to preserve credibility (trust). Such governance choices highlight the importance of building trust and legitimacy in early-stage ecosystems, especially in ecosystems with high uncertainty and sensitive regulations. Mukhopadhyay and Bouwman (2019) support this stance, arguing that different design choices for governance mechanisms can influence the optimization of value creation and enhance long-term sustainability.

The business model is also as important as the platform's governance mechanism in shaping the value proposition. It determines how participant incentives and network growth are balanced while preserving the platform's actual value. Stakeholders' participation in platform-enabled services is also dependent on clear, fair pricing and access logic. Our findings further indicate that stakeholders expect the platform's business model to remain adaptable and responsive to evolving ecosystem needs. This highlights the importance of iterative repositioning. Platform services and value-creation mechanisms must be continuously refined to remain relevant and support ongoing ecosystem development. Consistent with (Islind et al., 2019), such adaptability enables the platform to respond to evolving user requirements throughout its development process.

5.4. The role of external institutional and contextual factors

Finally, our study identified external institutional and contextual factors that are highly effective in shaping the ecosystem's dynamics, especially in sustainability-driven energy initiatives. The regional municipality's role as a facilitator through public procurement and zoning policies creates a productive ground for the platform's growth, where regional support will encourage the initial momentum and drive regional participation. This is evident in the previous research where Vink et al. (2021) highlights how institutional arrangements can enable long-term change. Aldenius and Khan (2017) argued that the green public procurement (region using tender criteria to favour low-carbon options) can stimulate the local markets in the sustainable transport ecosystem, while in the biogas context, it is clearly evident from the empirical findings that regions can promote the adoption of biogas through rewarding the biogas use in transport, providing zoning support and legitimizing the low carbon emission initiatives while clearly rejecting the direct ownership. Indirect support mechanisms enable value emergence by strengthening legitimacy and coordination within the ecosystem. This extends prior research by highlighting the regulatory, facilitative, and legitimizing roles of institutional actors in early-stage ecosystem development.

Moreover, the ability to incorporate biogas with the developing markets for hydrogen and carbon dioxide is also seen as an opportunity for value emergence. This type of multi-vector integration enables the system to extend beyond niche functions and operate as a higher-level system within the context of meso-level regional energy transition. Such integration can create new value streams and increase platform resilience. It can also support national and EU sustainability and environmental goals.

6. Conclusions

6.1. Theoretical contributions

This study makes three main theoretical contributions. First, it advances platform ecosystem research by providing a processual framework that illustrates how value propositions emerge through co-creation during the pre-development phase of sustainability-oriented B2B digital platform ecosystems. Recent research has established that platforms facilitate complementary innovation and network effects (Gawer and Cusumano, 2014), ecosystems consist of interdependent actors organized around complementarities (Jacobides et al., 2018), and ecosystem alignment is focused around a value proposition (Adner, 2017). Recent research on digital platforms has also stressed the need to consider platforms as evolving socio-technical systems (De Reuver et al., 2018). However, this literature explores less how the value proposition itself forms before the platform architecture, governance structures, and actor roles become established. Although some recent studies have explored early-stage platform and ecosystem emergence, including co-evolution of platform architecture, services, and governance (Jovanovic et al., 2022), value discovery and contextual embedding (Thomas et al., 2022), early problem framing and scope choices (Murthy and Madhok, 2021), non-linear value proposition development (Lingens et al., 2023), decision-making under uncertainty (Dattée et al., 2018), and organizational boundary redefinition during platform creation (Abed Alghani et al., 2026). However, less is known about how stakeholders collectively co-create a value proposition well in advance of the platform's operationalization. This study demonstrates how stakeholders can progress from fragmented needs and shared vulnerabilities to a sustainability-oriented platform value proposition through external triggers, stakeholder engagement, and circumstantial moderators. It theorizes value proposition co-creation as a dynamic and collective process that precedes, and helps shape, later platform architecture, governance, and ecosystem alignment.

Second, the research extends the Service-Dominant Logic (SDL) literature by providing insight into an often-ignored yet increasingly significant context for value co-creation, e.g., shared uncertainty and vulnerability. According to SDL, overall value arises from actor-to-actor interaction, resource integration, and institutional arrangements (Vargo et al., 2008; Vargo and Lusch, 2004, 2011, 2016). Our findings support this view but also extend it by showing that, in sustainability-oriented B2B ecosystems, value co-creation may be triggered not only by market opportunities but also by shared risks. Political instability, regulatory ambiguity, fragmented infrastructure, uncertain demand, and environmental compliance requirements prompted stakeholders to seek collective solutions. To explain this mechanism, the study introduces value-in-risk-mitigation as a key mechanism within the broader processual framework. Value-in-risk-mitigation refers to the way stakeholders co-create value by jointly reducing shared regulatory, environmental, infrastructural, and market vulnerabilities. This concept extends existing SDL concepts such as value-in-use, value-in-context, and value-in-experience by showing that value can also emerge from collective efforts to manage shared risks and vulnerabilities (Vargo et al., 2008; Vargo and Lusch, 2011, 2017). The results are consistent with previous research, which states that actors in nascent ecosystems willingly collaborate to reduce uncertainty and stabilize future market conditions rather than only to pursue immediate economic gains (Dattée et al., 2018).

Third, the study contributes to Digital Service Innovation (DSI) and sustainability-oriented platform ecosystem research by demonstrating how digital services simultaneously support economic coordination and environmental management. Prior DSI research has established how digital infrastructures and data-driven services transform value propositions, business models, and ecosystem relationships (Opazo Basáez et al., 2024; Paiola et al., 2021; Rabetino et al., 2024). Building on this literature, the findings provide strong evidence that DSI-enabled services reduce coordination problems through information sharing, matchmaking, demand aggregation, stakeholder visibility, and collaborative data exchange. Meanwhile, these services further help to achieve sustainability objectives such as emissions tracking and management, circular resource flows, sustainability verification, and regulatory compliance. This shows that DSI is not just a technological enabler but also an institutional and environmental enabler within new ecosystems.

Additionally, findings are further supported by research on industrial symbiosis and circular digital platforms, which highlights the importance of digital matchmaking, platform-based coordination, and collaborative information-sharing mechanisms for overcoming cooperation and coordination barriers in sustainability transitions (Afash et al., 2026; Krom et al., 2022; Prisco et al., 2026). Consequently, the study advances understanding of how digital services can simultaneously generate economic, environmental, and institutional value in pre-development ecosystem settings.

However, the study also contributes to sustainability governance research by showing how institutional actors play an indirect yet critical role in the pre-development of platform ecosystems. Municipalities and regional actors did not necessarily own or control the platform; instead, they served as soft enablers, strengthening legitimacy, facilitating stakeholder coordination, supporting zoning and procurement alignment, and encouraging long-term regional collaboration. These collective practices enhanced the legitimacy and acceptance of the emerging value proposition and mitigated uncertainty for ecosystem actors. This contributes to SDL discussions of institutional arrangements by demonstrating the indirect ways public actors influence value co-creation in sustainability-oriented ecosystems, where policy stability and establishment and maintenance of trust and legitimacy are key elements (Aldenius and Khan, 2017; Vargo and Lusch, 2016). The study contributions are also consistent with existing studies showing that public institutions often support ecosystem emergence through facilitation, stakeholder convening, legitimacy-building, and institutional coordination (Rehm et al., 2021). Overall, this study contributes to the understanding of how sustainability-oriented B2B digital platform ecosystems emerge before reaching platform maturity. It integrates insights from platform ecosystem literature, Service-Dominant Logic (SDL), Digital Service Innovation (DSI), and sustainability governance research. Together, these perspectives provide a unified process-based explanation of early-stage value proposition emergence.

6.2. Practical implications

This study offers practical insights for managers, platform developers, entrepreneurs, and policymakers involved in the early development of sustainability-oriented B2B digital platform ecosystems. For platform orchestrators and ecosystem developers, these findings indicate that recognizing common vulnerabilities within each sector should aid in the initial development of the platform before focusing on specific technical components. In fundamentally fragmented and highly regulated sectors (e.g., biogas), stakeholders are more likely to collaborate in a platform ecosystem setting if the platform mitigates shared risks associated with regulatory uncertainty, infrastructure gaps, market thinness, emissions traceability, and compliance. Thus, platform orchestrators should promote safe spaces for dialogue in addition to mapping stakeholder needs in order to translate common and mutual risks into tangible services associated with the platform, including matchmaking, demand aggregation, certification support, and sustainability verification through data-based traceability.

For B2B entrepreneurs and digital service providers, the findings highlight the importance of legitimacy and trust in early-stage platform formation. Entrepreneurs should not presume that just providing technical functionality will be sufficient to attract stakeholders. Rather, they must demonstrate how the digital services they offer will mitigate coordination challenges and help stakeholders meet their economic and environmental objectives. The entrepreneur may use workshops, pilot studies, stakeholder forums, and trials to highlight the platform's value proposition and help them convince stakeholders.

For industrial managers and participating firms, the findings suggest that engagement in emerging platform ecosystems can help reduce uncertainty and access new value opportunities. Firms can benefit from new business opportunities, better access to information, improved sustainability reporting, and stronger compliance readiness. By participating early, firms can also influence the platform's governance, pricing, data-sharing rules, and service design.

6.3. Limitations and future research

Our study has several limitations. These limitations should be considered before objectively evaluating the findings and conducting further research. The first limitation is the methodological choices that affect the research's validity, reliability, and generalizability. Selecting a detailed single-case qualitative study as the methodological approach is a reasonable choice for exploring unexamined phenomena. However, it limits the findings to be generalized to other digital platform contexts or cases (Yin, 2018). The key result of this study is a processual framework that identifies mechanisms for the emergence of value propositions, including external triggers, stakeholder-driven co-creation, and contextual enablers. These mechanisms can support mid-range theory development for sustainability-oriented B2B digital platform ecosystems operating in high-regulation, high-uncertainty environments. In the context of the selected case study, the Finnish energy sector is characterized by unique economic, regulatory, and cultural factors. These factors indicate that study conclusions are not necessarily applicable to other contexts. So, the interpretations are mainly specific to this context rather than demonstrating universal principles of platform development.

The second limitation is the primary methods of data collection and data analysis. Continuous efforts were made to reduce interpretive bias through techniques like iterative coding and reflexivity. The use of multiple languages during data collection and translation bias in data analysis also accounts for a limitation of this study. Interviews conducted in Finnish and English may have experienced small changes in meaning during translation, paraphrasing, and coding across languages.

Another important limitation is the study period, which followed the development of the platform and value proposition over a predetermined timeframe (June 2024 to January 2025). The final processual framework may not accurately reflect the dynamic nature of platform ecosystems, as extended observation may reveal further changes in stakeholder activities, governance arrangements, or market responses.

Furthermore, these changes could alter core value propositions or contradict research findings. Although the intention was to broaden stakeholder representation to provide a more comprehensive picture of the situation, the resulting representation remains very limited. Despite the inclusion of key players of the main biogas value chain, such as farmers, biogas consumers, technology suppliers, local governments, and developers. The data-gathering process did not involve other relevant stakeholders, including financial investors, national regulators, or external policy groups that could affect the study's findings.

Lastly, while our research describes how value propositions evolve in sustainable platform ecosystems that are still in their early stages, where value co-creation is not clearly predefined. Its application is limited in the following situations: (i) if institutional arrangements are not aligned, (ii) if governance choices change, putting more risk on specific actors (e.g., extractive pricing, ambiguous decision rights), (iii) if market thinness persists (limited participants to realize complementarities), or (iv) if organizational routines and infrastructure prevent resource integration.

There are several directions in which future studies could extend this research. First, there is a need for prospective and real-time longitudinal studies. This will examine how sustainability-oriented B2B digital platform ecosystems evolve over time, from actor mobilization to a commitment to platform development. The early stages of platform development could also be examined using other qualitative approaches, such as ethnographic, action research, or longitudinal case study designs, to better understand how actors negotiate inclusion, exclusion, and transformation of sustainability elements.

Secondly, future research can compare sustainability-oriented and non-sustainability-oriented B2B digital platforms. Such comparative

studies help clarify whether a sustainability orientation adds more actor groups, increases negotiation complexity, or introduces more complex governance mechanisms. In this regard, paired case studies in the energy, logistics, circular economy, recycling, or industrial platforms sectors would be particularly helpful to understand how sustainability modifies the initial conditions of platform ecosystems.

Lastly, future research needs to analyze the development of sustainability-oriented B2B platforms across different geographical contexts. Existing available evidence remains limited to European industrial settings. Global research on emerging economies could reveal how various regulatory constraints and infrastructural conditions could shape the emergence of value propositions.

CRediT authorship contribution statement

Syed Wajahat Ali: Conceptualization, Data curation, Formal analysis, Project administration, Resources, Validation, Visualization, Writing – original draft. **Rodrigo Rabetino:** Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Validation, Writing – review & editing. **Jahanzaib Shahzad:** Conceptualization, Data curation, Formal analysis, Visualization, Writing – original draft.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interestsThe author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix

Project Questionnaire	
Questions	Answers
1. Could you briefly describe your organization and your role in the biogas sector?	
2. What are the main opportunities and challenges in the regional biogas market?	
3. How do regulations, policy uncertainty, environmental requirements, or subsidy changes affect your organization's biogas-related decisions?	
4. What infrastructure, logistics, storage, or market barriers limit the development of the biogas sector?	
5. What kind of value would your organization expect from a regional digital biogas platform?	
6. What problems should the platform help solve for producers, users, raw material suppliers, distributors, service providers, or public actors?	
7. What digital services would be most useful?	
Examples: matchmaking, demand aggregation, producer/user listing, emissions tracking, certification support, logistics coordination, or market information.	
8. What would motivate your organization to participate in such a platform?	
9. What concerns or risks might prevent your organization from participating?	
10. What kind of data would your organization be willing or unwilling to share through the platform?	
11. Who should own, manage, or govern the platform, and why?	
12. What pricing or revenue model would be acceptable?	
Examples: subscription fee, transaction fee, cooperative membership, public support, or freemium model.	

References

Abed Alghani, K., Rabetino, R., Kohtamäki, M., 2026. Incumbent-Born B2B platforms: organizational boundary dynamics in platform creation. J. Prod. Innovat. Manag., 70025 https://doi.org/10.1111/jpim.70025 jpim.

Adner, R., 2017. Ecosystem as structure: an actionable construct for strategy. J. Manag. 43 (1), 39–58. https://doi.org/10.1177/0149206316678451.

Afash, H., Yu, Y., Koeva, M., Yazan, D.M., 2026. Hubs for circularity: reference architecture of digital collaboration platforms. Circ. Econ. Sustain. 6 (1), 20. https://doi.org/10.1007/s43615-026-00755-z.

Aldenius, M., Khan, J., 2017. Strategic use of green public procurement in the bus sector: challenges and opportunities. J. Clean. Prod. 164, 250–257. https://doi.org/10.1016/j.jclepro.2017.06.196.

Alvesson, M., Sandberg, J., 2011. Generating research questions through problematization. Acad. Manag. Rev. 36, 247–271. https://journals.aom.org/doi/abs/10.5465/amr.2009.0188.

Andersen, A.D., Frenken, K., Galaz, V., Kern, F., Klerkx, L., Mouthaan, M., Piscicelli, L., Schor, J.B., Vaskelainen, T., 2021. On digitalization and sustainability transitions. Environ. Innov. Soc. Transit. 41, 96–98. https://doi.org/10.1016/j.eist.2021.09.013.

Baker, J.J., Storbacka, K., Brodie, R.J., 2019. Markets changing, changing markets: institutional work as market shaping. Mark. Theory 19 (3), 301–328. https://doi.org/10.1177/1470593118809799.

Baldwin, Carliss Y., Woodard, C. Jason, 2008. The Architecture of Platforms: A Unified View. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1265155. http://www.ssrn.com/abstract=1265155.

Benz, C., Riefle, L., Schwarz, C., 2021. Co-Creating Value in B2B Platform Ecosystems – towards a Deeper Understanding of the Emergence and Nature of Actor Engagement.

Bonina, C., Koskinen, K., Eaton, B., Gawer, A., 2021. Digital platforms for development: foundations and research agenda. Inf. Syst. J. 31 (6), 869–902. https://doi.org/10.1111/isj.12326.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3 (2), 77–101. https://doi.org/10.1191/1478088706qp063oa.

Brodie, R.J., Fehrer, J.A., Jaakkola, E., Conduit, J., 2019. Actor engagement in networks: defining the conceptual domain. J. Serv. Res. 22 (2), 173–188. https://doi.org/10.1177/1094670519827385.

Bustamante, M.J., 2023. Digital platforms as common goods or economic goods? Constructing the worth of a nascent agricultural data platform. Technol. Forecast. Soc. Change 192, 122549. https://doi.org/10.1016/j.techfore.2023.122549.

Carrasco-Farré, C., Snihur, Y., Berrone, P., Ricart, J.E., 2022. The stakeholder value proposition of digital platforms in an urban ecosystem. Res. Pol. 51 (4), 104488. https://doi.org/10.1016/j.respol.2022.104488.

Ceccagnoli, Forman, Huang, Wu, 2012. Cocreation of value in a platform ecosystem! the case of enterprise software. MIS Q. 36 (1), 263. https://doi.org/10.2307/41410417.

Chávez, C.A.G., Chari, A., Ito, A., Bärring, M., Friis, M., Mörstam, M., Lopes, P.V., Stahre, J., 2023. Using digital platforms for value chain sustainability – cases from the digitala stambanan project. Proced. CIRP 120, 1137–1142. https://doi.org/10.1016/j.procir.2023.09.138.

Corbin, J.M., Strauss, A.L., 2015. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory, fourth ed. SAGE.

Coskun-Setirek, A., Carmela Annosi, M., Hurst, W., Dolfsma, W., Tekinerdogan, B., 2024. Architecture and governance of digital business ecosystems: a systematic literature review. Inf. Syst. Manag. 41 (1), 58–90. https://doi.org/10.1080/10580530.2023.2194063.

Cusumano, M.A., with Gawer, A., Yoffie, D.B., 2019. The Business of Platforms: Strategy in the Age of Digital Competition, Innovation, and Power, first ed. HarperCollins Publishers.

Dattée, B., Alexy, O., Autio, E., 2018. Maneuvering in poor visibility: how firms play the ecosystem game when uncertainty is high. Acad. Manag. J. 61 (2), 466–498. https://doi.org/10.5465/amj.2015.0869.

De Reuver, M., Sørensen, C., Basole, R.C., 2018. The digital platform: a research agenda. J. Inf. Technol. 33 (2), 124–135. https://doi.org/10.1057/s41265-016-0033-3.

Directive (EU), 2018. 2018/2001 of the European parliament and of the council of 11 December 2018 on the promotion of the use of energy from renewable sources. L 328/82 Official Journal of the European Union L328, 82–209 europa.eu.

Dolata, U., Schrape, J.-F., 2025. Platform companies on the internet as a new organizational form. A sociological perspective. Innovat. Eur. J. Soc. Sci. Res. 38 (3), 1228–1247. https://doi.org/10.1080/13511610.2023.2182217.

Dubois, A., Gadde, L.-E., 2002. Systematic combining: an abductive approach to case research. J. Bus. Res. 55 (7), 553–560. https://doi.org/10.1016/S0148-2963(00)00195-8.
Eisenhardt, K.M., 1989. Building theories from case study research. Acad. Manag. Rev. 14 (4), 532–550. https://doi.org/10.2307/258557.
Eisenmann, T., Parker, G., Van Alstyne, M., 2011. Platform envelopment. Strateg. Manag. J. 32 (12), 1270–1285. https://doi.org/10.1002/smj.935.
Eisenmann, T.R., Parker, G., Alstyne, M.V., 2008. Opening Platforms: How, when and Why?.
Ekman, P., Röndell, J.G., Anastasiadou, E., Kowalkowski, C., Raggio, R.D., Thompson, S. M., 2021. Business actor engagement: exploring its antecedents and types. Ind. Mark. Manag. 98, 179–192. https://doi.org/10.1016/j.indmarman.2021.08.009.
European Commission, 2019. *The European Green Deal* (COM(2019) 640 Final). European Commission. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52019DC0640.
Evans, D.S., Schmalensee, R., 2016. The new economics of multi-sided platforms: a guide to the vocabulary. SSRN Electron. J. https://doi.org/10.2139/ssrn.2793021.
Florek-Paszkowska, A., 2025. The digital-sustainability ecosystem: a conceptual framework for digital transformation and sustainable innovation. Journal of Entrepreneurship, Management and Innovation 21 (2), 116–137. https://doi.org/10.7341/20252127.
Frow, P., Payne, A., 2011. A stakeholder perspective of the value proposition concept. Eur. J. Market. 45 (1/2), 223–240. https://doi.org/10.1108/03090561111095676.
Gawer, A., 2021. Digital platforms' boundaries: the interplay of firm scope, platform sides, and digital interfaces. Long. Range Plan. 54 (5), 102045. https://doi.org/10.1016/j.lrp.2020.102045.
Gawer, A., Cusumano, M.A., 2008. How companies become platform leaders. MIT Sloan Manag. Rev. 49, 28–35.
Gawer, A., Cusumano, M.A., 2014. Industry platforms and ecosystem innovation. J. Prod. Innovat. Manag. 31 (3), 417–433. https://doi.org/10.1111/jpim.12105.
Gioia, D.A., Corley, K.G., Hamilton, A.L., 2013. Seeking qualitative rigor in inductive research: notes on the gioia methodology. Organ. Res. Methods 16 (1), 15–31. https://doi.org/10.1177/1094428112452151.
Gomes, E., Lehman, David W., Vendrell-Herrero, Ferran, 2026. The dual effects of digitalization on SMEs: export gains and learning losses. J. Int. Bus. Stud.
Hawlitschek, F., Hodapp, D., 2024. Challenges to Co-Creating value in nascent platform ecosystems: gaps between theory and practice. Int. J. Electron. Commer. 28 (2), 156–185. https://doi.org/10.1080/10864415.2024.2332046.
Heikinheimo, M., Hautamäki, P., Julkunen, S., Koponen, J., 2025. Dynamic capabilities and multi-sided platforms: fostering organizational agility, flexibility, and resilience in B2B service ecosystems. Ind. Mark. Manag. 125, 179–194. https://doi.org/10.1016/j.indmarman.2025.01.006.
Hein, A., Schreieck, M., Riasanow, T., Setzke, D.S., Wiesche, M., Böhm, M., Krcmar, H., 2020. Digital platform ecosystems. Electron. Mark. 30 (1), 87–98. https://doi.org/10.1007/s12525-019-00377-4.
Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., Krcmar, H., 2019. Value co-creation practices in business-to-business platform ecosystems. Electron. Mark. 29 (3), 503–518. https://doi.org/10.1007/s12525-019-00337-y.
Hellemans, I., Porter, A.J., Diriker, D., 2022. Harnessing digitalization for sustainable development: understanding how interactions on sustainability-oriented digital platforms manage tensions and paradoxes. Bus. Strat. Environ. 31 (2), 668–683. https://doi.org/10.1002/bse.2943.
Häikiö, J., Koivumäki, T., 2016. Exploring digital service innovation process through value creation. J. Innov. Manag. 4 (2), 96–124. https://doi.org/10.24840/2183-0606_004.002_0006.
Isckia, T., De Reuver, M., Lescop, D., 2018. Digital innovation in platform-based ecosystems: an evolutionary framework. In: Proceedings of the 10th International Conference on Management of Digital Ecosystems, pp. 149–156. https://doi.org/10.1145/3281375.3281377.
Islind, A.S., Lindroth, T., Lundin, J., Steineck, G., 2019. Co-designing a digital platform with boundary objects: bringing together heterogeneous users in healthcare. Health Technol. 9 (4), 425–438. https://doi.org/10.1007/s12553-019-00332-5.
Jacobides, M.G., Cennamo, C., Gawer, A., 2018. Towards a theory of ecosystems. Strateg. Manag. J. 39 (8), 2255–2276. https://doi.org/10.1002/smj.2904.
Jovanovic, M., Sjödin, D., Parida, V., 2022. Co-evolution of platform architecture, platform services, and platform governance: expanding the platform value of industrial digital platforms. Technovation 118, 102218. https://doi.org/10.1016/j.technovation.2020.102218.
Kapoor, K., Ziaee Bigdeli, A., Dwivedi, Y.K., Schroeder, A., Beltagui, A., Baines, T., 2021. A socio-technical view of platform ecosystems: systematic review and research agenda. J. Bus. Res. 128, 94–108. https://doi.org/10.1016/j.jbusres.2021.01.060.
Katz, M.L., Shapiro, C., 1985. Network externalities, competition, and compatibility. Am. Econ. Rev. 75, 424–440.
Köhler, J., Geels, F.W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M.S., et al., 2019. An agenda for sustainability transitions research: state of the art and future directions. Environ. Innov. Soc. Transit. 31, 1–32. https://doi.org/10.1016/j.eist.2019.01.004.
Koilo, V., 2025. Driving the circular economy through digital servitization: sustainable business models in the maritime sector. Inside Bus. 5 (1), 12. https://doi.org/10.3390/businesses5010012.
Kolk, A., Ciulli, F., 2020. The potential of sustainability-oriented digital platform multinationals: a comment on the transitions research agenda. Environ. Innov. Soc. Transit. 34, 355–358. https://doi.org/10.1016/j.eist.2019.12.008.
Kretschmer, T., Leiponen, A., Schilling, M., Vasudeva, G., 2022. Platform ecosystems as meta-organizations: implications for platform strategies. Strateg. Manag. J. 43 (3), 405–424. https://doi.org/10.1002/smj.3250.
Krom, P., Piscicelli, L., Frenken, K., 2022. Digital platforms for industrial symbiosis. J. Innov. Econ. Manag. 39 (3), 215–240. https://doi.org/10.3917/jie.pr1.0124. N°.
Latinovic, Z., Chatterjee, S.C., 2024. Value co-creation: balancing B2B platform value and potential reverse-value effects. J. Bus. Res. 175, 114518. https://doi.org/10.1016/j.jbusres.2024.114518.
Lavikka, R., Hirvensalo, A., Smeds, R., Jaatinen, M., 2017. Transforming a supply chain towards a digital business ecosystem. In: Lödding, H., Riedel, R., Thoben, K.-D., Von Cieminski, G., Kiritsis, D. (Eds.), Advances in Production Management Systems. the Path to Intelligent, Collaborative and Sustainable Manufacturing, 514. Springer International Publishing, pp. 295–301. https://doi.org/10.1007/978-3-319-66926-7_34.
Lingens, B., Seeholzer, V., Gassmann, O., 2023. Journey to the Big Bang: how firms define new value propositions in emerging ecosystems. J. Eng. Technol. Manag. 69, 101762. https://doi.org/10.1016/j.jengtecman.2023.101762.
Magnani, G., Gioia, D., 2023. Using the Gioia methodology in international business and entrepreneurship research. Int. Bus. Rev. 32 (2), 102097. https://doi.org/10.1016/j.ibusrev.2022.102097.
Mihailova, D., Schubert, I., Burger, P., Fritz, M.M.C., 2022. Exploring modes of sustainable value co-creation in renewable energy communities. J. Clean. Prod. 330, 129917. https://doi.org/10.1016/j.jclepro.2021.129917.
Mukhopadhyay, S., Bouwman, H., 2019. Orchestration and governance in digital platform ecosystems: a literature review and trends. Digit. Pol. Regul. Govern. 21 (4), 329–351. https://doi.org/10.1108/DPRG-11-2018-0067.
Murthy, R.K., Madhok, A., 2020. The emergence of digital platform ecosystems: a problem-solving perspective. In: Academy of Management Proceedings, 17767. https://doi.org/10.5465/AMBPP.2020.17767abstract, 2020(1).
Murthy, R.K., Madhok, A., 2021. Overcoming the early-stage conundrum of digital platform ecosystem emergence: a problem-solving perspective. J. Manag. Stud. 58 (7), 1899–1932. https://doi.org/10.1111/joms.12748.
Musiolik, J., Markard, J., Hekkert, M., 2012. Networks and network resources in technological innovation systems: towards a conceptual framework for system building. Technol. Forecast. Soc. Change 79 (6), 1032–1048. https://doi.org/10.1016/j.techfore.2012.01.003.
Nerbel, J.F., Kreutzer, M., 2023. Digital platform ecosystems in flux: from proprietary digital platforms to wide-spanning ecosystems. Electron. Mark. 33 (1), 6. https://doi.org/10.1007/s12525-023-00625-8.
Ninan, J., Zaharia, A., Bosch-Rekveldt, M., 2026. How digital platforms enable sustainability transitions in the built environment. Construct. Manag. Econ. 44 (4), 300–317. https://doi.org/10.1080/01446193.2026.2629869.
Opazo Basáez, M., Vendrell-Herrero, F., Bustinza, O.F., Raddats, C., 2024. Guest editorial: Digital service innovation: ontology, context and theory. J. Serv. Manag. 35 (2), 129–140. https://doi.org/10.1108/JOSM-03-2024-498.
Paiola, M., Schiavone, F., Grandinetti, R., Chen, J., 2021. Digital servitization and sustainability through networking: some evidences from IoT-based business models. J. Bus. Res. 132, 507–516. https://doi.org/10.1016/j.jbusres.2021.04.047.
Parker, G.G., Van Alstyne, M.W., Choudary, S.P., 2016. Platform Revolution: How Networked Markets are Transforming the Economy and How to Make them Work for you. W.W. Norton & Company.
Peng, H., Lu, Y., Gupta, S., 2023. Promoting value emergence through digital platform ecosystems: perspectives on resource integration in China. Technol. Forecast. Soc. Change 189, 122338. https://doi.org/10.1016/j.techfore.2023.122338.
Petrik, D., Hiller, S., Morar, D., 2025. Digital platforms for circular economy: empirical development of a taxonomy and archetypes. Electron. Mark. 35 (1), 60. https://doi.org/10.1007/s12525-025-00792-w.
Prisco, A., Rey, A., Sciarelli, M., Tuccillo, D., 2026. Linking loops: how digital platforms orchestrate circular economy networks. Sustain. Dev. sd, 70641. https://doi.org/10.1002/sd.70641.
Rabetino, R., Kohtamäki, M., Foss, N.J., Rahman, N., Huikkola, T., 2025. Microfoundations for business model innovation: exploring the interplay between individuals, practices, and organizational design. J. Prod. Innovat. Manag. 42 (4), 704–736. https://doi.org/10.1111/jpim.12784.
Rabetino, R., Kohtamäki, M., Parida, V., Vendrell-Herrero, F., 2024. Sustainable servitization for cleaner and resource-wise production and consumption: past, present, and future. J. Clean. Prod. 469, 143179. https://doi.org/10.1016/j.jclepro.2024.143179.
Rahman, N., Rabetino, R., Rajala, A., Makkonen, H., 2025. Prosumer flexibility as an enabler for ecosystem value Co-Creation: a resource integration approach from the Finnish electricity markets. Appl. Energy 390, 125814. https://doi.org/10.2139/ssrn.4706888.
Regulation (EU), 2024. 2024/1735 of the European Parliament and of the council of 13 June 2024 on establishing a framework of measures for strengthening Europe's net-zero technology manufacturing ecosystem, L 2024/1735. Off. J. Eur. Union L 1735, 1. https://eur-lex.europa.eu/eli/reg/2024/1735/oj/eng.
Rehm, S.-V., McLoughlin, S., Maccani, G., 2021. Experimentation platforms as bridges to urban sustainability. Smart Cities 4 (2), 569–587. https://doi.org/10.3390/smartcities4020030.
Rochet, J.-C., Tirole, J., 2006. Two-sided markets: a progress report. Rand J. Econ. 37 (3), 645–667. https://doi.org/10.1111/j.1756-2171.2006.tb00036.x.
Rustholllkarhu, S., Hautamaki, P., Aarikka-Stenroos, L., 2021. Value (Co-)creation in B2B sales ecosystems. J. Bus. Ind. Market. 36 (4), 590–598. https://doi.org/10.1108/JBIM-03-2020-0130.
Schreieck, M., Wiesche, M., Krcmar, H., 2021. Capabilities for value co-creation and value capture in emergent platform ecosystems: a longitudinal case study of SAP's

cloud platform. J. Inf. Technol. 36 (4), 365–390. https://doi.org/10.1177/02683962211023780.
Seclen-Luna, J.P., Fernandez-Olmos, M., Monroy-Osorio, J.C., 2026. Servitization for environmental and social management practices in manufacturing: the role of digitalization as an enabler. J. Environ. Manag. 407, 129814. https://doi.org/10.1016/j.jenvman.2026.129814.
Shi, X., Li, F., Chumnumpan, P., 2021. Platform development: emerging insights from a nascent industry. J. Manag. 47 (8), 2037–2073. https://doi.org/10.1177/0149206320929428.
Siggelkow, N., 2007. Persuasion with case studies. Acad. Manag. J. 50 (1), 20–24.
Siswanto, N., Rosdaniah, S., 2023. Driving Blue Economy for sustainable development: a case of stakeholder collaboration platform development. In: IOP Conference Series: Earth and Environmental Science, 012013. https://doi.org/10.1088/1755-1315/1198/1/012013, 1198(1.
Skålén, P., Gummerus, J., Von Koskull, C., Magnusson, P.R., 2015. Exploring value propositions and service innovation: a service-dominant logic study. J. Acad. Market. Sci. 43 (2), 137–158. https://doi.org/10.1007/s11747-013-0365-2.
Smith, G., Ofe, H.A., Sandberg, J., 2016. Digital service innovation from open data: exploring the value proposition of an open data marketplace. In: 2016 49th Hawaii International Conference on System Sciences (HICSS), pp. 1277–1286. https://doi.org/10.1109/HICSS.2016.162.
Spagnoletti, P., Kazemargi, N., Constantinides, P., Prencipe, A., 2024. Data Control Coordination in the Formation of Ecosystems in Highly Regulated Sectors.
Spagnoletti, P., Resca, A., Lee, G., 2015. A design theory for digital platforms supporting online communities: a multiple case Study. J. Inf. Technol. 30 (4), 364–380. https://doi.org/10.1057/jit.2014.37.
Storbacka, K., 2019. Actor engagement, value creation and market innovation. Ind. Mark. Manag. 80, 4–10. https://doi.org/10.1016/j.indmarman.2019.04.007.
Storbacka, K., Brodie, R.J., Böhmann, T., Maglio, P.P., Nenonen, S., 2016. Actor engagement as a microfoundation for value co-creation. J. Bus. Res. 69 (8), 3008–3017. https://doi.org/10.1016/j.jbusres.2016.02.034.
Storbacka, K., Nenonen, S., 2011. Scripting markets: from value propositions to market propositions. Ind. Mark. Manag. 40 (2), 255–266. https://doi.org/10.1016/j.indmarman.2010.06.038.
Sun, S., Gu, B., Tang, F., 2025. Cross-category innovation strategy and evolution of digital platform ecosystems: a technology-driven perspective. Sustainability 17 (11), 5113. https://doi.org/10.3390/su17115113.
Suri, H., 2011. Purposeful sampling in qualitative research synthesis. Qual. Res. J. 11 (2), 63–75. https://doi.org/10.3316/QRJ1102063.
Yin, S., Jiang, M., Chen, L., Jia, F., 2024. Digital transformation and the circular economy: an institutional theory perspective. Ind. Manag. Data Syst. 124 (4), 1627–1655. https://doi.org/10.1108/IMDS-10-2023-0792.
Thomas, L.D.W., Autio, E., Gann, D.M., 2022. Processes of ecosystem emergence. Technovation 115, 102441. https://doi.org/10.1016/j.technovation.2021.102441.
Timmermans, S., Tavory, I., 2012. Theory construction in qualitative research: from grounded theory to abductive analysis. Sociol. Theor. 30 (3), 167–186. https://doi.org/10.1177/0735275112457914.
Tiwana, A., 2014. Platform Ecosystems: Aligning Architecture, Governance, and Strategy. MK.
Tiwana, A., 2015. Platform desertion by app developers. J. Manag. Inf. Syst. 32 (4), 40–77. https://doi.org/10.1080/07421222.2015.1138365.
Tracy, S.J., 2010. Qualitative quality: eight "Big-Tent" criteria for excellent qualitative research. Qual. Inq. 16 (10), 837–851. https://doi.org/10.1177/1077800410383121.
Trevisan, A.H., Lobo, A., Guzzo, D., Gomes, L.A.D.V., Mascarenhas, J., 2023. Barriers to employing digital technologies for a circular economy: a multi-level perspective. J. Environ. Manag. 332, 117437. https://doi.org/10.1016/j.jenvman.2023.117437.
Vargo, S.L., Maglio, P.P., Akaka, M.A., 2008. On value and value co-creation: a service systems and service logic perspective. Eur. Manag. J. 26 (3), 145–152. https://doi.org/10.1016/j.emj.2008.04.003.
Vargo, S.L., Lusch, R.F., 2004. Evolving to a New Dominant Logic for Marketing.
Vargo, S.L., Lusch, R.F., 2011. It's all B2B…and beyond: toward a systems perspective of the market. Ind. Mark. Manag. 40 (2), 181–187. https://doi.org/10.1016/j.indmarman.2010.06.026.
Vargo, S.L., Lusch, R.F., 2016. Institutions and axioms: an extension and update of service-dominant logic. J. Acad. Market. Sci. 44 (1), 5–23. https://doi.org/10.1007/s11747-015-0456-3.
Vargo, S.L., Lusch, R.F., 2017. Service-dominant logic 2025. Int. J. Res. Market. 34 (1), 46–67. https://doi.org/10.1016/j.ijresmar.2016.11.001.
Villa, D., Jovanovic, M., Gastaldi, L., 2026. Rails without trains: value design under temporal decoupling in policy-driven platform ecosystem formation. SSRN. https://doi.org/10.2139/ssrn.6752124.
Vink, J., Koskela-Huotari, K., Tronvoll, B., Edvardsson, B., Wetter-Edman, K., 2021. Service ecosystem design: propositions, process model, and future research agenda. J. Serv. Res. 24 (2), 168–186. https://doi.org/10.1177/1094670520952537.
Wang, C., Zhao, X., Hong, J., 2024. A meta-analysis of the effects of interaction on value Co-Creation in online collaborative innovation communities based on the service ecosystem framework. Behav. Sci. 14 (12), 1177. https://doi.org/10.3390/bs14121177.
Wareham, J.D., Fox, P.B., Cano Giner, J.L., 2014. Technology ecosystem governance. SSRN Electron. J. https://doi.org/10.2139/ssrn.2201688.
Yiling, F., Weili, Z., Qiaosong, J., 2019. Evolution of Digital Platform-based Ecosystem: a Theoretical Framework.
Yin, R.K., 2018. Case Study Research and Applications: Design and Methods, sixth ed. SAGE.
Yrjölä, M., Mattila, M., Mikkonen, M., 2023. Value-creating and value-eroding decoupling in B2B platforms – a multiple case study. In: Marinova, S.T., Marinov, M. A. (Eds.), Reconfiguration of Business Models and Ecosystems, first ed. Routledge, pp. 98–117. https://doi.org/10.4324/9781003326731-7.