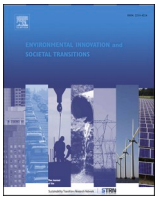
Environmental Innovation and Societal Transitions 61 (2026) 101148

Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist



Metagovernance as scaffolding: strategies promoting co-created learning and innovation for sustainability transitions

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ARTICLE INFO

Keywords:
Co-creation
Collaborative learning and innovation
Metagovernance
Scaffolding
Sustainability transitions

ABSTRACT

Co-creation among cross-sectoral actors offers a promising pathway for fostering collaborative learning and innovation in response to complex societal challenges. While prior research highlights the role of metagovernance in shaping co-creation, it has often focused on the use of discrete governance tools rather than on how these tools operate in combination. This article argues that a key task for metagovernors is to scaffold co-creation through the strategic configuration of complementary and interlocking governance factors that support three dimensions of collaborative learning and innovation: (a) reciprocal knowledge exchange and perspective transformation (input); (b) adaptive responsiveness to emerging needs and feedback (process); and (c) collective ownership and commitment to both the collaborative process and its outcomes (output). Based on a within- and cross-case analysis of four successful co-created sustainability initiatives in Denmark, the United States, Malaysia, and Serbia, we draw the distinction between (1) necessary scaffolding, which provide the baseline support structures for co-creation, and (2) contingent scaffolding, which are situationally activated in response to context-specific challenges. Our findings demonstrate that successful co-creation emerges not from the additive effects of individual governance tools, but from their configurational and mutually reinforcing interaction, through which their combined impact exceeds the sum of their parts.

1. Introduction

Co-creation refers to a mode of collaborative governance in which a network of actors—typically crosscutting sectoral boundaries—jointly engage in the mutual exchange of knowledge, experience, and perspectives to develop and implement shared solutions to complex societal problems (Ansell and Torfing, 2021; Hofstad et al., 2023). It holds particular relevance for addressing sustainability challenges, as it fosters collective learning and enables the emergence of socially robust and scalable innovations in settings marked by distributed authority, diverse interests, and systemic uncertainty (Sengers et al., 2019; Torfing, 2016). By mobilizing distributed expertise and aligning actor interests through iterative problem-solving, co-creation offers a promising governance pathway for guiding sociotechnical transitions by supporting the development of niche innovations while anchoring them in participatory

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https://doi.org/10.1016/j.eist.2026.101148
Received 2 October 2025; Received in revised form 27 April 2026; Accepted 18 May 2026
Available online 23 May 2026

processes that enhance their legitimacy, adaptability, and potential for embedding in broader regime transitions (Ba et al., 2024; Geels, 2011; Halbwachs et al., 2025; Smith et al., 2005).

However, there are often many centrifugal forces at play that hampers the ability of a diverse group of actors to successfully collaborate: the actors tend to have different interests, goals, norms, beliefs, and their time and energy are invested in many different tasks and projects, thus stretching their resources and attention spans. These obstacles can diminish the participants' ability to understand and willingness to learn from each other, which, in turn, limits their ostensible commitment to collectively design and implement joint solutions to shared problems (Emerson et al., 2012). Recognizing these barriers to co-creation, governance researchers have pointed to (meta)governance as a mechanism for addressing them. In the governance literature, metagovernance is customarily conceptualized in two analytically distinct ways. On the one hand, it refers to soft and indirect forms of steering that help enable collaborative processes without exerting direct control, such as facilitation, agenda-setting, and platform design (Ayres, 2019; Sørensen and Torfing, 2009), for which reason it is sometimes also simply referred to as governance. On the other hand, metagovernance is also conceptualized as the strategic configuration of multiple governance tools and interventions to create a coherent institutional framework for collaboration (Jessop, 2020; Kooiman, 2003; Meuleman, 2008).

While the extant literature has extensively theorized and studied the role of individual governance tools in fostering co-creation consistent with the former definition (Ayres, 2019; A. L. Q. Chen and Hustad, 2025; Sørensen and Torfing, 2017), it provides limited insight into how these tools can be strategically configured to create synergies across different phases of collaborative processes according to the latter definition. This gap is particularly evident in the lack of theorization about the mechanisms through which the interaction of multiple governance factors generates outcomes that exceed the sum of their individual effects within the governance context of co-creation. In light of this theoretical and empirical gap, we pose the following research question: *how do different configurations of (meta)governance factors interact to create stable organizational contexts that support collaborative learning and innovation in co-creation processes*? In response to this research question, we advance the concept of *scaffolding* as a complementary definition to metagovernance, which operationalizes the configurational logic latent in the latter concept. We define scaffolding as the flexible and context-sensitive arrangement of complementary governance factors that collectively establish a stable organizational framework for co-creation.

Metagovernance *qua* scaffolding builds and extends upon the emerging body of research in collaborative governance that outlines on a 'laundry-list' of discrete governance factors, which are each known to be individually efficacious, to identify configurations of drivers and causal pathways that enhance collaboration (Molenveld et al., 2021; Mosley and Wong, 2021; Øjvind et al., 2024; Torfing et al., 2020). Scaffolding complements these research agendas by offering a relational-configurational theorization of metagovernance, that is, a coherent framework that accounts not only for the presence of individual governance factors, but for how they their cumulative layering work together in practice to support co-created learning and innovation. We evaluate the success of scaffolding based on its capacity to strengthen three complementary dimensions of collaborative learning and innovation: (a) reciprocal knowledge exchange and perspective transformation (input); (b) adaptive responsiveness to emerging needs and feedback (process); and (c) collective ownership and commitment to the collaborative process and its resulting solutions (output). To this end, we utilize an exploratory and abductive research strategy that draws on four successful case studies of locally co-created sustainability transitions from Denmark, Serbia, the United States, and Malaysia to analytically tease out how the differential configurations of five key governance factors has supported the three complementary dimensions of co-creation.

The article proceeds as follows. First, we review the three defining dimensions of co-creation that are crucial for promoting learning and innovation. Next, we elaborate on the need for metagoverning co-creation and introduce the concept of scaffolding in detail. After presenting the case study design, we compare the empirical findings across four cases, illustrating how various scaffolding configurations have facilitated co-created learning and innovation. The discussion problematizes the findings in relation to the extant literature on collaborative governance and transitions management, followed by a summarizing conclusion on the theoretical and empirical contributions of the article.

2. Theoretical context and framework

The broader literature on sustainability transitions has established that achieving transformative change depends on the capacity of diverse actors to develop and test alternatives (or niche-level experimentation) to established practices within so-called protective spaces, referring to organizational settings that shield sustainability innovations from selection pressures (Geels, 2011; Sengers et al., 2019; Smith et al., 2005). Co-creation represents a relevant institutional avenue through which such collaborative experimentation is organized, bringing actors together across sectoral boundaries to jointly develop solutions to complex sustainability challenges. The central mechanism through which co-creation contributes to these processes is the generation of collaborative learning and innovation (Ansell and Torfing, 2021): the reciprocal exchange of knowledge across actor groups, the iterative refinement of emerging solutions, and the consolidation of collective ownership that enables jointly developed innovations to gain traction. Nonetheless, while the transitions literature identifies learning and innovation as essential to transformative change, it tends to treat the governance of collaborative processes as a background condition rather than an object of sustained analytical attention. In response, the co-creation literature provides the micro-level complement by offering analytical tools for examining how these collaborative dynamics unfold in practice. Most notably, research on intermediaries and boundary work from the transitions literature on the one hand, and metagovernance from the network governance literature on the other, provide overlapping and complementary insights from two parallel perspectives on how actors mediate between different knowledge systems and introduce various (governance) interventions to facilitate collaborative learning and innovation (Halbwachs et al., 2025; Long et al., 2013; Meerkerk and Edelenbos, 2018; Smink et al., 2015).

2.1. The dimensions of collaborative learning and innovation

Co-creation, when construed as a process of collaborative learning and innovation, involves a complex, multi-layered social dynamic structured around collaborative problem-solving. Rather than relying on positional bargaining among stakeholders defending fixed interests, co-creation emphasizes the joint exploration of problems and solutions through structured interaction and mutual bargaining among diverse actors (Susskind and Field, 1996). Such joint exploration rarely unfolds as a linear process but instead involves multiple layers of collaborative interactions through which actors exchange knowledge, iteratively refine emerging ideas, and gradually build commitment to shared solutions. For analytical purposes, these dynamics can be analytically disaggregated into three dimensions, corresponding to the input, process, and output phases of collaborative problem-solving[1] (Table 1). The analytical framework illustrates how co-creation unfolds as an analytically structured, albeit stylized, sequence that captures the internal logic of collaborative problem-solving—from the initial exchange and transformation of knowledge (input), through the iterative and adaptive shaping of responses (process), to the consolidation of shared ownership and commitment to jointly developed solutions (output) .[2]

From an input perspective, a defining feature of co-creation is the meaningful engagement of diverse, relevant, and affected actors in processes of collective deliberation, design, and implementation to address shared problems (Torfing et al., 2019). In the context of sustainability transitions, such diversity is especially important, as these transitions typically require the reconciliation of competing priorities, values, and types of knowledge held by public, private, and civil society actors operating across multiple sectors and governance levels (Halbwachs et al., 2025). Co-creation fosters deliberative engagement that enables dynamic exchanges of knowledge, experiences, and situated perspectives, establishing the preconditions for collaborative (or social) learning. This form of learning is both a process and an outcome of shared inquiry, wherein actors engage in reciprocal knowledge exchange that fosters collective intelligence and greater preparedness for joint problem-solving. In co-creation settings, exposing assumptions and unsettling dominant ways of knowing can disturb entrenched regimes of practice and open space for new sustainability imaginaries and transition pathways to emerge (Ansell and Torfing, 2021; Wenger, 2000).

From a process perspective, however, the generation of collective intelligence does not mechanically yield innovative outcomes. Sustainability transitions often unfold under conditions of deep uncertainty, institutional inertia, and fragmented authority, meaning that ideas must be tested, refined, and anchored in practice to realize their transformative potential (Angeles et al., 2021; Chen-Florea et al., 2026). Transformative innovations—those that significantly alter existing structures, paradigms, or routines—require both knowledge generation as well as sustained joint effort to turn novel ideas into actionable outcomes. This demands a governance process marked by adaptive responsiveness, which is the ability to iteratively experiment, absorb feedback, and collectively make sense of changing needs and conditions (Wenger, 2000). In this context, iterative feedback loops are crucial levers of collaboration, allowing solutions to evolve in ways that align with both long-term transition goals and the situated concerns of actors. Such responsiveness ensures that innovation remains context-sensitive and incrementally aligned with shared objectives, enhancing both feasibility and impact of co-created sustainability solutions.

From an output perspective, a persistent challenge in sustainability transitions lies in sustaining ownership and commitment once the initial momentum of co-design wanes. Transition efforts often entail power shifts, resource reallocation, and normative realignments that may generate resistance or disengagement, particularly when the costs and consequences of implementation become more visible (A. L. Q. Chen and Hustad, 2025; J. Chen et al., 2020; Hartley, 2005). Participants may experience second thoughts or resort to strategic withdrawal, resulting in deadlocks that may cause the unraveling of collaborative gains built in the prior phases of co-creation (Bryson et al., 2006; Sørensen and Torfing, 2021). In such cases, the success of co-creation hinges on its capacity to build and sustain collective ownership and commitment beyond the design phase. This includes embedding accountability and responsibility into the governance architecture and investing in mechanisms of trust-building, recognition, and inclusive decision-making. When supported by the right governance structures, co-creation can thereby help overcome implementation barriers and anchor innovations in durable, long-term pathways for societal transformation[3] (Emerson et al., 2012).

2.2. Governance factors enabling metagovernance

Defined as 'the governance of (self-)governance' (Whitehead, 2003), metagovernance promotes the three dimensions of co-creation by designing and facilitating collaborative processes that subtly and indirectly incentivize, stimulate, and guide collaborative

[1] Table 1 zeroes in on the functionally distinct aspects of co-creation that are integral to learning and innovation, intentionally bracketing out subsequent phases—such as the scaling and diffusion of outcome— which lie beyond the immediate scope of this study.

[2] As a caveat, it must be noted that co-creation does not always follow a linear trajectory but often involves iterative cycles and feedback loops across the input, process, and output phases. The proposed framework thereby presents, to reiterate, a stylized representation of the progression from intangible learning to tangible innovations.

[3] However, it should be added that collective ownership among co-creation participants does not automatically translate into organizational anchoring. A persistent challenge in collaborative governance is that co-creation often unfolds at the operative level, while the adoption and implementation of co-created solutions depends on gatekeepers within participants' home organizations, such as municipal leadership, corporate boards, or civil society executives, who may not have been directly involved in the collaborative process (Klijn et al., 2025). The gap between collaborative agreement and intra-organizational adoption thus represents a scope condition for the output dimension as theorized here: our analytical focus is on the consolidation of collective ownership within the co-creation process itself, while recognizing that subsequent organizational anchoring introduces governance challenges that extend beyond the immediate collaborative setting.

Table 1
Dimensions of collaborative learning and innovation.

Dimension	Key features
Input: reciprocal knowledge exchange and perspective transformation	• Reciprocal sharing of expertise, insights, and beliefs • Broadens understanding through diverse perspectives • Encourages critical examination and evolution of viewpoints into shared insights • Lays the foundation for open dialogue, mutual learning, and collaborative problem-solving
Process: adaptive responsiveness to emerging needs and feedback	• Ongoing refinement through feedback loops. • Responsiveness to new information and evolving circumstances. • Facilitates the transformation of inputs into actionable outputs. • Balances flexibility with collaborative objectives.
Output: collective ownership and commitment to the collaborative process and its resulting solutions	• Alignment of individual interests with collective objectives by supporting the integration of diverse perspectives into a coherent agenda • Builds mutual investment in collaborative process, outputs, and outcomes. • Ensures a long-term commitment to transforming the collaborative learning processes into durable and actionable outcomes, especially in the implementation and maintenance phases

problem-solving between a network of diverse actors. A central premise in the extant literature is that fostering successful learning and innovation in collaborative networks depend on preserving a significant degree of network autonomy, since overly directive hierarchical control or excessively competitive market dynamics may impose rigid structures that result in a narrow focus on task execution or competition, which may, in turn, stifle the potential for collaborative learning and innovation[4] (Berthod and Segato, 2019; Thomson and Perry, 2006). To this end, metagovernance typically involves deliberate interventions, enacted by metagovernors, aimed at coordinating and steering collaborative processes towards their overarching objectives without imposing rigid control (Ayres, 2019; A. L. Q. Chen and Hustad, 2025), instead creating and shaping the organizational conditions that foster cooperation, joint motivation, and collaborative problem-solving (Emerson et al., 2012). In the context of sustainability transitions, metagovernors perform functions that parallel what the transitions literature terms intermediaries and boundary spanners, that is, actors and organizations that facilitate connections across institutional boundaries, mediate between different knowledge systems, and support the capacity-building required for collaborative experimentation (Halbwachs et al., 2025). The five governance factors examined below specify the concrete mechanisms through which this intermediary work is operationalized[5] (see Table 2), which have been consistently identified in the collaborative governance and co-creation literature as mechanisms shaping collaborative learning and innovation (Torfing et al., 2024). Theoretically, these governance factors exhibit discernible mechanisms through which input, process, and output dimensions of co-creation are expected to improve. Such governance factors can either operate at a distance, creating a supportive structural context that enable co-creation processes, or involve more direct, tactical interventions that involve the operational engagement between the metagovernors and participants to provide adaptive guidance to navigate collaborative obstacles as they arise (Sørensen and Torfing, 2009).

Purposefully constructing narratives that highlight successful multi-actor collaborations (1) can help to build shared values and ensure a principled engagement towards a shared mission (Emerson et al., 2012). Shared narratives provide interpretive frames through which participants can understand their roles, the collective purpose of the collaboration, and the broader significance of their contributions. In effect, they foster a shared goal orientation and emotional commitment that motivates actors to invest in joint problem-solving and remain engaged throughout the collaborative process (Orr and Bennett, 2016). Furthermore, by aligning expectations and identities around a common story of collective action, narrative construction strengthens the motivational base of collaborative learning and innovation.

Designing and instituting institutional arenas and institutional platforms (2) for collaboration provides a structured space and predictable context for multi-actor interactions. These platforms both reduce the transaction costs of collaboration by offering organizational templates and communication infrastructures, as well as establish continuity, clarity of roles, and procedural norms that make it easier for diverse actors to coordinate, deliberate, and sustain engagement over time (Ansell and Gash, 2018). By creating stable venues for deliberation and knowledge exchange, institutional platforms enable participants to share perspectives, integrate diverse forms of expertise, and iteratively refine emerging solutions, thereby supporting the learning dynamics central to co-creation (Ansell and Torfing, 2021).

Interventions aimed at the inclusion and empowerment of relevant and affected actors (3) are equally important for enabling co-creation processes. When some voices are marginalized, collaborative problem-solving becomes distorted and learning opportunities are reduced. Inclusion and empowerment therefore seek to create conditions for a "reflexive, participatory, and deliberative dialogue"

[4] Nevertheless, collaborative processes rarely occur in isolation from broader institutional environments. As several note, however, collaborative governance typically unfolds "in the shadow of hierarchy" (Scharpf, 1994; Whitehead, 2003) where formal authority structures may provide the institutional backdrop that enables network-based interaction. However, these background conditions are outside the scope of the analysis, insofar as they only indirectly provide the necessary conditions for co-creation to take place, rather than demonstrating concrete mechanisms through which collaborative learning and innovation is advanced.

[5] While the metagovernance scholarship commonly conceptualizes governance as a combination of hierarchical, market, and network modes (Jessop, 2016; Kooiman, 2003; Meuleman, 2008), the present study focuses specifically on governance factors associated with network governance, which are best at preserving the collaborative problem-solving capacities of co-creation processes.

Table 2
Overview of the governance factors.

Governance factors	Lever of influence
Construction of narratives about successful multi-actor collaboration (1)	Purposeful articulation of shared stories and missions to foster emotional connection, align interests, and build commitment to collaborative goals.
Building or harnessing institutional platforms and arenas (2)	Structured arenas or organizational templates that lower transaction costs and provide stable spaces for multi-actor coordination and deliberation.
Inclusion and empowerment of relevant and affected actors (3)	Strategies to engage relevant and affected actors equitably, enabling reflexive, participatory dialogue and harmonization of diverse interests.
Trust-building and conflict mediation (4)	Targeted interventions to manage uncertainty, build interpersonal trust, and de-escalate tensions that may hinder collaborative engagement.
Use of experimental approaches (5)	Iterative testing and adaptation (e.g., prototyping) of solutions through structured feedback loops that facilitate learning and avoid implementation failure

(Rist et al., 2007, p. 26) in which actors with diverse identities and experiences can articulate their interests, exchange perspectives, and negotiate shared understandings (Dunsire, 1993). Effectively, these interventions broaden the epistemic base of collaboration and enable the collective recombination of knowledge that underpins collaborative innovation (Anderson, 2006).

Trust-building and conflict mediation (4)—in the form of targeted interventions rather than an emergent and unintended outcome—are critical for improving collaborative dynamics by addressing interpersonal and intergroup tensions (Thomson and Perry, 2006). Trust-building functions as a mechanism to cope with the uncertainty and interdependence inherent in co-creation processes, fostering the confidence necessary for open information-sharing and joint problem-solving. Conflict mediation, in turn, refers to structured protocols and facilitative practices aimed at de-escalating disruptive tensions, clarifying misunderstandings, and restoring cooperative relationships among participants (Vangen and Huxham, 2003).

Finally, experimental approaches (5) can be leveraged to facilitate mechanisms for feedback through which participants can assess the progress of the collaborative endeavors and refine their goals over time (Ansell and Bartenberger, 2016; Sanders and Stappers, 2008). Practices such as prototyping, piloting, and iterative testing allow participants to translate emerging ideas into tangible experiments, generating practical knowledge about what works in specific contexts. By enabling iterative learning and adaptive refinement, experimental approaches help transform deliberative insights into actionable innovations while reducing the risks associated with implementation.

Empirical studies of co-creation corroborate that this set of governance factors are efficacious (Ansell et al., 2022; A. L. Q. Chen and Hustad, 2025; Emerson et al., 2012), although they conclude the success of metagoverning co-creation often require a combination of governance factors (Sørensen and Torfing, 2009, 2017). However, our knowledge of which particular configurations of governance factors affect the ability of co-creation processes to effectively foster learning and innovation is still theoretically underdeveloped. While the ideal assumption is that all governance factors should be present to maximize the chances of successful collaborative learning and innovation, this expectation does not match the concrete reality for a vast majority of co-creation initiatives. Under conditions of imperfections, however it is unknown whether all the governance factors are necessary conditions, or the absence of some can have a substitutive effects.

2.3. *Metagovernance as scaffolding*

Ansell and Torfing (2021) introduce the metaphor of scaffolding to describe organizational templates that help initiate, guide, and sustain co-creation processes. They define scaffolding as the use of preestablished guidelines, strategies, and organizational forms that reduce the transaction costs associated with collaboration (Ansell et al., 2022). This conceptualization highlights the generative role of scaffolding in removing institutional, cognitive, and relational barriers that often constrain the self-organizing capacities of diverse actors. However, parallel insights from educational psychology suggest that learning and innovation, hereunder within the context of co-creation, do not emerge necessarily simply because constraints are lifted; instead, they require purposeful and structured support. In pedagogical contexts, scaffolding serves to close the gap between what learners can accomplish independently and what becomes possible through guided assistance (Mercer, 1994). This involves building confidence, enhancing problem-solving skills, and cultivating the competencies necessary for joint exploration and practical application. Structured support mechanisms—such as guided instruction, prompts, feedback loops, and model-based learning—help learners approach complex tasks that would otherwise be beyond their independent reach (Malachowski et al., 2024).

The pedagogical aim of scaffolding is not to create dependency but to develop the capacity for independent, self-directed learning. This transformation—from passive knowledge acquisition to active engagement and implementation—is central to how scaffolding enables deep learning. This pedagogical logic has direct parallels in co-creation processes. Just as scaffolding in education supports learners without overriding their agency, scaffolding in collaborative governance aims to support co-creation without undermining the autonomy of collaborative networks. In both domains, the challenge lies in calibrating support to ensure that actors remain empowered, and that local initiative and ownership are preserved. The goal is not to impose solutions that stifle innovation potential but to provide enabling conditions for participants to navigate complexity and produce their own solutions through joint learning and experimentation.

In terms of differences, unlike classroom settings, where learning goals are typically aligned and authority is centralized, collaborative learning and innovation unfolds in contexts marked by bounded rationality, fragmented authority, and asymmetrical power

relations (Moyson et al., 2017). As a result, scaffolding in co-creation processes must be capable of not only enabling learning but also mediating heterogeneity, bridging institutional divides, and nurturing collective ownership despite diverging interests and power asymmetries.

While much of the extant literature on scaffolding and metagovernance conceptualizes support primarily in terms of discrete structures or tools (Ansell and Torfing, 2021), this view can be further advanced by focusing on how these support structures interlock and reinforce one another to form an integrated support system. According to educational psychology, rather than functioning as isolated mechanisms, scaffolding comprises interdependent governance factors that collectively create a stable organizational context for learning and innovation (Hammond, 2001; Mercer, 1994). Building on this insight, we conceptualize scaffolding as a complementary elaboration of metagovernance, which foregrounds the relational-configurational logic through which governance factors are aligned to sustain co-creation. While the metagovernance literature broadly acknowledges the strategic benefits of combining governance modes and instruments to advance co-creation processes (Torfing et al., 2024), it often lacks a substantive theorization of the mechanisms that make certain configurations more effective than the sum of their parts.[6] In response, introducing the concept of scaffolding serves the specific purpose of understanding how governance factors concretely interlock and generate interactive complementarities that support collaborative learning and innovation.

Consistent with a cumulative perspective on collaborative governance, interactive complementarities emerge when multiple forms of support are strategically aligned and layered to enhance each other's effects, resulting in a robust and context-sensitive framework for co-creation (A. L. Q. Chen and Hustad, 2025). In a similar vein, the relational-configurational perspective on scaffolding emphasizes that the effectiveness of governance tools depends on their strategic interplay and relative emphasis in fostering complementarities across the input, process, and output dimensions of co-creation (see Fig. 1). These complementarities operate on two integrated levels.

First, functional complementarities arise when governance tools perform distinct roles that amplify each other when combined. For instance, trust-building reduces interpersonal uncertainty (Nahapiet and Ghoshal, 1998), but its effects are magnified when paired with institutional platforms that offer sustained opportunities for interaction. In such settings, trust becomes embedded in shared routines, reinforcing mutual commitment and engagement. Similarly, inclusion and empowerment can expand the diversity of perspectives, but without experimental approaches that facilitate feedback and iterative refinement (Ansell and Bartenberger, 2016), this diversity may remain unstructured. Together, these mechanisms ensure that diversity is not a source of fragmentation, but a driver of adaptive problem-solving.

Second, functional complementarities are reinforced by institutional isomorphism based on the diffusion of similar collaborative structures, routines, and expectations across different governance tools. As DiMaggio and Powell (1983) argue, isomorphic pressures produce cognitive and normative alignment across otherwise distinct interventions, increasing the likelihood that governance factors will work in concert to improve collaborative dynamics. When multiple governance interventions draw upon overlapping norms of transparency, deliberation, and inclusion, they are more likely to reinforce each other and less likely to produce unintended friction or misalignment. This compatibility strengthens the interactive complementarities of scaffolding by enhancing institutional coherence across input, process, and output phases of co-creation[7] (A. L. Q. Chen and Hustad, 2025).

3. Methodology

3.1. Case selection logic

We assess the explanatory power of scaffolding through four successful case studies of co-created sustainability transitions (see Table 3). While all four cases exhibit successful outcomes, they differ significantly in the presence and configuration of the five governance factors, offering a methodologically apt setting for analyzing how distinct scaffolding configurations can lead to comparable successes in collaborative learning and innovation. By selecting cases that share successful co-creation outcomes but differ in their configurations of governance factors, the design provides an empirical basis for exploring which factors recur across cases and which appear context-dependent, supporting the subsequent theory-building distinction between necessary and contingent scaffolding developed in the findings (Seawright and Gerring, 2008). As a caveat, this exploratory logic does not permit strict causal isolation, as the cases also differ on multiple contextual dimensions; rather, it supports abductive pattern identification consistent with the study's theory-building ambition. By opting for a diverse case selection, characterized by high outcome similarity but differing scaffolding configurations, the study leverages comparative insights for its theory-building efforts into how complementary governance factors

[6] In the metagovernance literature, not applied to the context of co-creation, there are multiple attempts to theorize the interactive complementarity between various governance factors (Meuleman, 2008, 2019). However, they operate at a higher level of abstraction than the ones we outline, for which reason they do not directly map unto the context of co-creation.

[7] These complementarities can be interpreted as necessary conditions for effective and sustainable co-creation. The core challenges of collaborative governance—uncertainty, communication barriers, fragmented authority, and conflicting interests—are too multifaceted to be mitigated by any single governance tool. While individual governance factors may reduce specific frictions or enhance discrete aspects of collaboration, they often plateau when deployed in isolation. Without an interlocking and mutually reinforcing configuration, such discrete governance tools may lack the momentum or integrative function required to translate learning into innovation. A coherent scaffolding of governance factors, by contrast, provides the stability, flexibility, and adaptive capacity necessary to overcome coordination problems and steer collaborative processes toward shared and actionable outcomes (Ansell et al., 2022).

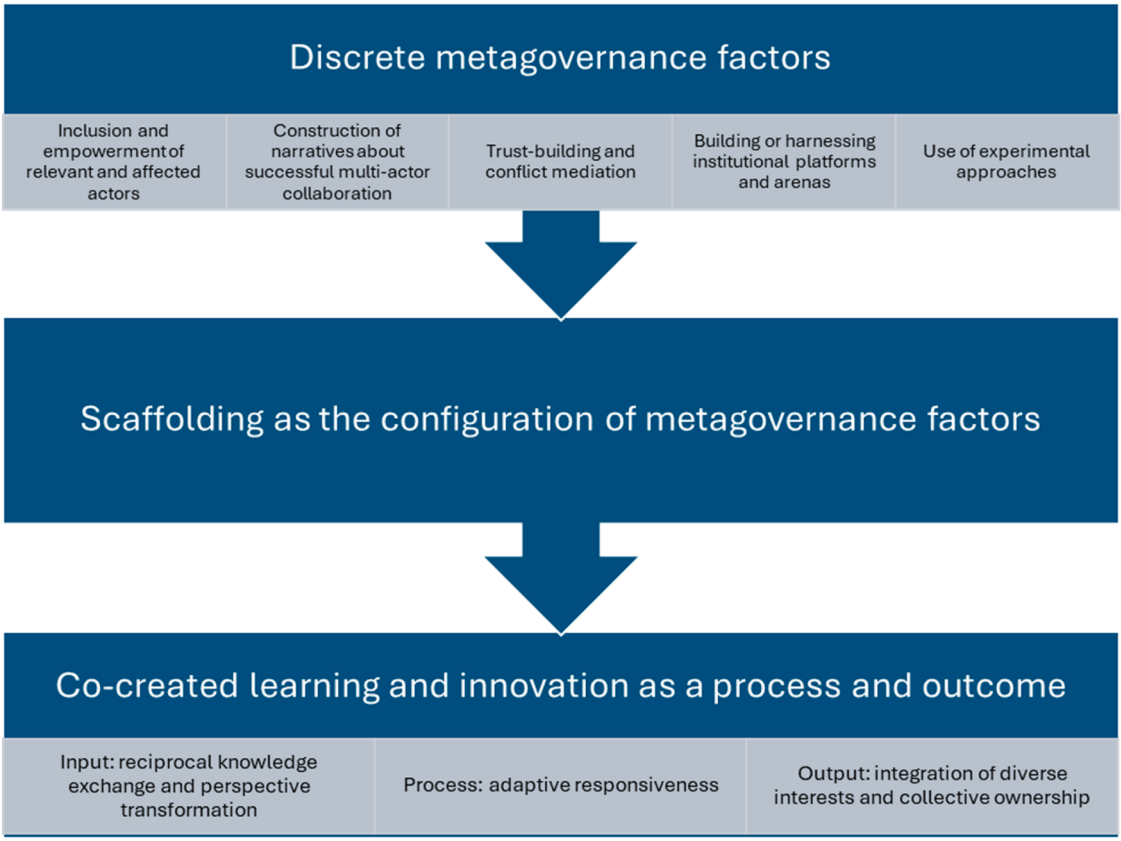

Fig. 1. The configurational perspective of scaffolding.

can be strategically assembled to stabilize and support co-creation across varied transition domains. Finally, the cases also qualify as diverse case selection strategy based on additional two dimensions of variations.

First, it maximizes variation across geographical and socio-political contexts insofar as the case analyses serve exploratory purposes to identify scaffolding configurations, capturing a diverse range of institutional, cultural, and environmental conditions relevant to sustainability transitions. Denmark's strong tradition of state-led environmental planning contrasts sharply with the market-driven and industry-led sustainability initiatives in the United States. Serbia, with its post-socialist legacy and growing grassroots activism, illustrates how decentralized energy communities emerge in contested governance settings. Maylasia highlights the complex task of balancing biodiversity conservation with urban development in a multi-ethnic society. Second, the cases span four distinct domains of sustainability transitions (housing, wildlife conservation, renewable energy, and agriculture), each characterized by unique governance contexts. This thematic diversity reflects the complexity of sustainability transitions, which require context-sensitive metagovernance strategies that can address competing stakeholder interests, regulatory fragmentation, and technical and distributive challenges (Balint et al., 2011; Meuleman, 2008, 2019). Consequently, comparing across such dissimilar settings serves a scope-broadening rather than a control function, in line with the abductive analytical strategy outlined below. Where comparable

Table 3
Overview of case studies.

Case name	The Roskilde Craftsmanship Dormitory	The Bridge to Co-exist	Sonoma County Winegrowers Electrification	Solarna Stara
Country	Denmark	Malaysia	The United States	Serbia
Period	2022–2027	2016–2024	2021 - 2023	2022–2023
Purpose	To co-design a sustainable and socially inclusive dormitory for craftsmanship students.	To develop a safe arboreal crossing for wildlife to foster a sustainable human-animal coexistence in the urban landscape.	To make grape growing more sustainable while also reducing production costs, through the electrification of work vehicles.	To advance sustainable energy production and provide local communities with economic benefits through solar energy.
No. of interviews	13	21	15	9
Observations	3 co-design workshops	5 seminars and information meetings	1 board meeting and 2 summits	2 site visits to the two villages

scaffolding dynamics are observed despite pronounced contextual differences (Lijphart, 1971), this provides provisional grounds for treating the identified patterns as potentially generalizable rather than artifacts of a single institutional or policy environment.

3.2. Data collection and analysis

Each case study synthesizes interviews, observations, documents, and survey data, enabling comprehensive triangulation of findings and enhancing the credibility, depth, and analytical robustness of the study (Gerring, 2004). This approach ensured that multiple sources of data and evidence were considered as part of the data analysis, enhancing its reliability, consistency, comparability, and depth. To analyze how different scaffolding strategies shape the three dimensions of co-creation, we employed an abductive analytical strategy (Tavory and Timmermans, 2014) based on a total of 58 interviews and 13 site visits and/or observations (see Appendix A for a list of informants). This approach enabled us to iteratively move between theoretical expectations and empirical observations, refining our understanding of scaffolding not as a fixed set of inputs, but as a variable causal configuration that mediates the relationship between governance factors and co-creation outcomes. Rather than treating scaffolding as an exogenous or pre-given variable, our abductive analysis focused on identifying the interlocking mechanisms through which governance factors were configured and layered to overcome case-specific barriers and enable sustained co-created learning and innovation. In practical terms, this meant tracing how different configurations of governance factors contributed to the strengthening (or in some instances, the relative weakening) of the three dimensions of co-creation.

The abductive analysis has concretely proceeded in three steps. First, each of the five governance factors was deductively coded based on established definitions from the literature. Second, we used abductive reasoning to identify how different combinations of these factors formed viable scaffolding configurations, focusing on their dynamic interplay and functional complementarities. Third, we conducted iterative cross-case comparisons to refine these insights, assess their contextual variation, and identify recurring scaffolding mechanisms that supported the three dimensions of co-creation (see Appendix B for an overview of the coding scheme). The abductive analysis is aligned with the broader traditions of abductive and interpretive research, where credibility and dependability—not formal replication—serve as the markers of rigor (Thompson, 2022; van Hulst and Visser, 2024). To ensure transparency and analytical robustness, our abductive coding process was rooted in collaborative sense-making. In effect, all cases were coded through team-based deliberation, with iterative discussion and agreement on code application and interpretation, enabling a reliable identification of mechanisms across highly diverse empirical contexts.

4. Findings

The analysis and findings are presented in two parts. The first part (Sections 4.1–4.4) offers a within-case analysis of the four case studies, examining how different configurations of governance factors interlock to form interactive complementarities and shape the three dimensions of co-creation. Each case is analyzed according to these dimensions—reciprocal knowledge exchange and perspective transformation (input), adaptive responsiveness (process), and collective ownership and commitment (output)—highlighting how specific governance factors function as scaffolding mechanisms. This mapping reveals how varying configurations influence the relative success of each case in fostering collaborative learning and innovation.

The second part (Section 4.5) builds on this by conducting a cross-case comparison, identifying recurring patterns and differences in scaffolding configurations across Denmark, Serbia, the United States, and Malaysia. This comparative lens allows us to evaluate four distinct scaffolding arrangements that created context-specific yet stable organizational conditions for co-creation. The cases are presented in descending order of relative success—based on composite scores across the three dimensions—illustrating how different combinations of governance factors contribute to co-creation outcomes in diverse institutional and cultural settings (see Table 4).

4.1. Roskilde craftsmanship dormitory

4.1.1. Case context

The Roskilde Craftsmanship Dormitory (*RCD*), launched in 2020 by BRFfonden, set out to design a socially inclusive and sustainable dormitory for vocational students under training as craftsmen in Roskilde's Musicon district. Key stakeholders included BRFfonden, the facilitation team Hele Landet, architects, artists, and approximately 35 craftsmanship students from Roskilde Technical School. Between 2021 and 2023, Hele Landet organized three intensive co-design workshops spanning 3 weekends with the aim of co-creating a design proposal for the dormitory, alongside complementary informational workshops on sustainable building

Table 4
Analytical progression of case studies based on the three dimensions of co-creation.

	Input: reciprocal knowledge exchange and perspective transformation	Process: adaptive responsiveness	Output: collective ownership and commitment
Roskilde Craftsmanship Dormitory	High	High	High
The Bridge to Coexist	Moderate-high	High	High
Sonoma County Winegrowers	Moderate	High	Moderate
Solarna Stara	Moderate	Moderate	High

materials, international study trips, and an architectural competition. As of 2024, the co-creation process has concluded with the selection of a final design proposal, which is currently under construction and expected to be completed by 2027. The final design meets the stringent requirements for DGNB Gold Certification and has garnered broad support from all participants, paving the way for its successful implementation.

4.1.2. Dimensions of co-creation supported by the scaffolding of governance factors

Reciprocal Knowledge Exchange and Perspective Transformation (Input): The co-creation was characterized by high levels of reciprocal knowledge-sharing through dedicated interventions to integrate insights from students and professionals (artists and architects) to advance a shared understanding of and commitment to sustainable design principles. An initial barrier to effective knowledge exchange with the purpose of co-creating dormitory design proposals was the disparity in expertise between the students and professionals. The students' limited experience in design, architecture, and sustainable building practices initially hindered their ability to participate meaningfully in the co-creation process, as they "found it difficult to envision abstract design ideas" (Student 1 & 2). In response, inclusion and empowerment (3) were necessary for bridging this knowledge gap, which involved the introduction of several interactive workshops that provided instructive tutorials on the utility and application of sustainable building materials and practices, all of which "rendered the abstract design ideas into tangible design options" (Project Facilitator 1). They also provided the students with a repository containing samples of different recycled building materials, which allowed them to tap into their tactile, visual, and olfactory senses. Consequently, the students were better equipped to contribute to the co-creation processes, as they "felt increasingly more confident in sharing and exchanging design perspectives" (Student 1 & 3). Trust-building and conflict mediation (4) further bolstered knowledge sharing by fostering an open atmosphere through communal activities and informal discussions, which minimized potential intimidation and encouraged the exchange of insights. Students felt that these socialization activities effectively bridged the social distance between their peers, as they quickly "managed to establish friendships and increased familiarity" (Student 4).

Adaptive Responsiveness (Process): The co-design workshops were organized around iterative feedback and prototyping cycles, which enabled adaptive improvements to the dormitory design that ensured gradual alignment with both sustainability goals and students' needs. The primary challenge to adaptive responsiveness was integrating the use of sustainable materials with the practical needs of students. The use of experimental approaches (5) proved helpful in overcoming this barrier, as it provided a structured procedure for prototyping and testing various design elements. Full-scale room mock-ups allowed the students and professionals to evaluate and modify the designs, making adaptive changes that reflected collective feedback. The students felt that this allowed them to articulate their interests more clearly through "continuous experimentation, which was both a fun experience and an enriching learning opportunity" (Student 3). Additionally, they also organized design workshops that involved student inputs that were transformed into collated design proposals, based on which iterative developments were made through sustained deliberations and further rounds of evaluation. In sum, this iterative cycle of feedback and revision was critical for aligning the dormitory layout with sustainability goals and student preferences. Institutional platforms (2) also played a significant role in supporting adaptive improvements, insofar as the workshops held in "a dedicated space within the Musicon district provided a consistent venue for collaboration, reinforcing participant engagement and enabling continuous learning" (Project Facilitator 2). The familiar environment bridged the gap between abstract theory and concrete practice, empowering students to contribute confidently and propose adjustments based on their lived experiences. Meanwhile, trust-building activities (4) buttressed the collaborative learning and innovation by promoting a supportive atmosphere, which was essential "for participants to feel safe to propose changes and navigate potential conflicts" (Project Facilitator 1).

Collective Ownership and Commitment (Output): The co-creation fostered a strong sense of collective ownership, supported by various calibration mechanisms that strengthened participants' commitment and aligned their contributions with the project's overarching goals. A significant challenge lay in balancing the professional norms and judgments of architects and artists with the students' interests and needs concerning livability and aesthetics as prospective tenants. The active role of experimental approaches (5) in soliciting inputs and the passive function of institutional platforms (2) in facilitating collaborative interactions created a complementary dynamic. Together, these mechanisms established channels for gathering input and enabled the continuous recalibration of diverse perspectives. This synergy reinforced broader efforts to promote inclusion and empowerment (3) by ensuring that all participants' contributions were not only acknowledged and integrated into adaptive improvements but also actively incorporated into the final design proposals to reflect a broad diversity of interests. Concurrently, the construction of narratives (1) further strengthened collective ownership by emphasizing the collaborative and community-focused nature of the project. These narratives "leveraged the Musicon district's history of inclusive and innovative urban planning" (Project Facilitator 2) and the collectivist ethos characteristic of Danish culture, motivating participants to commit to a shared vision of collaborative problem-solving.

Distillation of case insights: RCD stands out for its high performance across all three dimensions of co-creation and the presence of all five governance factors, which formed a complementary and interlocking relationship. Passive strategies—the construction of narratives (1), institutional platforms (2), and trust-building and conflict mediation (4)—lowered transaction costs, fostering an enabling environment for sustained collaboration. In turn, this reinforced inclusion and empowerment (3) and experimental approaches (5), which facilitated input solicitation, knowledge exchange, and participant commitment to the dormitory design. As a benchmark case, RCD illustrates how a strategically configured interplay between governance factors can scaffold co-creation. Its success provides a comparative reference for examining how different governance configurations influence the three dimensions of co-creation across the other case studies.

4.2. The bridge to co-exist

Case context: The Bridge to Co-exist (*BTC*) project was initiated by Langur Project Penang (LPP) in 2023 to mitigate arboreal wildlife roadkill and foster human-wildlife coexistence in Tanjung Bungah, Penang, Malaysia. This initiative arose amidst increasing urbanization and habitat fragmentation, which exacerbated conflicts between humans and wildlife. The primary objective and output of the project was to construct an arboreal bridge, enabling dusky langurs and other species to safely cross urban roads by reconnecting fragmented habitats, while also addressing prospective concerns over the perceived nuisance of such installations by residents. Key stakeholders included LPP, residents of Concord Garden, the Penang Public Works Department, the Department of Wildlife and National Parks, and international funders such as the Disney Conservation Fund and The Rufford Foundation. Regularized collaborative engagements, including workshops and community meetings, played a pivotal role in aligning stakeholder interests and gathering feedback, leading to iterative refinements of the project design. The project has culminated with the successful implementation of the first co-created Malaysian arboreal crossing (treetop canopy bridge), which bridges the urban and wildlife area based on a sustainable landscape approach.

4.2.1. Dimensions of co-creation supported by the scaffolding of governance factors

Reciprocal Knowledge Exchange and Perspective Transformation (Input): A significant barrier to collaborative learning was the entrenched perception among local residents that wildlife, hereunder dusky langurs, was a nuisance rather than a community asset. This skepticism arose from a knowledge gap about the arboreal bridge's potential benefits, which many assumed would increase disruptions caused by the local wildlife. To address this, LPP prioritized inclusion and empowerment (3) by engaging skeptical residents—especially senior residents, who were the most skeptical—through workshops that raised "ongoing awareness and engagement in the data gathering process" (Habitat Foundation Staff 1), engaging the residents actively in wildlife observation about the dusky langurs' habitat and behavior. The collaborative workshops served as venues where residents could engage in collaborative activities, such as mapping potential crossing sites aligned with both ecological functionality and the practical needs, routines, and priorities of local users of the landscape. These sessions created opportunities for residents to exchange personal experiences, enriching the project's knowledge base and shaping its direction. Residents were notably thereby transformed from passive bystanders into "informed stakeholders" (Langur Project Staff 1), who could share their valuable insights, providing them with a voice in not only the design of the canopy bridge but also in shaping the co-creation process itself. In parallel, narrative construction (1) played a critical role in reducing skepticism, as LPP highlighted the success of similar initiatives, such as the Teluk Bahang crossing, to reframe wildlife as "valuable members of the local ecosystem rather than nuisances" (Langur Project Staff 2). Presented in community forums and workshops, these narratives cultivated a shared purpose and indirectly fostered trust among participants. The combined efforts of workshops, narrative shifts, and data-gathering sessions not only reduced skepticism but also leveraged community input to enhance the bridge's design and cultivated a sense of collaborative spirit that enabled collaborative learning.

Adaptive Responsiveness (Process): The complexity of designing an effective and sustainable wildlife bridge that successfully aligned with both ecological and community needs presented a significant challenge, as ecological criteria for optimal placement often diverge from local land-use patterns and community priorities, necessitating iterative negotiation to reconcile these competing considerations. The use of experimental approaches (5) was critical in overcoming this barrier, whereby LPP employed a prototyping approach that experimented with various materials, such as repurposed firehoses to test for durability and safety, while also drawing upon the observational data gathered by the residents. This trial-and-error process allowed the team to iteratively refine the design based on feedback from both the community and ecological experts. Prototypes were evaluated in real-time "based on detailed specifications on, for example, the height [of the dusky langurs] and local landscape characteristics" (Langur Project Staff 2), and continuous adjustments were made to address issues raised by residents and align with the ecological data collected on wildlife movement. To this end, institutional platforms and arenas (2) also played a complementary role in facilitating this iterative design and prototyping process. For example, community centers and digital communication channels functioned as spaces where stakeholders could discuss design changes and provide feedback. These platforms ensured that the adaptive improvements were inclusive, allowing continuous input from all relevant and affected parties. In result, the project participants felt a sense of inclusion and empowerment (3), whereby they were meaningfully contributing to a continuously evolving collaborative project. LPP thus managed to create a responsive governance framework that adapted to evolving community needs and environmental considerations.

Collective Ownership and Commitment (Output): The integration and (re)alignment of diverse interests was one of the most challenging aspects of the project due to varying attitudes toward wildlife conservation. The construction of narratives (1) about successful collaborative efforts played a noticeable role in aligning these interests. By framing the project as part of a broader conservation movement and sharing stories of prior successes, LPP was able to inspire trust and cooperation among community members. These narratives positioned wildlife conservation as a shared responsibility and helped shift the perception of the dusky langurs from being a problem to a valued part of the local ecosystem by emphasizing both their ecological role in sustaining forest ecosystems and their cultural, symbolic, and potential economic value to local communities. These narratives successfully latched onto the consciousness of project participants insofar as the parallel efforts towards inclusion and empowerment (3) ensured that the community felt invested in the project's outcomes. Residents were not just consulted but actively involved in decision-making processes, which reinforced their sense of collective ownership. To this end, the institutional platform and arena (2) "centered around the local residential community center [also] provided a gathering space for anchoring local commitments to the project" (Habitat Foundation Staff 2), as the joint presence of many local stakeholders created a "collective effervescence" (see Durkheim, 1995)—or moments of strong shared emotional experience and feeling of belonging—that supported the organic consolidation and evolution of the narratives about successful the local community as a frontrunner in the conservation movement.

Distillation of case insights: BTC scores highly across all three dimensions of co-creation, demonstrating effective interest alignment and the integration of diverse perspectives. Notably, the project lacked dedicated trust-building and conflict mediation (4). Instead, trust emerged organically through the interplay of other governance factors—including transparent communication, inclusive engagement, and shared narratives—illustrating how trust can be cultivated indirectly through consistent, participatory practices that foster openness and a shared sense of purpose. The absence of this governance factor offers valuable insight into how a stable and viable organizational context for co-creation can still be achieved by leveraging the remaining four governance factors.

4.3. Sonoma county Winegrowers electrification

4.3.1. Case context

The Sonoma County Winegrowers (*SCW*) electrification pilot project, launched in 2021, represents an entrepreneur-driven co-creation initiative aimed at advancing sustainability within California's wine industry through the adoption of electric vehicles (EVs) in vineyard operations. *SCW*, a quasi-public agricultural organization promoting sustainable wine production, partnered with Ford Pro, a division of Ford Motors, and three local vineyard operators: Dutton Ranch, Bevill Vineyard Management, and Vino Farms. The co-creation processes centered on deploying electric vehicle prototypes, equipped with specialized software and charging solutions powered by solar panels. The project leveraged iterative feedback loops involving vineyard operators and Ford engineers to refine vehicle capabilities, reflecting a robust co-creation model where knowledge exchange, innovation, and stakeholder alignment were integral. The project concluded with the development of a successful proof of concept for the EVs, which has paved the way for their subsequent scaling to 45 prospective test farms.

4.3.2. Dimensions of co-creation supported by the scaffolding of governance factors

Reciprocal Knowledge Exchange and Perspective Transformation (Input): There was an initial skepticism among vineyard operators regarding the operational suitability of EVs for rigorously executing agricultural tasks. This barrier emerged from concerns over vehicle durability, battery life, and the feasibility of adapting existing workflows. Interventions to promote inclusion and empowerment (3) proved effective in addressing this perception bias, ensuring that vineyard operators played an active role in the co-creation process by conducting regular workshops, field visits, and participatory sessions. The President of SCW stressed that inclusion was crucial for ensuring success: "Without the farmer's support and commitment we can do nothing, for which reason we made sure to involve farmers in the project from day one and most notably by establishing three test farms that could be the center of the farmer-Ford Pro collaboration" (SCW President). These activities facilitated the exchange of technical insights from Ford engineers and practical field knowledge from farmers, allowing both parties to bridge the technical and practical gaps. In effect, this reciprocal knowledge exchange led to a mutual learning process where operators gained confidence in EV capabilities, while engineers adapted vehicle features to meet field-specific demands. *SCW*'s strategic use of practical, ground-level engagement ensured that reciprocal knowledge-sharing translated into meaningful perspective transformation.

Adaptive Responsiveness (Process): The adaptive features of the *SCW* pilot project were fundamental to addressing the integration of electric vehicles into vineyard operations, particularly in meeting the intensive demands of harvest seasons and rugged terrain. Experimental approaches (5) played a central role in meeting these demands, as Ford Pro engineers employed a trial-and-error strategy, testing prototypes under real-world conditions. A farmer explains that "they [Ford Pro engineers] spent three days with each of us at [the test farms], during which they watched how we harvested the crops" (Farmer 1). The iterative feedback gathered enabled targeted modifications, such as battery enhancements and software updates, ensuring the vehicles met operational needs, namely completing a full field run without recharging, with sufficient buffer to handle unforeseen contingencies. A defining characteristic of the *SCW* pilot was the absence of dedicated institutional platforms (2) for centralized collaboration. Instead, feedback mechanisms were embedded within the experimental approach (5), with workshops and field-testing facilitating communication and iterative improvements throughout the pilot project. This structure resulted in a fragmented coordination model whereby each farm engaged with Ford Pro in its capacity as lead organization in relative isolation, with limited lateral interactions between farms. Instead, the co-creation process was shaped by bilateral engagements between Ford Pro and each farm, based on which feedback loops were created. In this sense, coordination occurred across multiple centers of localized experimentation, with Ford Pro serving as central coordinating node, approximating a hub-and-spoke model of collaboration.

Collective Ownership and Commitment (Output): Balancing the diverse interests of *SCW*'s sustainability goals, Ford Pro's technological ambitions, and vineyard operators' focus on operational efficiency posed a significant challenge, as these priorities entailed trade-offs between environmental performance, technological development, and reliable, cost-effective day-to-day operations. The construction of narratives (1) played an integral role in aligning these interests, with *SCW* framing the electrification pilot as part of a Farm of the Future vision that resonated with the shared goal of sustainable and cost-effective farming. By embedding the project within Sonoma County's broader sustainability agenda, *SCW* cultivated a collective purpose that encouraged openness to new technologies centered around a 'Farm of the Future' narrative. Central to this narrative was to instill a sense of optimism by creating "a real chance of going on the offensive and wanting to be proactive" (SCW President) in combating global climate challenges. In parallel, inclusion and empowerment (3) further reinforced this alignment by ensuring vineyard operators had a meaningful role in decision-making. Their active participation fostered robust horizontal partnerships, enabling continuous dialogue and direct feedback that strengthened their sense of collective ownership over the co-creation processes and outcomes. Trust-building (4) complemented these efforts, with *SCW* fostering transparency, open discussions, and visible responsiveness to stakeholder concerns. Central to this trust-building has entailed "being brutally honest that things are going to go wrong and admitting that up front brings some humility to the whole practice" (SCW Vice President). This stakeholder-centric approach successfully integrated diverse interests, demonstrated

through joint investments in solar-powered charging solutions and a sustained commitment to expanding sustainable practices. Ultimately, collective ownership emerged as both an outcome and a driving force behind the collaborative learning and innovation embedded in the pilot project.

Distillation of case insights: Unlike the two prior case studies, this project has been characterized by a weak system of pluricentric coordination centered around Ford Pro and the three participating farms, which has minimized the need for a collective institutional platform (2) for collaboration. While the project scored relatively high across the three dimensions of co-creation, the reliance on a hub-and-spoke model with Ford Pro as the lead organization reveals potential barriers to both reciprocal knowledge exchange and perspective transformation (input) and collective ownership and commitment (output). Insofar as the project involves the three farms interacting with Ford Pro as a central coordinating entity, it has limited the full prospects of horizontal collaboration as exemplified in *RCD* and *BTC*. Nonetheless, the overall success of *SCW* reveals another viable configuration of governance factors that creates a stable organizational context for promoting collaborative learning and innovation.

4.4. Solarna Stara

4.4.1. Case context

The Solarna Stara (*SS*) project, launched in 2022 by the grassroots cooperative Elektropionir, aimed to establish solar energy as a sustainable alternative to the controversial mini-hydropower plants in Stara Planina, Eastern Serbia. Facilitated by Elektropionir in partnership with the Pirot municipality, the initiative engaged residents from the villages of Temska and Dojkinci, focusing on installing solar panels on public buildings and directing the revenue toward community-driven projects. The co-creation process centered on negotiating and coordinating interests among three key stakeholder groups to develop a viable organizational model for investing in and managing solar installations. The project's primary co-created output was twofold: (1) the successful installation of solar panels, and (2) the creation of an innovative legal-organizational model that enabled community ownership of energy resources. The latter model ensured that both the environmental and economic benefits of renewable energy remained within the community, reinforcing local self-sufficiency and sustainability.

4.4.2. Dimensions of co-creation supported by the scaffolding of governance factors

Reciprocal Knowledge Exchange and Perspective Transformation (Input): Elektropionir, the municipal authorities, and the two villages all had prior experience with sustainable energy transitions, particularly through local hydropower projects, providing them with relevant expertise in developing, implementing, and utilizing local renewable energy. However, the primary challenge lay in coordinating reciprocal knowledge exchange among stakeholders to develop a community-led energy solution that balanced their diverse interests. While *SS* lacked institutional platforms (2) and experimental approaches (5), Elektropionir nonetheless successfully facilitated a moderate level of reciprocal knowledge exchange by effectively leveraging mechanisms of inclusion and empowerment (3) through targeted engagement with municipal authorities and village communities with the aim of "building a real partnership with the local community" (Elektropionir Project Coordinator). Their input was iteratively but nonetheless systematically incorporated into decisions on solar panel installations and the development of a legal-organizational model for community ownership, which allowed Elektropionir to develop "close [relationship] with the City of Pirot and the local community" (Elektropionir Project Coordinator). In the absence of a formal collaborative space, Elektropionir assumed the role of mediator and central coordinator, consolidating stakeholder perspectives through direct engagement, including ad hoc site visits, informal meetings, and continuous communication with village representatives and municipal authorities. Meanwhile, all involved parties acknowledged that the unevenness of reciprocal knowledge exchange highlighted the limitations of relying solely on informal coordination. Despite these challenges, the initiative effectively fostered stakeholder engagement, demonstrating that carefully guided facilitation can still promote knowledge exchange and even serve a substitutive effect in the absence of structured experimental approaches or formal collaborative spaces.

Adaptive Responsiveness (Process): SS demonstrated a moderate level of adaptive responsiveness, largely driven by its strong reliance on inclusion and empowerment (3), which facilitated iterative feedback cycles through sustained communication between Elektropionir, municipal authorities, and village communities. Based on the inputs from the municipal authorities and village representatives, Elektropionir successfully refined the legal-organizational model underpinning the solar panel installations in response to emerging challenges and shifting stakeholder priorities. Due to the absence of institutional platforms (2), coordination occurred through bilateral channels, with Elektropionir engaging separately with each village and municipal actor. This hub-and-spoke configuration allowed Elektropionir to act as a lead organization aggregating inputs and mediating interests. This network-organizational dynamic meant that adaptive changes were neither systematic nor institutionalized but rather contingent on Elektropionir's discretion and organizational capacity to balance competing interests informally. In effect, this governance model also revealed several faultlines, as the absence of direct interaction among stakeholder groups constrained mutual learning and consensus-building across the broader network. Consequently, the project's adaptive capacity was shaped by its reliance on informal negotiation and intensive relational brokerage, investing significant time in cultivating and maintaining personal ties with municipal authorities and village communities by "understanding [their] struggles" (Citizen Representative 1). This proactive brokering of relationships functioned as a form of 'trust work', that is, a deliberate strategy to build rapport, credibility, and mutual confidence among actors.

Collective Ownership and Commitment (Output): Due to the project's dependence on Elektropionir's discretion and informal problem-solving capacity, trust-building and conflict mediation (4) played a critical role in reinforcing their legitimacy as the central coordinating entity. Recognizing the importance of maintaining stakeholder trust, Elektropionir prioritized sustained engagement, ensuring transparency through regular updates on project progress and fostering rapport "in anticipation of potential conflicts and disagreements" (Elektropionir PR Representative), while also strengthening commitment to the co-creation process by "create a sense

of hope and potential for ecological renewal" (Citizen Representative 3). Narrative construction (1) had a complementary function as it further reinforced collective ownership by framing solar energy as a continuation of local environmental activism and the region's pioneering role in sustainable energy transitions. This strategic framing was instrumental in securing and maintaining community support, highlighting the power of narrative framing in co-creation processes. This alignment encouraged residents to view the project as a shared responsibility, deepening their commitment beyond mere acceptance. Inclusion and empowerment (3) also played a critical role by ensuring that sustained communication between Elektropionir and village representatives gave residents confidence that their interests were adequately represented.

Distillation of case insights: SS achieved relatively high scores across the three dimensions of co-creation, largely due to its success in mobilizing local support for solar energy as a viable, community-driven alternative. The case demonstrates how inclusion and empowerment (3) can foster reciprocal knowledge exchange and adaptive responsiveness, compensating for the absence of institutional platforms (2) and experimental approaches (5). However, this flexible, decentralized approach also introduced certain limitations. Without formalized mechanisms for structured experimental approaches based on systematic deliberation or prototyping, adaptation relied heavily on Elektropionir's ability to sustain stakeholder engagement and manage evolving expectations. While the project successfully navigated logistical and regulatory challenges through informal coordination and ad hoc problem-solving, its dependence on a single coordinating entity underscores the potential constraints of relying on decentralized, unstructured forms of co-creation.

4.5. Comparative insights into the scaffolding of governance

The findings across the four case studies reveal both commonalities and variations, illustrating how different configurations of interlocking governance factors can establish stable organizational contexts for successful co-creation. Based on these patterns, we propose an analytical distinction between necessary scaffolding (NS) and contingent scaffolding (CS) (see Fig. 2). NS comprises two interdependent pillars and collectively refers to the foundational governance support structures that are indispensable for sustaining the core functions of collaborative learning and innovation. These governance factors span all three dimensions of co-creation (input, process, and output) and are consistently present across the four cases, indicating that they form a generalizable baseline for scaffolding effective co-creation processes that yield learning and innovation.

The first pillar includes one or more interlocking and complementary modes of collaborative engagement that institutionalize spaces and processes for reciprocal knowledge exchange and perspective transformation (input): experimental approaches (5), institutional platforms and arenas (2), and inclusion and empowerment (3). These mechanisms furthermore serve to connect distributed actors, facilitate sustained interaction, and ensure adaptive responsiveness to emerging needs and feedback (process) throughout the co-creation process.

The second pillar involves constructing narratives about successful multi-actor collaboration (1), serving as a centripetal force that integrates diverse interests, aligns identities, and fosters a shared sense of purpose. By articulating a unifying mission or vision, narrative construction mobilizes stakeholders by building alignment around a common agenda, which, in turn, reinforces collective ownership and commitment to both the co-creation process and its outcomes. These narratives thereby mitigate the centrifugal forces inherent in multi-actor collaboration by reframing co-creation as a shared endeavor—coalescing around a collective identity—thereby sustaining the commitment of participants to the collaborative processes in face of uncertainty (Emerson et al., 2012).

By contrast, CS refers to context-dependent governance support that is activated in response to situational challenges or constraints, thereby allowing us to highlight variation across cases (see Table 5). The key governance factor of CS is trust-building and conflict mediation (4), which operates as a 'social lubricant' by lowering transaction costs and smoothing communication (Nahapiet and Ghoshal, 1998). For example, in *BTC*, the use of compelling narratives (1) was sufficient to foster trust and alignment, even in the absence of dedicated trust-building interventions. This suggests that in high-trust and/or low-conflict settings, CS may play a smaller role, as alignment can be achieved through other governance factors without the need for targeted interventions. Narrative construction, when effective, can frame co-creation as a positive-sum endeavor, encouraging stakeholders to "work together to derive policies that maximize collective benefits" rather than "fight over the costs and benefits associated with policy alternatives in an attempt to maximize individual gains" (Mclaughlin et al., 2022, p. 545). However, we do not exclude the possibility that trust-building may become necessary in more adversarial political or institutional environments. In this respect, the activation of CS resembles the logic of situational leadership, where governance responses must adapt to the conditions and constraints of a given co-creation context (Hersey et al., 2013). In effect, CS should be construed as situational, inasmuch as its relevance depends on the presence of context-specific obstacles that threaten the stability of co-creation.

Across the four case studies, we observe that the combined presence of the three modes of collaborative engagement generates interactive complementarities that reinforce the co-creation process. However, these governance factors can also serve as functional substitutes, with each mode individually qualifying as CS. This suggests that even when only a subset of these governance factors is present, collaborative learning and innovation can still emerge, albeit with context-specific constraints that shape the process and its outcomes (see Table 6).

In *RCD* and *BTC*, all three collaborative engagement modes were present, resulting in high scores across the input, process, and output dimensions. This enabled sustained multi-actor interaction, feedback-driven refinement, and a robust sense of collective ownership of outcomes:

- Experimental approaches (5) provided structured settings for iterative learning and solution testing.

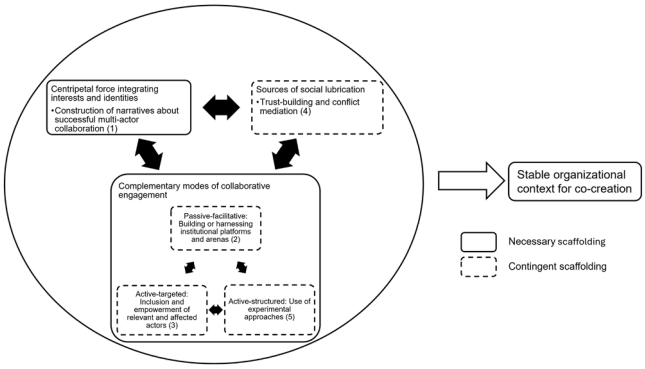

Fig. 2. The necessary and contingent scaffoldings.

Table 5
The scaffolding of governance factors across case studies.

	Roskilde Craftsmanship Dormitory	Bridge to Co-exist	Sonoma County Winegrowers	Solarna Stara
Construction of narratives about successful multi-actor collaboration (1)	Present	Present	Present	Present
Building or harnessing institutional platforms and arenas (2)	Present	Present	Absent	Absent
Inclusion and empowerment of relevant and affected actors (3)	Present	Present	Present	Present
Trust-building and conflict mediation (4)	Present	Absent	Present	Present
Use of experimental approaches (5)	Present	Present	Present	Absent

Table 6
Modes of collaborative engagement.

Governance factor	Characteristics
Building or harnessing institutional platforms and arenas (2)	Passive-facilitative: Creates enabling conditions for learning and innovation without directing the process
Inclusion and empowerment of relevant and affected actors (3)	Active-targeted: Emphasizes targeted measures to stimulate involvement, collaboration, and empowerment to drive collective learning and innovation
Use of experimental approaches (5)	Active-systematic: Uses deliberate, structured methodologies to achieve innovation and learning

- Institutional platforms (2) offered continuity in stakeholder interaction, even where they did not systematically integrate emergent insights.
- Inclusion and empowerment (3) enabled facilitators to make targeted interventions to address engagement barriers.

However, the role of inclusion and empowerment (3) varied across these two cases. In RCD, it was activated to overcome students' disengagement caused by the abstract nature of dormitory design. Facilitators introduced hands-on workshops and full-scale mock-ups to translate the abstract features of design processes into concrete, actionable activities that enable participation. In BTC, inclusion and empowerment were crucial when senior residents expressed skepticism about the project's local relevance. Through participatory wildlife observation and tailored engagement, facilitators fostered perspective transformation and local ownership, the synergy of which created interactive complementarities that explain the two cases' relative success in producing collaborative learning and innovation.

In SCW, the absence of institutional platforms (2) was compensated by inclusion and empowerment (3) and experimental approaches (5). These mechanisms fostered feedback and mutual adjustment through a hub-and-spoke model where Ford Pro acted as the central node and, by extension, lead organization. This demonstrates that institutional platforms are not strictly necessary for co-creation, as mutual adjustments and adaptive learning can still occur through sustained negotiation and communication facilitated by boundary-spanners or lead organizations within the collaborative network (Long et al., 2013; Pedersen et al., 2011). However, a hub-and-spoke model—where interactions are primarily mediated through a central coordinating entity rather than a shared institutional space—introduces potential limitations for system-wide learning. Structural gaps within the network may result in limited or infrequent lateral interactions between certain participants (Burt, 1992), reducing opportunities for horizontal knowledge exchange and cross-sectoral learning. This highlights the complementary role of institutional platforms (2), which—similar to narrative construction (1)—help build connectivity and distribute ownership across the network.

In *SS*, both institutional platforms (2) and experimental approaches (5) were absent. However, inclusion and empowerment (3)

were actively leveraged by Elektropionir to engage stakeholders, maintain communication, and ensure some degree of co-created learning and innovation. Notably, this governance factor was present in all four cases, suggesting its centrality in building the minimum participatory capacities needed for co-creation (Sørensen and Torfing, 2017). However, SS also reveals the fragility of relying on informal, ad hoc leadership. While Elektropionir succeeded in sustaining bilateral engagement with stakeholders, the absence of institutionalized mechanisms for coordination and iterative feedback left the scaffolding vulnerable. Without institutionalized channels to support ongoing coordination, the pillar of collaborative engagement might be left fragile and thereby risk undermining the overarching stability of the scaffolding.

5. Discussion

The cross-case comparison reveals that successful co-creation can emerge through distinct scaffolding configurations, provided that certain baseline conditions are met. The NS/CS distinction captures this pattern analytically, but several implications invite for further reflection.

A first observation concerns how characteristics of the policy domain may condition which scaffolding configurations are feasible. In the housing and wildlife conservation cases (BTC), the co-created outputs were spatially bounded and materially tangible, providing participants with concrete reference points around which iterative feedback and prototyping could be organized. This tangibility may partially account for the activation of all three collaborative engagement modes. In contrast, the energy transition case (SS) required co-creating an abstract organizational-legal model for community ownership, which offered fewer natural opportunities for structured experimentation and placed greater demands on relational brokerage. Finally, the agriculture case (SCW) exhibited a different dynamic, as the concentration of technical expertise on the Ford Pro side produced a hub-and-spoke structure rather than the pluricentric collaboration observed where domain-relevant knowledge was more evenly distributed. These observations suggest that properties such as the tangibility of co-created outputs, the distribution of relevant expertise, and the regulatory complexity of the policy field may shape which scaffolding configurations are necessary or feasible in a given setting. With one case per policy domain, however, these remain suggestive patterns rather than robust claims, which point toward a promising line of future inquiry.

A second observation concerns the relationship between scaffolding and the broader dynamics of sustainability transitions. While the collaborative governance and co-creation literatures, from which this study primarily draws, have extensively theorized the internal conditions for successful collaboration, the transitions literature offers a complementary perspective on how such collaborative processes relate to wider sociotechnical change. In the multi-level perspective, co-creation of the kind examined here operates primarily at the niche level, where protected spaces allow actors to experiment with novel practices and develop alternatives to incumbent regimes (Geels, 2011; Smith et al., 2005). Our findings qualify that scaffolding functions as the governance infrastructure that stabilizes these niche-level processes, providing the organizational conditions under which diverse actors can engage in the collaborative learning and innovation that transitions research identifies as central to niche development (Sengers et al., 2019). To this end, the scaffolding concept intersects with recent work on transition intermediaries, that is, actors and organizations that facilitate connections, mediate between different knowledge systems, and support capacity-building across institutional boundaries (Halbwachs et al., 2025). In particular, the metagovernors in our cases performed such intermediary functions, and the NS/CS distinction offers a way to differentiate between the baseline governance structures that intermediaries must establish and the situational interventions they deploy in response to context-specific challenges.

A final observation concerns how the scaffolding framework, as developed here, analytically focuses primarily on the internal governance dynamics of co-creation. However, the cases also point toward a challenge that the network and collaborative governance literature has long recognized, which concerns the downstream integration of the co-created solutions in the organizational hierarchies of participating entities (Klijn et al., 2025). Co-creation processes typically engage actors at the operative-collaborative level, yet the implementation of jointly developed solutions often depends on decision-makers who were not directly involved in the collaborative process, such as municipal leadership, corporate boards, or civil society executives. Our cases offer suggestive evidence in this respect that invites for further examination. In RCD, the final design garnered broad support and proceeded to implementation, but the mechanisms through which it was anchored in BRFfonden's organizational governance were not the focus of our analysis. In SS, Elektropionir brokered agreement with the Pirot municipality, yet the internal municipal politics of adopting the community ownership model remained largely outside the scope of the co-creation process as studied. This anchoring challenge occupies the boundary between the niche-level collaborative dynamics that scaffolding is designed to support and the broader regime-level embedding that the transitions literature identifies as essential for sustained sociotechnical change (Smith et al., 2005).

6. Conclusion

Given the inherent complexity of collaborative governance and co-creation, there is no one-size-fits-all approach to metagovernance. To be more precise, what is required is the "deliberative cultivation of a flexible repertoire (requisite variety) of responses" (Jessop, 2020, p. 75) tailored to the evolving conditions of specific co-creation processes. From this perspective, the scaffolding concept provides a valuable analytical lens to foreground the interactive complementarities among governance factors and to assess how context-dependent configurations enable or constrain collaborative learning and innovation. Our findings qualify the assumption that successful co-creation depends not only on the presence of individual governance factors but on how they are strategically configured.

Building on this configurational perspective, we propose a refinement in how scaffolding mechanisms are conceptualized. The mechanisms observed across the cases can be grouped analytically into NS and CS. This distinction has strategic implications for the

design and governance of co-creation processes. NS comprises core support structures that establish the foundational conditions for sustained collaborative learning and innovation. These governance factors should be prioritized, as they underpin the essential functions of co-creation across its input, process, and output phases. In contrast, CS refers to support mechanisms that are activated in response to specific contextual challenges, such as trust deficits, power asymmetries, or institutional fragmentation. Their relevance depends on the particular characteristics of the co-creation setting, requiring metagovernors to assess when and how they should be deployed. Construing scaffolding as a flexible and evolving configuration of governance factors, rather than a static set of best practices, enables a more responsive and context-sensitive strategy for facilitating co-created sustainability transitions.

As a broader research agenda, this configurational perspective on scaffolding opens several promising avenues of further research. First, the framework is well aligned with Qualitative Comparative Analysis, offering a way to examine larger-N datasets to identify equifinal pathways and necessary conditions (Ragin, 1987). While this study provides a proof of concept by identifying viable scaffolding configurations in four successful cases, future research can further explore variation in interactive complementarities, identify compensatory mechanisms, and test the robustness of the NS/CS distinction. However, given our exploratory, theory-building ambition and small-N design, the findings should not be interpreted as generalizable claims about co-creation in general. Instead, the value lies in conceptual innovation and the identification of configurational dynamics worthy of further empirical scrutiny.[8]

Second, the framework of co-creation structured around input, process, and output provides an effective heuristic for analyzing how learning processes translate into innovation. By distinguishing between reciprocal knowledge exchange, adaptive responsiveness, and collective ownership, the framework clarifies the internal dynamics of successful collaboration. However, a critical next step lies in theorizing how innovations emerging from co-creation processes scale beyond their original contexts. While the current framework identifies five key governance factors for enabling collaboration within bounded settings, the broader diffusion, adoption, and mainstreaming of co-created solutions introduces a new layer of challenges that likely require an expanded set of governance capacities[9] (Ansell and Torfing, 2021). Expanding the scope of co-created solutions introduces a unique set of challenges that, at first glance, require a different set of governance factors than the five hypothesized by the extant literature. At the stage of scaling, the primary barrier is no longer the facilitation of collaborative interactions among participants but rather the societal adoption of these innovations through effective diffusion channels (Breaugh et al., 2021).

Future research should thus explore what scaffolding strategies are needed to enable the scaling and social diffusion of co-created innovations, and how these strategies interact with established institutional and political structures (Ciulli et al., 2022; Wigboldus et al., 2016). To this end, it is necessary to engage with a wider repertoire of governance factors outside the five identified for this article. For example, Meuleman (2019) and Torfing et al. (2024) outline a larger toolbox of governance factors, or styles, which provide an analytical entry-point to theorize how governance can enable the sustained scaling of co-creation.

CRediT authorship contribution statement

Alexander L.Q. Chen-Florea: Writing – review & editing, Writing – original draft, Visualization, Validation, Resources, Project administration, Investigation, Conceptualization. **Eva Sørensen:** Writing – review & editing, Validation, Resources, Investigation. **Mohd Sallehuddin Mat Noor:** Validation, Resources, Investigation. **Rastislav Vrbensky:** Validation, Resources, Investigation. **Yoon Ai Chin:** Validation, Resources, Investigation.

Declaration of competing interest

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

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eist.2026.101148.

[8] The apparent conclusion seems to be that the 'safest bet' is to ideally check all boxes on metagovernance factors. However, this implicit assumption can also be problematized, as we have so far operated the concept of scaffolding under the assumption that certain configurations of metagovernance factors can result in interactive complementarities but have not mirrored the assumption that there might also be configurations with disruptive effects if not carefully balanced. For example, Page et al. (2023) underscore a trade-off between promoting unity for participant agreement and encouraging diversity to fuel innovation. While unity can enhance collaboration, it may inadvertently limit learning and innovation; conversely, fostering diversity can stimulate innovative ideas but may also lead to social tensions and conflicting interests. Thus, the effectiveness of metagoverning co-creation depends on a strategic balance of these tools, carefully navigating trade-offs to prioritize either effectiveness, democratic legitimacy, or innovation (Sørensen & Torfing, 2017). Further inquiry is thus warranted to examine if, and if so, under which conditions the co-presence of various metagovernance factors can have an adverse effect that stifles collaborative learning and innovation.

[9] Innovation can often be context-specific, representing a novel solution tailored to a localized challenge without needing to be groundbreaking on a broader, societal level. Even if a solution is not new in a global context, its application in an original, previously unaddressed setting, as exemplified by user-driven innovation, can still provide meaningful value by addressing specific needs within that environment (Hippel, 2005).

Data availability

The research protocol and case reports based on which the analysis has been developed can be accessed at https://www.gogreen-project.com.

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