Multi-level learning for systemic transformation: Experiences from an expedition in North Mid Sweden

Citation for the original published paper (version of record):
Williams, S., Holmén, J., Holmberg, J. (2024). Multi-level learning for systemic transformation: Experiences from an expedition in North Mid
Sweden. Environmental Science and Policy, 156. http://dx.doi.org/10.1016/j.envsci.2024.103740

Environmental Science and Policy 156 (2024) 103740

Contents lists available at ScienceDirect

Environmental Science and Policy

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

Multi-level learning for systemic transformation: Experiences from an expedition in North Mid Sweden

Stephen Williams *, Johan Holmén, John Holmberg

Chalmers University of Technology, Gothenburg, Sweden

ARTICLE INFO

Keywords:
Stakeholder learning
Sustainability transition labs
Sustainability transition
Evaluation
Regional innovation policy
Regional environmental policy

ABSTRACT

Learning is often a component, and sometimes an explicit goal, of sustainability transition projects. Despite a growing interest in designing, facilitating, and evaluating such exploratory initiatives with respect to their systemic, less work has focused on how such initiatives support learning and capacity-building among its partaking actors and institutions including building experimental governance capacity. In this paper, we aim to better understand how exploratory and experimental initiatives with transformative sustainability ambitions relate to and influence their partaking actors and institutions. We draw from the North Mid Sweden Challenge Lab, an initiative to adapt, test and learn a governance approach to navigate complex sustainability challenges and transformations. It was part of a high impact action within a pilot for regional industrial transition framed around experiments in governance and policy by the European Commission and Organisation for Economic Co-operation and Development, where peer-learnings by and between regions was stated as an explicit goal. We focus on the kind of learning and knowledge creation processes that occur in these open-ended and multi-levelled social interaction processes. In this paper, we empirically engage with such learning processes with a focus on governance capacity, based on direct experiences from its participating actors and related institutions. This study builds on and extends conceptual understandings of scaling, embedding and other types of strategies and diffusion mechanisms in sustainability transformations and transitions with a focus on learning. We conclude that conducting exploratory initiatives seems to have functioned in legitimizing open-ended, cross-sectoral purposeful activities of deliberation, learning and search. However, sending out and leading explorations is not the same as preparing for and working with procedures to scale, transfer, embed and institutionalise learnings and results to alter mainstream ways of governing for complex challenges and systemic change – all key elements in developing experimental governance capacity in response to sustainability challenges.

1. Introduction

Contemporary complex sustainability challenges and transformations invite us to learn new ways to purposefully navigate systems change (Scoones et al., 2020). Such efforts call for reflexive ways of working, acknowledging the interdependencies between modes of governing on the one hand and the nature of societal challenges on the other, aspiring to achieve coherence between the two (Pickering, 2019; Voß and Kemp, 2005; Rotmans et al., 2008). The shift to more reflexive modes of governing imply letting-go of a control-based logic into encouraging strategic processes of exploration, learning, search and upscaling capacities to institutionalise new ways of working and achieving systemic impact in relation to the width and depth of sustainability challenges (Loorbach et al., 2020; Lam et al., 2020; von Wirth et al., 2019). They increasingly hold a transformative sustainability ambition, taking the form of challenge-led and mission-oriented initiatives within experimental platforms, labs, or arenas, often within a wider frame of transformative innovation policy (Haddad et al., 2022; Diercks et al., 2019; Schot and Steinmueller, 2018).

Despite a growing interest in designing, running and evaluating such exploratory initiatives with respect to their systemic effects (Luederitz et al., 2017; Williams and Robinson, 2020; Holmén et al., 2022), less work has focused on how such initiatives support learning and capacity-building among its partaking actors and institutions. In this paper, we aim to better understand how exploratory and experimental initiatives with transformative sustainability ambitions relate to and influence their partaking actors and institutions. We focus on the kind of learning and knowledge creation processes that occur in these

* Correspondence to: Chalmers University of Technology, Gothenburg 41296, Sweden.
E-mail address: stephengarywilliams@gmail.com (S. Williams).

https://doi.org/10.1016/j.envsci.2024.103740
Received 13 July 2023; Received in revised form 13 March 2024; Accepted 22 March 2024
Available online 4 April 2024

open-ended and multi-levelled social interaction processes. In this paper, we empirically engage with such learning processes with a focus on governance capacity, based on direct experiences from its participating actors and related institutions. This study thus builds on and extends conceptual understandings of scaling, embedding and other types of strategies and diffusion mechanisms in sustainability transformations and transitions (Lam et al., 2020; Loorbach et al., 2020; von Wirth et al., 2019) with a focus on learning.

We draw from the North Mid Sweden Challenge Lab (NMS C-Lab), an initiative to adapt, test and learn a governance approach to navigate complex sustainability challenges and transformations. It was part of a high impact action within a pilot for regional industrial transition framed around experiments in governance and policy by the European Commission (EC) and OECD, where peer-learnings by and between regions was stated as an explicit goal. The NMS C-Lab intended to explore more transformative ways and alternatives to dominant ways of governing in a direction towards sustainability. The purpose of such an exploration is not only to explore new paths, develop new knowledge and ideas but also figure out how those can be transferred, institutionalized, scaled into mainstream institutions from a perspective of learning for lasting change.

2. Literature review

Multi-level governance, policy mixes and collective experimentation are considered key processes in response to grand societal challenges (Schot and Steinmueller, 2018; Haddad et al., 2022). Schot and Steinemuller argue that explicit learning platforms must be created for increasing the legitimacy of actions directed towards addressing grand challenges. This requires reflexive governance capacity to deliberately navigate systemic change with a (shared) sense of direction across various actor groups and levels.

Reflexive governance capacity can be understood as encompassing the following three components: (1) the capacity to recognise and frame contemporary challenges and anticipate future ones, including one's role in contributing to as well as ameliorating those challenges, (2) the capacity to reflect upon what conditions and changes are needed to address the challenges at hand, including negotiating desired direction of developments, and (3) the capacity to actually respond to societal challenges that cover both a re-orientation of institutional practices and values, and the initiation and capturing of learning from exploratory and experimental approaches into mainstream institutions (Pickering, 2019). From this understanding, reflexive governance capacity not only encompasses the ability to launch exploratory initiatives, in transition research often approached as labs, arenas, or experiments (Loorbach et al., 2017). However, it is important to remember that, as Broerse and Grin note, "ultimately it is the incumbent regime that has to change" (Broerse and Grin, 2017, p. 286). It is not enough to simply conduct experiments in governance not the arenas. This approach runs the risk of simply reinforcing existing structures.

To address this issue, labs and similar initiatives are often designed to support processes of learning that move beyond the boundaries of the lab itself, via various scaling and diffusion mechanisms (Lam et al., 2020). They can be understood to either implicitly or explicitly contribute to systemic change through (a) embedding lab practices into mainstream organisations, (b) translating lab practices and experiences to other challenge domains and contexts, and (c) scaling lab practices in terms of mobilising additional actors and resources and spreading results (von Wirth et al., 2019; Loorbach et al., 2022).

While learning is often considered a goal in Labs processes, it is important to clarify what type of learning is desired and occurs. In transition experimentation, learning is described as the "processes of obtaining and developing new knowledge, competence or norms and values'' by individuals, organisations and regimes, within a normative stance (Van den Bosch 2010, p. 232). In addition, social learning and interaction refers to "the sharing and integration of knowledge through enhanced communication between actors [and] to inter-relational learning and the consolidation of social networks oriented toward action through the development of collective activities and relational practices" (Ducrot, 2009).

Challenge Labs (Holmberg and Holmén, 2020) represent a specific form of learning-oriented governance innovation. This includes a set of methodologies designed to support new ways of thinking and doing oriented towards exploring alternatives, re-negotiating direction and influencing systemic innovation. Here, the lab intervention seeks to stimulate ways of thinking beyond (i.e. moving beyond existing systems into desired futures), thinking behind/below (i.e. identifying underlying causes, reasons and conditions of challenges rather than quickly moving to solutions), thinking broad (i.e. broadening attention from a narrow technical challenge to include e.g. social conditions and well-being), and thinking together (i.e. creating safe space for participants to build openness, trust and co-create). The Challenge Lab approach is framed within a *cruise ship-expedition* logic to distinguish between the kind of ordinary routine-based learning procedures happening at mainstream institutions (*cruise ship*), and the more open-ended purposeful, reformative and transformative, learning processes involving exploration, deliberation and search needed to figure out new future paths and alternatives (*expedition*) (Ibid. Cf. Bateson, 1972; Winter et al., 2015). The purpose of an expedition is to explore desired future paths and learn how those can be navigated then return with insights in terms of what works to the cruise ship to alter its mainstream activity (*docking*). Such approaches to institutional change open a risk-minimizing way of exploring implications of alternative ways of working in a small and safe setting. These explorations can then scale into mainstream organisations to alter their direction and practices. We return to this metaphor in our Discussion.

3. Methodology

3.1. Case description

The NMS C-Lab was designed as a multi-stakeholder participatory process to build capacity and facilitate regional industrial transition. The Lab hosted activities that sought to explore the role of hydrogen in realising a good life in North Middle Sweden through circular and low carbon industrial transformation. Guided by a backcasting methodology in which 25–30 stakeholders from various sectors took part, the lab was facilitated in a series of workshop-led steps with interim analysis work, collective reflection, ongoing monitoring and embedded evaluation. The project was financed by the European Commission as one of 10 pilot projects across the EU for industrial transition. Additional financing of the development of the NMS approach for industrial transition was funded by the Swedish Agency for Economic and Regional Growth (Tillväxtverket) with direct support from the regional council development administrations in Dalarna, Gävleborg and Värmland. Financing sources are relevant here as the EC had a particular emphasis on fudning learning projects. At the same time, regions contributed financial resources with the expectation of developing real-world transition projects that could be implemented locally. The geographical regions have a historically industrial economic basis amid several facets of transition - some purposeful, some from external contexts. After selection as a pilot project, the Lab design went through an evolution from a "general" energy transition lab to one focused on hydrogen. Holmberg's research group was engaged to co-design, facilitate, and evaluate the Lab. The C-Lab methodology (Holmberg, 2014; Larsson and Holmberg, 2018) was chosen both for its systems focus and to create a space for technical, social, and policy innovation as the lab designers felt that regional transition was a "complex issue too big for individual organizations. [We] needed to bring people and organizations together in new ways, use backcasting to explore transformative solutions and leadership for that" (Respondent 1).

The backcasting process in NMS C-Lab included formulating the

guiding question of the Lab, meta-question (in this case related to navigating the hydrogen transition), created space (e.g. ensuring commitment and connecting with ongoing processes) and selected actors (e.g. through identifying, mapping, and inviting key stakeholders). The Lab was organized as a set of four workshops with the following steps: (1) framing a sustainable and desired future on a level of principles, (2) analysing the present situation on a basis of the principles to illuminate gaps and challenges, (3) identifying leverage point interventions with (transformative) potential to bridge the gaps, and (4) strategic experimentation in leverage points. The workshops emphasised not only analysis and action in direct relation to governing systemic change, but put emphasis on building commitment, openness, and trust in the group through various exercises.

3.1.1. Lab design goals

The NMS C-Lab had ambitious goals. After the initial design sessions, the core challenge was described as "Exploring the role of hydrogen in realising a good life in North Middle Sweden through circular and low-carbon industrial transformation" (Douglas et al., p. 12) and the goals of the project were creating knowledge, enabling change, addressing the challenge, and building capacity (Ibid, p. 11). It is important to clarify that these goals were developed for the NMS C-Lab itself. The EC had its own goals in funding the pilot projects. For example, the EC had goals of "helping member states and regions implement reforms for jobs and growth" (Richter in Sandra, 2022) through experimental governance and supporting peer learning. The EC recognized that "while each region has its own policy mix, each region can learn from each other to find solutions, OECD/EC are ideal forums for knowledge exchange. Cities and regions learn best from their peers" (Morgan in Sandra, 2022). These different goals made their way into the project as, for example, regional administrations expressed that

> a big transition to more climate friendly production is very much needed for competitiveness, involving big companies and resources to reshape the innovation system for green transformation and help orchestrate it in partnership with regions (Respondent 1).

These divergent goals of different groups of stakeholders - sometimes mutually reinforcing, sometimes conflicting - will be explored further in our results section.

We also note that these goals map to our analytical concepts of content knowledge (goals 1 & 3) process knowledge (2 & 4) (see Section 3.2). For example, while not explicitly designed as a research project, learning and evaluation was embedded in the goals of the project from the beginning. This was desired as multiple levels for different reasons. As the project was funded as a pilot by the EC, there was a desire to learn about the Challenge Lab process itself and assess feasibility for use of the approach in different geographical and sectoral settings across the EC. There was also a desire to learn – and share – knowledge about the process across the three regions participating in the Lab. There was also a desire to foster – and capture – learning among and between participants. Finally, the design team committed to an iterative developmental evaluation approach whereby evaluation was embedded in the process. Evaluation happened at multiple points in the process with results and insights shared with participants and the design team which influenced design of the Lab.

3.1.2. Project actors

The project included four overlapping sets of actors: Lab participants, the Design and Facilitation Team, stakeholders from the three regions directly engaged in the project, and the European Commission. The boundaries between these actor groups were fluid within the project. For example, Lab participants are also part of wider organizations and institutions, facilitators were also part of regional administrations, and individuals took different roles over time.

3.1.2.1. Participants. Participants came from across the region with the majority from Gävleborg. Participants came from a range of sectors including small, medium, and large enterprises, research clusters/science parks, higher education institutions, and the public sector (see Fig. 1). Note that while total attendance was consistent across the four workshops, there was some variation in who attended each. Participants were selected to represent a cross-section of regional actors. We note that regional design team members were largely responsible for selection of project participants, not the research group.

3.1.2.2. Design & facilitation team. The lead designers were John Holmberg (Chalmers) [2] and Anna Douglas (Region Gävelborg). Additional design support was provided by a consultant originally engaged by the EC and members of the Chalmers research group. Facilitation was provided by representatives from each of the regions and volunteering participants. Facilitators were selected both for their current expertise and to support process learning and build capacity in experimental governance forms such as C-Lab. Note that building capacity (i.e. supporting process learning) within regions and the design team was an explicit goal of the project.

3.1.2.3. Regions. Three regions – Gävleborg, Dalarna, and Värmland - provided people, support, and participated in the design and facilitation of the project. These included people with roles and functions such as sustainability strategists, strategists for research and innovation, for regional development and growth, head of business and innovation, and innovation project leaders.

3.1.2.4. European commission. The pilot project was funded through the Directorate-General Regio - Regional and Urban Policy, the EC department "responsible for EU policy on regions and cities" (DG-Regio, 2023). The funding stream was designed to support regional industrial transformation through experiments in governance and stakeholder engagement. DG-Regio provided consultants to regions applying for funding (including NMS) and initial project design. In the NMS case, one of these consultants with experience in innovation policy continued to stay engaged with the project as part of the design and evaluation team. However, the EC was not directly involved with the NMS C-Lab during the project but conducted assessment in partnership with the OECD after the Lab and other EC pilot projects were completed (OECD, 2023).

3.2. Analytical methods

We followed a longitudinal intensive case study design (Yin, 1994; Bryman, 2012) utilizing action- and embedded research (Van de Ven,

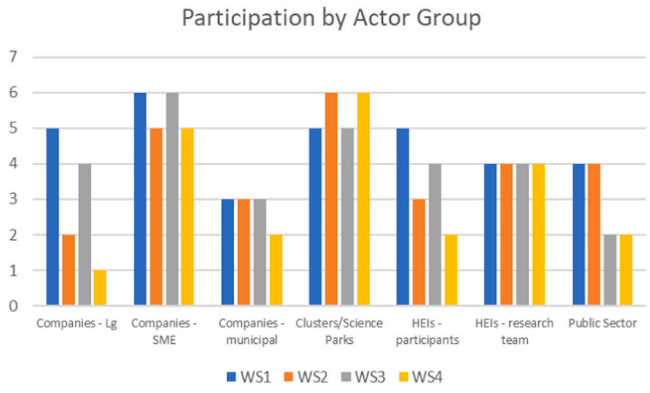

Fig. 1. Participation by Actor Group by Workshop (WS), Douglas et al. (2021).

[2] Researcher and institution names removed for peer-review process.

2007). Evaluation was embedded into the project to provide reflexive monitoring and evaluation for participants and project design team. This provided advantages in adapting evaluation tools and methods aligned to project improvement. However, the in-project evaluation focus was on participants, regions, and the design team but not the EU/OECD level. This analysis was added post-project by interviews with EC representatives, OECD consultants, and reviewing EC and OECD reports (see Appendix A: Interview Protocols). The history and design of the Lab was informed by review of design team meeting notes, personal experience of the authors as part of the design process, and interviews with the lead project organizer. Participant experience of the Lab was informed by a survey (n=17) and semi-structured interviews with Lab participants conducted at the mid-point of the Lab (n = 15). A second round of interviews conducted one month after completion of the Lab (n = 14) was supplemented by personal observations of the Lab process along with review of workshop agendas, facilitation guidance, workshop slides, and post-workshop "after action reviews" (See Appendix B: Supplemental Research Materials).

We approach learning in NMS C-Lab across two dimensions. The first is intended vs. emergent learning. Here we examine what learning intentions were for different categories of actors and compare with the emergent learning. This allows us to capture eventual unintended outcomes. The second dimension is content vs. process learning. Labs are usually oriented around a specific topic such as energy, health, transportation, food, creating general expectations that learning about that topic will take place – what we term as *content learning*. At the same time, Labs are inherently learning-oriented and aim to foster collaboration, understanding of different viewpoints and alternative futures, and new ways of working towards sustainability transition. This we term *process learning*. Learning in the Lab was assessed across the two above-described dimensions – intended vs. emergent and content vs. process. Comparing intended to emergent learning allows us to also surface unintended consequences of the project.

Finally, we investigate knowledge mobilization process across scales. We follow the same logic by examining intended dissemination (i.e., what strategies were put in place to facilitate knowledge mobilization) and emergent dissemination (i.e. how was knowledge shared, with whom, and with what outcomes).

Post-Lab outcomes and results were informed by official documents and presentations produced by the regions, interviews with Lab designers and facilitators from regions, and interviews with representatives from the European Commission and consultants (See Table 1 for Supplementary Research Material and Supplemental Materials 8.1 for Interview Protocols). Additionally, EC consultants produced reports on the pilot project. Finally, the EC and OECD facilitated an online Forum where representatives from the Region discussed the history and outcomes of the Lab (see Table 1 in Supplementary Research Materials)

4. Results

Different actors had different interests in types of learning. For example, most participants were interested in learning more about hydrogen and transition potentials in the region. The EC were more interested in learning from a pilot in regional industrial transformation that could be replicated in different contexts, with less interest in the specifics of hydrogen in NMS.

At the level of the Lab and participants, content learning goals were framed around "creat[ing] knowledge" and "address[ing] our challenge (Douglas et al., p. 11). Design team members (many who worked in regional governments) intended to learn about new ways of engaging a wider group of stakeholders to foster a sustainable regional industrial transition, and at the same time build capacity in the Challenge Lab process of engagement. Regions themselves hoped to build better relationships across stakeholders that have historically been disconnected and build capacity for further innovation and develop a regional Hydrogen Valley industrial ecosystem. At the EC, content learning

Table 1
Results Summary.

		Participants	Design Team	Regions	European Commission
Content Learning	*Intended*	Hydrogen Transition potentials in the region	New ways of engaging a wider group of stakeholders to foster a sustainable regional industrial transition	Build better relationships across stakeholders Build internal knowledge for further innovation Develop a regional Hydrogen Valley industrial ecosystem Application to domains beyond hydrogen	Learning how regions were approaching industrial transformation Build skills within regions to both apply for funding to support industrial transformation as well as implement innovative forms of governance
	Emergent	Learning about diverse perspectives and world views Increased confidence and commitment to sustainability transformation	Little observed		Little observed
Process Learning	*Intended*	Very little intended	How to design and facilitate C-Lab process independently	Build process and facilitation skills in the Challenge Lab process	Learn about the process by which regions apply for funding to support regional industrial transition How to adapt existing funding mechanisms to support regions Facilitate learning across regions through peer-peer learning
	Emergent	Co-creating sustainability vision Learning at level of values and principles learning about Lab processes such as backcasting	Building trust and relationships between disparate groups of stakeholders Building process knowledge, skills, and conditions for experimentation	Building trust and relationships between disparate groups of stakeholders Value of new people and perspectives Building process knowledge, skills, and conditions for experimentation Integrating C-Lab processes in regional development strategies;	Little observed

intentions were not as concerned with specific technological trajectories such as hydrogen but in learning how regions were approaching industrial transformation. In addition, the EC wished to build capacity (i.e. content learning) within regions with skills to both apply for funding to support industrial transformation as well as the capacities needed to implement innovative forms of governance.

A key element of Challenge Lab design is to foster new ways of thinking and doing in participating organizations. The Lab hoped to support concrete process learning in how to design and facilitate Challenge Labs but also to broaden awareness of the need for systemic approaches to regional sustainability transitions. This was articulated in the Lab goals as a desire to enable change and build capacity (Ibid, p. 11)

These process goals were primarily at the design team and regional levels. Participant learning intentions were more content focused although, as we describe below, they also demonstrated process learning. The EC intended to learn about the process by which regions apply for funding to support regional industrial transition and how to adapt existing funding mechanisms to support regions. In addition, the EC wished to facilitate learning across regions through peer-peer learning. Table 1 below summarizes intended and emergent learning across participant groups for both content and process learning. The following sections present evidence of content and process learning among different stakeholders and notes where differences occurred between intended and emergent learning.

4.1. Content learning

4.1.1. Participants

At the participant level, 57% of respondents (n=14) reported high levels of content learning about hydrogen specifically and new insights and perspective on energy/hydrogen transition while 7% reported limited or no new insights (see Fig. 2).

While participants expected to learn about the potential for hydrogen to technically support regional transition, many reported how their perspective had broadened. For example, one participant noted that:

Challenge Lab has reinforced my views that the energy transition is not just about technical change, but also requires changed individual/societal behaviours and new business models (Ibid, p. 29).

In addition to knowledge about hydrogen and transition, participants also reported higher levels of confidence and commitment to contributing to regional energy transition (see Fig. 3).

This is a critical element of learning in transitions. Content learning is important but without confidence in their own abilities, and commitment to transition, learning runs the risk of stagnating and remaining locked within participants without being mirrored in action.

Participants who demonstrated this learning and capacity continued, and started new, transition activities even after the lab was completed:

…the people who are involved are leading new processes. So, they're really like they're daring to say, let's do something different, which I think is the most fun thing to see. And they're daring to speak to new people (Douglas, 2021).

We explore the implications of this focus on *daring to speak to new people* in Section 5.3 on knowledge sharing and integration.

4.1.1.1. Design team. Members of the design and facilitation team, in particular members from regional governments have demonstrated learning and implementation of the content specific elements of regional hydrogen transition. For example, through "mobilization for a common strategy for industrial transition in NMS" (Douglas, 2021), development of shared industrial support programs across regions in NMS, and funding of hydrogen projects that emerged from the Lab and other funding calls. Alongside the interest in content learning was an awareness by the design team of the importance of process learning. For example, as the lead Lab designer notes, "instead of trying to predict a carbon reduction or you know, any of those, those things we focused much more on process and engagement" (Douglas, 2021).

4.1.1.2. Regions. Regions also reported substantial content learning in challenge-driven innovation. This learning was demonstrated through several extensions to the NMS C-Lab and additional activities. Alongside the Lab, there was a Seed Fund to provide up to €15.000 to project ideas that emerged from the Lab. The Fund provided resources for feasibility studies, customer research, and market research including electrification pilots. The Lead Designer notes that "those electrification pilots have been built up and many of them, all of the ones that are in the North Middle Sweden region, have inputs from Challenge Lab" (Douglas, 2021). Content learning at the regional level has been focused on these types of projects and in fostering cross-sectoral collaborations that emerged through participant learning about systems in transition. For example, with the

steel industry that must switch from natural gas and propane [that] looked at sectoral collaboration with transport sectors also using hydrogen [and] closer cooperation with wind power investors and production industry with common agenda (Respondent 1).

Regions have continued to support project ideas that emerged from the Challenge Lab. For example, in Region Gävleborg, "[there] was an opportunity to apply for projects to work with/implement the strategy – two projects [were] developed and financed" (Respondent 2). We also see evidence that learning has spread from the initial regional focus of Gävleborg into other regions. For example, in region Värmland, "one of the participants has started a massive hydrogen cluster on regional heating system to green hydrogen" (Douglas, 2021). This learning dissemination occurred organically through participation in the Challenge Lab and is a common occurrence in Labs (McCrory et al., 2022). In Section 5.3 we will investigate formal attempts for learning and knowledge sharing between stakeholders.

4.1.1.3. European commission (EC). Each region produced a technical report for the EC that, while possibly facilitating learning, was more focused on describing what had been done. When asked about EC learning from the projects, the EC representative commented "we would not be aware at a regional level" of Lab activities (Respondent 3). However, learning was supported by each region having a "closing event – one purpose was to present what had been achieved, another to share learning between different regions" (McCrory et al., 2022). The EC contracted with OECD consultants to conduct assessments leading to production of five case studies along with a report on the pilot project overall (OECD, 2023). In addition, the EC supported a conference with all regions invited as a knowledge sharing activity.

4.1.2. Intended and emergent learning

While all participant groups demonstrated content learning, project participants and regions also demonstrated emergent learning. Participants reported broadened perspectives in particular learning about perspectives of other participants and actors. Participants also reported higher levels of confidence in their ability to contribute to regional transformation and commitment to doing so. Regions reported learning about how learning within the NMS C-Lab can be applied to domains beyond the project focus of hydrogen. These areas of emergent learning have contributed to further actions taken by participant and regions for transformation. As we explore further in our discussion, experimental spaces such as Labs can be designed in a way that fosters learning beyond that which was intended.

4.2. Process learning

4.2.1. Participants

Participants reported process learning along three broad dimensions. The first was in learning about new approaches to defining sustainability

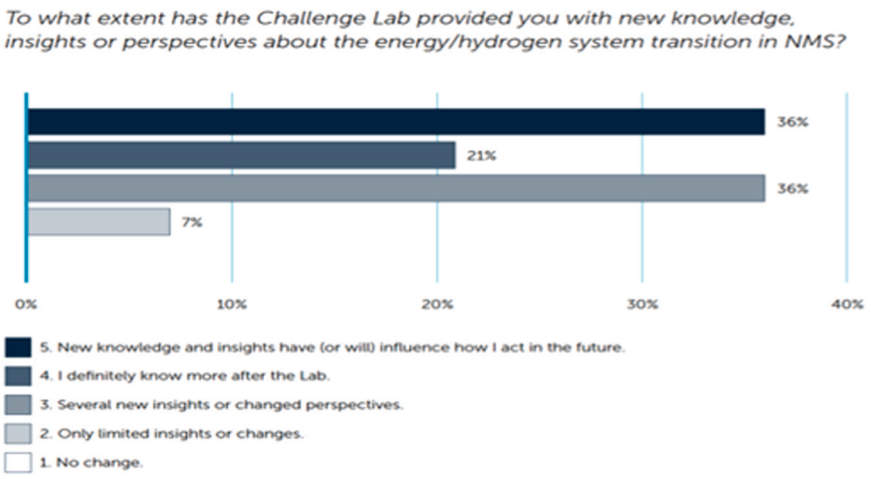

Fig. 2. Participant response re: new knowledge, insights and perspectives.

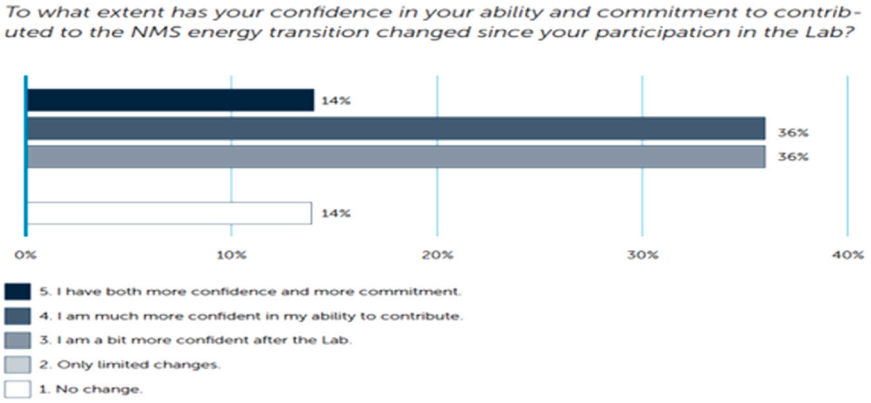

Fig. 3. Participant responses re: ability and commitment to energy transition.

and co-creating a long-term sustainability ambition for the future through the backcasting process. Second, participants reported learning at the level of values and principles. Primary about these was the value of engaging with "various actors from several geographies and sectoral/thematic perspectives to achieve a common goal" (Douglas et al., pp. 25–27). Finally, we note the potential of process learning to support deeper impacts. For example, "several participants reported plans to take inspiration from or use backcasting and some tools in their own organizations" (Ibid, p.24). However, further research is required to trace the long-term impacts of these examples of knowledge translation.

4.2.1.1. Design team. All members of the design team have reported process learning in engaging with sustainability challenges in the region. This has been implemented within regions by design team members. For example, referring to the value of the C-Lab process, one design team member reports their regional government is "stuck in former success in industrial thinking, affects our mindset, to get further on, we need to get out of that mindset to find new entrance points" (Respondent 1).

4.2.1.2. Regions. It is perhaps at the level of regions that we see greatest evidence of process learning. For example, the Logbook reported that

> we see initial signs of expedition transfer in the ongoing work to update Värmland's smart specialisation strategy, where there is a reformulation of regional smart specialisation towards sustainability, societal challenges and missions. (Douglas et al., p. 35).

In addition, regions report process learning in how Challenge Lab ideas and methodologies can be used to support new and different ways of approaching systems thinking and regional innovation. For example, "[region] Dalarna has started a comparable process [to C-Lab] in relation to development of transport infrastructure. The region has applied the backcasting methodology and process in the strategy development process" (Ibid., p.30). Another region is interested in standardizing the Challenge Lab approach as an entry point to innovation thinking. For example, in Region Gävleborg "when assembling people from the region with very different knowledges and opinions on addressing societal challenges" (Respondent 3). Further, another region reported how, through the Challenge Lab process, they had "discovered how to cooperate with big industry accelerators with startups that have been successful" (Respondent 1).

Regions also see potential in integrating Challenge Lab processes into new regional development strategies. For example, in the emerging Partnership for Regional Innovation (PRI) which is "very focused on business and enhancing competitiveness. But we have large societal issues. [EU] Green Deal shows we need another approach to societal challenges" (Respondent 2).

Finally, regions report a direct link between the Lab and development of experimental policy by "try[ing] new approaches to dealing with different challenges we have to increase our capacity" (Respondent 1). Crucially, regions report adoption and utilization of process learning in new projects that are not directly related to the NMS Challenge Lab. For example, one region reported that they have "used Challenge Lab tools to bring in new people/perspectives and bridge perspectives (within two ongoing research projects). By bringing in other actors in the system, the group can see with other lenses and gain additional wins" (Douglas et al., p. 30).

4.2.1.3. European commission. We also see some evidence that the EC has achieved its intended learning goals of better understanding (and improving) how regions can foster industrial transition. An EC representative, spoke of learning about the process of looking for new regional innovation strategies, not specifically from NMS but the 10 projects that were funded by EC. This has led to a "new generation of structural fund legislation" - the Inter-regional innovation instrument[3] - and was directly linked to pilot learning. [W]hat we learned from the pilot led to that" (Respondent 3).

4.2.2. Intended and emergent process learning

As with content learning, all actor groups demonstrated intentional process learning, i.e. learning about process that was an initial objective. However, participants reported emergent learning about the process of co-creating a sustainability vision, learning at the level of values and principles, and learning about Lab processes such as backcasting. Regions learned about the value of including new people and perspectives in engagement processes and how to integrate C-Lab processes in regional development strategies. Both of these learning outcomes went beyond their intended learning objectives.

4.3. Knowledge sharing and integration

Stakeholders put great emphasis on sharing their learning. For example, following the Lab, a webinar was organized by regional development administrations in Dalarna, Gävleborg and Värmland. 55 people attended the workshop to hear directly from participants, design team members, and regions about the Lab. The Lab also produced a Logbook that documented the design process, provided detail on how each workshop was facilitated, and results and outcomes of the Lab (Douglas et al., 2021). The EC enlisted consultants from the OECD to conduct assessments of the different pilot projects with the intention to share learning across the pilots. This was shared in an in-person workshop in Brussels on 18.11.22 and in an online workshop on 23.11.22 to support the EC intention of supporting peer learning. We note that learning at the EC level is continuing. At time of writing, the OECD is completing a case study on the NMS Challenge Lab that will be public and shared with other regions in the pilot project.

In addition to this intentional knowledge sharing, there was also considerable emergent knowledge sharing. For example, the consultants engaged by the EC to support NMS in developing the application have moved on to other projects, the original contact at the EC moved to a different department, and the lead process designer left their position in the region to move to a Swedish industrial company. In all cases, we may assume that they took their learning with them. In the context of this paper, we only have direct evidence from the lead process designer who has now left the regional government and is at a major industrial company in the region, reporting that they have

brought the approach of cruise ship/expedition [into the organization] and been quite successful…have applied in terms of strategic hedging…Ultimately has changed the strategy of the company with this approach [by] using as a description for exploring new territory (Respondent 2).

Finally, we note the inter-relationship between content and process learning. While the distinction is useful for analysis and reporting, as we have seen, there is a constant interplay between the two. Learning about *content* such as transitions, systems thinking, and technological possibilities of hydrogen is accelerated by *process* learning about deep engagement with stakeholders from different backgrounds and worldviews and building capacity for experimentation. While all actor groups demonstrated substantial content and process learning that was intended, our evidence shows more emergent learning within project participants and regions. This may be a result of the Design Team having a very broad set of intended learning so there was little "unexpected" learning. On the other hand, the EC had a very narrow set of intended learning objectives. Further research is exploring the role of institutional structures in facilitating and supporting emergent learning through experimental governance initiatives.

5. Discussion

While most labs emphasise learning and experimentation as instrumental to realise systems change, NMS C-Lab put learning and evaluation up front as explicit goals of the lab in finding new governance directions for a sustainable region. However, the different actor groups (i.e. within the process facilitators and hosts, partner organisations involved, the regional public authorities participating in NMS, and the EC) had different conditions, interests and understandings in what was to be learnt, how and why. This posed an interesting design challenge from the beginning to ensure that the methodology itself was learnt by its hosting organisation/facilitators and that effects spread beyond the scope of the expedition itself.

In our discussion, we explore two key insights from our analysis. First, the distinction between intended and emergent learning allowed us to tease out the differences in scales of intention and to understand how that intention was (or was not) realized. For example, while all stakeholders had learning as a goal, the *what* they intended to learn and what was actually learned varied widely. It was for example not intended or anticipated that the lead Lab designer would leave a regional government position to move to a corporation and embed thinking into a new organization. Here we further discuss the role of individuals in systemic change processes.

Second, we explore the phenomena of knowledge mobilization as practically referred to as *docking*, i.e. to not only succeed in exploring possible and desired future paths in through experimentation, but also ensure transfer and scaling of such learning and results into mainstream institutions. We explore this through our second analytical dimension of content vs. process learning that highlights the difference in intention and value in learning about, for example, technologies and processes for industrial innovation in hydrogen production and use in the region vs. processes for building trust and relationships between disparate groups of stakeholders.

5.1. Individuals and systemic change processes

A key insight from this research has been on the role of individuals in systemic change. For example, the effects of the lead process designer leaving a government role and moving to industry and the role of individual regional participants in implementing C-Lab methodologies in their institutions. Much transition literature puts societal systems as the primary unit of analysis and describes the roles of individuals in scaling innovation, understanding individuals as functional elements of an organization or intermediaries. On the other hand, transition management asks people to step out of their formal and institutionalised structures and roles to engage as persons with agential dispositions. What we observed in NMS C-Lab was the importance of distinguishing between and allowing for individuals to move between the functional and experimental logics with new lenses and enhanced sense of agency, bringing new thinking and actions inwards into partaking and other organisations, as well as outwards in societal systems by enacting sociotechnical change.

An implication for researchers is a need to understand the role of actors more deeply as individuals in transition processes respecting the complex interplays between structure and agency. Several authors (e.g. Smith and Stirling, 2007; Genus and Coles, 2008; Hodson and Marvin, 2010) have suggested paying closer attention to individuals in transition processes, but there is much less work on how to do so. Avelino et al. (2017) make such a call for distinguishing between individual and

[3] See https://ec.europa.eu/regional_policy/policy/themes/research-innovation/interregional-innovation-investments_en

organizational roles in analysis. Our case points to the importance of such work in understanding the linkage between individual and institutional roles.

Such an approach also has methodological significance for researchers and practical implications for process designers. In our case, we conducted surveys and post-workshop interviews with participants and design team members along with a smaller subset of follow-up interviews. To more fully understand how individuals are learning, sharing, and moving across and between institutions, more detailed methods should be used. For example, in a Canadian project Williams (2019) conducted interviews with process participants over a four-year period asking questions about knowledge sharing and action within and across organizations. In addition, an Actor-Network Theory (Latour, 2007) approach would give rich detail on individuals within a process in relation to other types of actants. However, these approaches come with a practical cost as these methods are very time intensive to conduct and analyze. For process designers, there is already substantial literature on building capacity for leadership in transitions processes in, for example, institutional entrepreneurs (Westley et al., 2011, Schlaile et al., 2021), transformational learning (Singer-Brodowski, 2023), and transformative leadership (O'Brien and Selboe, 2015; Senge et al., 2015). In our case, many facets of the C-Lab model (e.g. staying with the question, daring to think broader, building in personal check-ins) support capacity development in individuals. Our results imply that process designers should deepen attention to individual capacity while also supporting integration of experimental thinking within (and across) existing institutions.

5.2. Institutionalisation: docking procedures

A second point of discussion focuses on what we refer to as the docking procedures between an exploratory initiative such as NMS C-Lab and its surrounding mainstream institutions. Docking is intended to result in not only exploring and experimenting through Labs, but also embedding and institutionalising new ways of working in terms of, for example, new organisational culture, structure, practices, and values. Docking is inherently a multi-scalar phenomenon and can also be connected to mechanisms of replication, anchoring and organisational learning at large. However, it is not as straightforward to dock a single expedition with a single cruise ship. A cruise ship (e.g. an incumbent steel company) also needs to dock with the bigger system of which it is a part. The actors in the NMS C-Lab acknowledged the *need* to do this, but it is unclear to what extent such connections could be made. For example, while several regional participants mentioned they had implemented C-Lab methodologies in their stakeholder engagement processes, this had not changed overall governance policy. In a similar vein, while the EC did change policy related to regional industrial transformation, we see little evidence of changes in how the EC and OECD are thinking about innovation and sustainability transition. Regardless, docking acted as a guiding concept for stakeholder engagement, design and especially communications to create shared learning and understanding. This guiding concept feeds into the structuring and orientation of content and process learning to illuminate the importance of not only changing socio-technical systems but also their associated governance systems out of which all participating actors were part.

Added value from experimental approaches to sustainability transitions can thus be understood as flowing in these two directions. First, value is created in terms of learning about and responding to some outer complex challenge in its context – where impact is a matter of contributing to this challenge by focusing on translation and scaling of results. These impact mechanisms are those that are most commonly associated with systemic change (e.g. Loorbach et al., 2020; von Wirth et al., 2018). Second, exploratory initiatives also create value in terms of learning how complex challenges and transformations may be approached, understood, and addressed – where process impact becomes a matter of build-up of reflexive governance capacity. Here, building capacity to strategically work with expeditions for institutional change via a docking function may itself be considered a critical feature of a reflexive governance system with the capacity to continuously adapt and renew itself. While there are valid reasons for creating expeditions for innovation, experimentation, and innovation, the very act of creating these as separate initiatives creates the issue of how these expeditions will connect back to existing institutions. Crucially, it is not just knowledge that needs to be transferred for transformation but ways of thinking and doing – the logics of the cruise-ship.

Creating space for experiments, developing skills for facilitation, and engaging stakeholders are then both important for innovation and are also skills that can be learned. In our case, we see that participants and design team members did indeed learn these process skills even though that was not an explicit intention. An implication is that, as experimental spaces are designed, the spaces need to be open enough to allow – and even encourage – learning that was not intended. In further supporting docking to happen, it may be beneficial to not only stress that docking is important, but also create space, systems, and procedures for docking to happen as part of the design of an exploratory endeavour such as NMS C-Lab. A first step towards such may be to acknowledge that docking, as when switching between expedition and cruise, has its own unique logic and require a similar deliberate switch. This invites for further research to better understand docking in this analogy. Continuing research in our group is further exploring EC & OECD learning from the Regional Innovation Pilot projects including NMS C-Lab.

5.3. Evaluation

This leads to an additional area for further investigation: evaluation. The OECD and EC explicitly call for more use of "dynamic monitoring and evaluation systems" (Sandra, 2022) however evaluation is still primarily conceived as a compliance and audit tool for accountability, missing potential benefits as a learning tool. The authors have started this exploration (Williams et al., in review) distinguishing between evaluating for accountability, evaluating for learning, and evaluating for empowerment. However, more research is needed to understand how mainstream institutions view evaluation as a tool can support exploratory initiatives and docking procedures to flourish, rather than asking for evidence on effects that they never were designed to generate (Rohracher et al., 2023). For example, despite efforts to prepare for and trigger structural institutional change, it is our suspicion that changes in perspective and personal transformation may have a bigger impact on sustainability transition than the specific experiments emerging from sustainability transition labs. We welcome further research that can confirm or disprove our suspicions. Such research would put more emphasis on tracking the progress of individuals outside formal lab activities or question the way boundaries are set in labs (Cf. McCrory et al., 2022). This represents methodological as well as logistical issues. Capturing learning requires different methods based on the level of organisation and who is learning as learning and knowledge mobilization processes are very different at participant vs EC level. In this research project, we had to conduct some data gathering retroactively for regions and the EC to capture insights of relevance. In addition, we faced the challenge of making conclusions based on the data we found. There are likely stakeholders we did not talk to, policies we did not find, meetings we did not know about. This is a common challenge in assessing outcomes of participatory processes in open settings (Yin, 1994). However, the data we did find allows us to make preliminary claims about the relationship between intended and emergent learning, content, and process learning, and how learning transfers across scales in the kind of initiatives studied.

6. Conclusion

In our Introduction, we discussed the need for experimental

governance in response to global societal challenges. We see the results from our case as a sign that the NMS C-Lab may be a good model for developing this experimental governance capacity. We observed several indications that NMS C-Lab supported an increased awareness of contemporary challenges and pressures, in this context related to hydrogen transition and local-regional sustainable development issues, illuminated the gathering of multiple stakeholder perspectives, and envisioning desired futures. In terms of governance response, there are some indications of participants holding new lenses and perspectives resulting from the workshops, and some indications of re-articulated aims, values, and discourse. Signs are however weaker that those insights were docked and translated into wider institutional capacity-build up. Qq. While learning is a common outcome of Labs processes, the interplay between intended and emergent learning along with content and process learning represents a fruitful area of investigation for researchers and, at the same time, a valuable tool for Lab designers and practitioners.

In conclusion, in this paper we explored how an expedition unfolded from a perspective of intended-emergent and content-process learning among its participating and related actors and institutions. Framing exploratory initiatives as expeditions as complementary to ordinary cruise ship activity seems to have functioned in legitimizing open-ended, cross-sectoral purposeful activities of deliberation, learning and search. However, sending out and leading expeditions is not the same as preparing for and working with docking procedures to scale, transfer, embed and institutionalise learnings and results to alter mainstream ways of governing for complex challenges and systemic change – all key elements in developing experimental governance capacity in response to sustainability challenges.

CRediT authorship contribution statement

Johan Holmén: Writing – review & editing. **Stephen Williams:** Conceptualization, Investigation, Methodology, Supervision, Writing – original draft. **John Holmberg:** Writing – review & editing.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Stephen Williams reports financial support was provided by Family Kamprad Foundation.

Data availability

Data will be made available on request.

Acknowledgements

The authors gratefully acknowledge the financial support from the Family Kamprad Foundation, who had no involvement in the study. We also wish to thank Gavin McCrory for help with initial framing and structure of the paper. Finally, we wish to thank the Lab facilitators and participants for their time in reflecting on their experience.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.envsci.2024.103740.

References

Bateson, G., 1972. Steps To An Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology. Aronson.

Broerse, J.& Grin, J. (2017). The future of health systems: beyond the persistence of contemporary challenges. In *Toward Sustainable Transitions in Healthcare Systems*. Eds. Broerse, J.& Grin, J. pp. 261-286. Routledge.

Bryman, A., 2012. Social Research Methods, 4th ed. Oxford University Press.

DG-Regio (2023). Directorate-General Regio - Regional and Urban Policy. Retrieved from https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/regional-and-urban-policy_en.

Diercks, G., Larsen, H., Steward, F., 2019. Transformative innovation policy: Addressing variety in an emerging policy paradigm. Research Policy 48 (4), 880–894.

Douglas, A., 2021. McCrory, G. (Producer). Leadership Lecture 6, Course Leadership for Sustainability Transitions (Zoom). Chalmers University of Technology.

Douglas, A., Holmberg, J., Holmén, J., Williams, S., Wise, E. (2021) Challenge Lab NMS Log Book: Exploring the Role of Hydrogen in Realising A Good Life in North Middle Sweden through Circular and Low Carbon Industrial Transformation. Retrieved From https://www.researchgate.net/publication/360835978_Challenge_Lab_NMS_Log_Book_Exploring_the_role_of_hydrogen_in_realising_a_good_life_in_North_Middle_Sweden_through_circular_and_low_carbon_industrial_transformation.

Ducrot, R., 2009. Gaming across scale in peri-urban water management: contribution from two experiences in Bolivia and Brazil. Int. J. Sustain Dev. World Ecol. 16, 240–252. https://doi.org/10.1080/13504500903017260.

Genus, A., Coles, A.M., 2008. Rethinking the multi-level perspective of technological transitions. Res. Policy *37* (9), 1436–1445.

Haddad, C.R., Nakić, V., Bergek, A., Hellsmark, H., 2022. Transformative innovation policy: a systematic review. Environ. Innov. Soc. Transit. 43, 14–40.

Hodson, M., Marvin, S., 2010. Can cities shape socio-technical transitions and how would we know if they were? Res. Policy *39* (4), 477–485.

Holmberg, J., 2014. Transformative Learning and Leadership for A Sustainable Future: Challenge Lab at Chalmers University of Technology. In: Corcoran, I.P.B., Hollingshead, B.P., Lotz-Sisitka, H., Wals, A., Weakland (Red.), J.P. (Eds.), Intergenerational Learning and Transformative Leadership for Sustainable Futures. Wageningen Academic Publishers, pp. s. 91–102. ⟨http://www.wageningenacademic.com/doi/pdf/10.3920/978-90-8686-802-5_4⟩.

Holmberg, J., Holmén, J., 2020. Medskapande omställningsarbete: backcastingexpeditioner för agenda 2030. Sver. Kommune och Reg.

Holmén, J., Williams, S., Holmberg, J., 2022. Comparing sustainability transition labs across process, effects and impacts: insights from Canada and Sweden. Energy Res. Soc. Sci. 89, 102522 https://doi.org/10.1016/j.erss.2022.102522.

Lam, D.P.M., Martín-López, B., Wiek, A., Bennett, E.M., Frantzeskaki, N., Horcea-Milcu, A.I., Lang, D.J., 2020. Scaling the impact of sustainability initiatives: a typology of amplification processes. Urban Transform. 2 (1) https://doi.org/10.1186/s42854-020-00007-9.

Larsson, J., Holmberg, J., 2018. Learning while creating value for sustainability transitions: the case of Challenge Lab at Chalmers University of Technology. J. Clean. Prod. 172, 4411–4420. https://doi.org/10.1016/j.jclepro.2017.03.072.

Latour, B., 2007. Reassembling the Social: An Introduction to Actor-Network-Theory. Oxford University Press, Oxford.

Loorbach, D., Frantzeskaki, N., Avelino, F., 2017. Sustainability transitions research: transforming science and practice for societal change. Annu. Rev. Environ. Resour. *42*, 599–626.

Loorbach, D., Wittmayer, J., Avelino, F., von Wirth, T., Frantzeskaki, N., 2020. Transformative innovation and translocal diffusion. Environ. Innov. Soc. Transit. 35, 251–260. https://doi.org/10.1016/j.eist.2020.01.009.

Luederitz, C., Schäpke, N., Wiek, A., Lang, D.J., Bergmann, M., Bos, J.J., Burch, S., Davies, A., Evans, J., König, A., Farrelly, M.A., Forrest, N., Frantzeskaki, N., Gibson, R.B., Kay, B., Loorbach, D., McCormick, K., Parodi, O., Rauschmayer, F., Westley, F.R., 2017. Learning through evaluation – A tentative evaluative scheme for sustainability transition experiments. J. Clean. Prod. 169, 61–76. https://doi.org/10.1016/j.jclepro.2016.09.005.

McCrory, G., Holmén, J., Schäpke, N., Holmberg, J., 2022. Sustainability-oriented labs in transitions: an empirically grounded typology. Environ. Innov. Soc. Transit. *43*, 99–117.

O'Brien, K., Selboe, E. (Eds.), 2015. The Adaptive Challenge of Climate Change. Cambridge University Press.

OECD, 2023. Regional Development & Public Investment. Retrieved from. https://www.oecd.org/regional/multi-level-governance/mlgpublicinvestment.htm.

Pickering, J., 2019. Ecological reflexivity: characterising an elusive virtue for governance in the Anthropocene. Environ. Polit. 28 (7), 1145–1166. https://doi.org/10.1080/09644016.2018.1487148.

Rohracher, H., Coenen, L., Kordas, O., 2023. Mission incomplete: Layered practices of monitoring and evaluation in Swedish transformative innovation policy. Sci. Public Policy *50* (2), 336–349.

Rotmans, J., Loorbach, D., 2008. Transition Management: Reflexive Governance of Societal Complexity through Searching, Learning and Experimenting. In: van den Bergh, I.J.C.J.M., Bruinsma (Red.), F.R. (Eds.), Managing the Transition to Renewable Energy: Theory and Practice from Local, Regional and Macro Perspectives (s. Edward Elgar, pp. 15–46.

Sandra, H., 2022. International Forum on Regions in Industrial Transition. Organisation for Economic Co-Operation and Development.

Schlaile, M.P., Urmetzer, S., Ehrenberger, M.B., Brewer, J., 2021. Systems entrepreneurship: a conceptual substantiation of a novel entrepreneurial "species. Sustain. Sci. *16* (3), 781–794. https://doi.org/10.1007/s11625-020-00850-6.

Schot, J., Steinmueller, W.E., 2018. Three frames for innovation policy: R&D, systems of innovation and transformative change. Res. Policy 47 (9), 1554–1567.

Scoones, I., Stirling, A., Abrol, D., Atela, J., Charli-Joseph, L., Eakin, H., Ely, A., Olsson, P., Pereira, L., Priya, R., van Zwanenberg, P., Yang, L., 2020. Transformations to sustainability: combining structural, systemic and enabling approaches. Curr. Opin. Environ. Sustain. https://doi.org/10.1016/j.cosust.2019.12.004.

Senge, P., Hamilton, H., Kania, J., 2015. The dawn of system leadership. Stanf. Soc. Innov. Rev. 13 (1), 27–33.
Singer-Brodowski, M., 2023. The potential of transformative learning for sustainability transitions: moving beyond formal learning environments. Environ. Dev. Sustain. 1–19.
Smith, A., Stirling, A., 2007. Moving inside or outside? Objectivation and reflexivity in the governance of socio-technical systems. J. Environ. Policy Plan. *8* (3-4), 1–23.
Van de Ven, A.H., 2007. Engaged Scholarship: A guide for Organizational and Social Research. Oxford University Press on Demand.
Van den Bosch, S, 2010. Transition experiments: exploring societal changes towards sustainability. Erasmus Universiteit Rotterdam.
von Wirth, T., Fuenfschilling, L., Frantzeskaki, N., Coenen, L., 2019. Impacts of urban living labs on sustainability transitions: mechanisms and strategies for systemic change through experimentation. Eur. Plan. Stud. 27 (2), 229–257. https://doi.org/10.1080/09654313.2018.1504895.
Voß, J.-P., Kemp, R., 2005. Reflexive governance: learning to cope with fundamental limitations in steering sustainable development. Futures 39.
Westley, F., Olsson, P., Folke, C., Homer-Dixon, T., Vredenburg, H., Loorbach, D., Van Der Leeuw, S., 2011. Tipping toward sustainability: emerging pathways of transformation. Ambio *40*, 762–780.
Williams, S., 2019. University of British Columbia. In: The splash and the ripples: assessing sustainability transition experiments. Vancouver, Canada. Retrieved from. https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0383246.
Williams, S., Robinson, J., 2020. Measuring sustainability: an evaluation framework for sustainability transition experiments. Environ. Sci. Policy Volume 103, 58–66.
Winter, J., Cotton, D., Hopkinson, P., Grant, V., 2015. The university as a site for transformation around sustainability. Int. J. Innov. Sustain. Dev. 9 (3–4), 303–320.
Yin, R.K., 1994. Case Study Research: Design and Methods, 2nd ed. Sage.