

## **Systems Innovation Center Kft**

1106 Budapest, Gyakorló utca 18. fsz. 3.

**ID:** 01-09-405895 **VAT:** HU 32085879

 [systemsinnovation.eu](http://systemsinnovation.eu)

 [center@systemsinnovation.eu](mailto:center@systemsinnovation.eu)

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# **Literature review**

## **Transition theory and management for systems innovation**

*Attila Katona, 2017*

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### 1.1. Socio-technical transition theory

The socio-technical transition approach, as an emerging field of research, is firmly rooted in traditions of system thinking (Shove & Walker 2007), and a broader field of complexity science (Midgley 2003), governance research (Pierre 2000), sustainability and environmental science (Grin et al. 2010), innovation studies (Westley et al. 2011), resilience and adaptive capacity (Holling 1973; Gunderson & Holling 2002) and a broad range of other theoretical approaches (evolutionary economic theory, management theory, risks and reflexivity, etc.). Recent discussion on transitions originates from a policy-science debate around the fourth National Environmental Policy Plan of the Netherlands (2001), in which the transitions approach was proposed to better understand the failure of both policy and markets in steering modern society towards sustainable pathways, while seeking to explore new ways to achieve a fundamental reorientation (Kemp and Loorbach, 2006; Loorbach et al., 2015)

In transition literature, change in complex adaptive systems (such as sectors, regions, cities) is always a result of a non-linear co-evolution dynamic within cultures (such as attitudes, perceptions, worldviews), structures (such as institutions, hierarchies), and practices (such as behavior, procedures, routines) that progressively build up on the very long term (Rotmans et al. 2001; Frantzeskaki and de Haan 2009; Loorbach 2010; Loorbach et al. 2015). This co-evolutionary process can create a transitional pattern, a destabilization and reconfiguration, after which a new dynamic equilibrium emerges, constituting a revolutionary systemic change. Such transitions, according to Markard et al. (2012), usually *“require a combination of technological advances, systemic transformations and decisive interventions in governance, as well as a change in patterns of production, consumption and behavior”*. This transition is a non-linear, iterative process that involves complex, multi-actor systems and typically unfolds over considerable time-spans, allowing the emergence of new business models, services and organizations, partly complementing and partly substituting others. This leads up to the destabilization of the dominant practices, rules and technologies that reinforce the prevailing 'socio-technical regime' (Markard et al. 2012). A transition of such scale is, by definition, not only complex and uncertain, but also largely contested, as the most powerful (networks of) actors are adverse to disruptive change (Loorbach et al. 2015), thus the regime is prone to lock-in (Markard 2011), which is aggravated by highly intertwined technologies, lifestyles, day-to-day routines, business models, institutional structures, regulations, and political structures (Markard et al. 2012).

When describing transition as a temporal sequence, we can distinguish four alternating phases (Figure 1.) – 1.) the pre-development phase from a dynamic state of equilibrium in which the status quo starts changing in the background, 2.) the take-off phase, a point of ignition after which the process of

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structural change picks up momentum, 3.) The acceleration phase in which structural changes becomes visible, 4.) the stabilization phase where a new dynamic state of equilibrium is achieved (Grin et al. 2010). The manifestation of these phases produces an S-curve, but several other manifestations are also possible, such as the lock-in, described earlier.

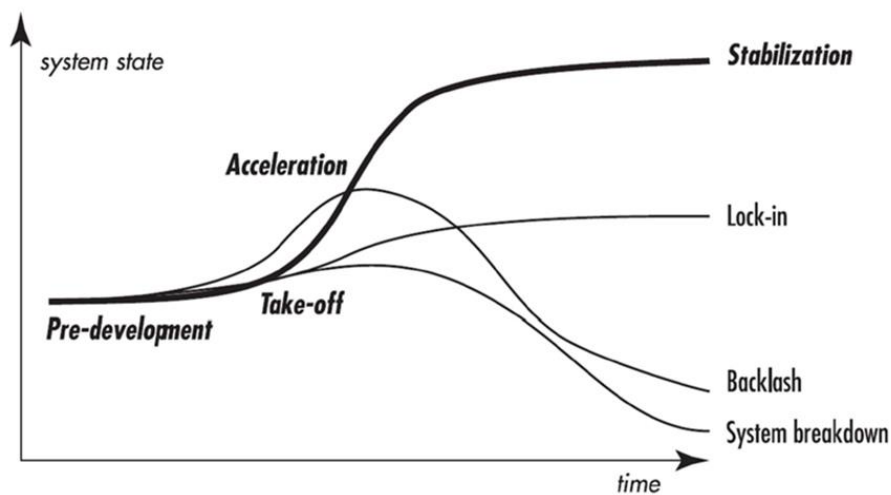


Figure 1.: Multi-phase trajectory, describing transition in time as a sequence of phases (Grin et al. 2010; van der Brugge and de Haan 2005)

Although retrospective analysis of the rise and fall of socio-technical regimes (such as the transition from horse-drawn carriages to cars, telegraph to telephones, clean water, etc.) (Geels 2002; Geels 2005; van der Brugge et al. 2005), are distanced from contemporary transitions, they can be used to conceptualize system dynamics by showing how processes, events and agents interact throughout a transition. Transition studies as a scientific field have during the past years developed and refined five important perspectives for analyzing sustainability transitions (Loorbach & Shiroyama 2016):

- **The niche perspective**, which focuses on micro-level innovations that have the potential to radically change the urban fabric and social practices towards sustainability;
- **The multi-phase perspective**, which takes a holistic and dynamic understanding of the multiple phases (i.e., pre-development, take-off, acceleration, lock-in, etc.) and the associated dynamics that a transition process can display;

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- **The co-evolution perspective**, which uses conceptual tools to understand what contributes to evolutionary interactions between environment and social transformations happening over a long period of time in an incremental way;
- **The multi-pattern perspective**, which observes different patterns of processes, considering policy, institutions, technology, and agency dynamics;
- **The multi-level perspective**, which observes inter-level and intra-level interaction dynamics that influence the transition as a whole.

From these conceptualizations, the multi-level perspective (MLP) as a middle-range theory deserves particular attention, as it views transitions as a result from the interplay of developments at three analytical levels: niches, regimes, and an exogenous landscape (Geels 2002; Rip and Kemp 1998; Geels 2011).

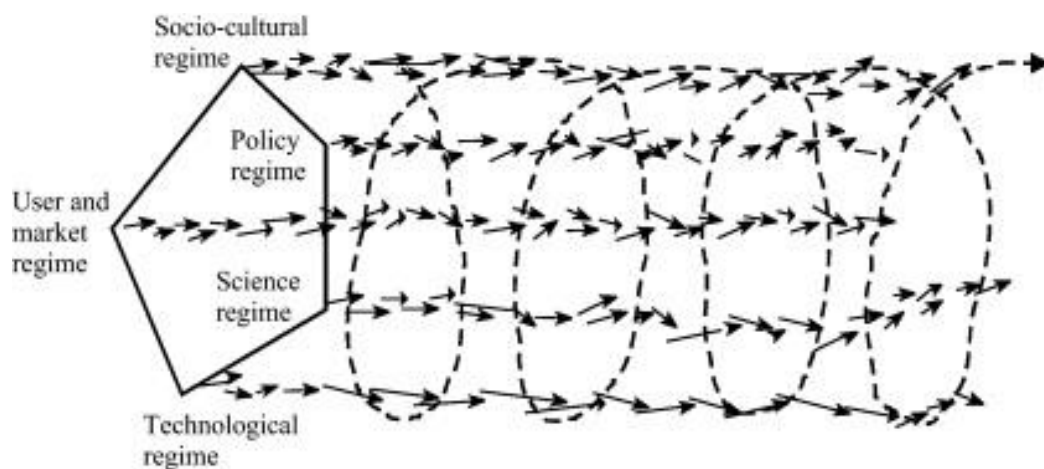


Figure 2.: Alignment of ongoing processes in a socio-technical regime (Geels 2011, adapted from Geels 2004)

The following definitions are based on the work of Geels (2002; 2004; 2011):

**Regime:** The deep structure of dominant and well-established practices, rules, actor configurations, cognitive routines, beliefs and technologies that accounts for and reinforces the stability of an existing socio-technical system. Regimes are stable due to their resilience to withstand disruptions that threaten regime stability, leading to a potential lock-in.

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**Niche:** a seed of change, potential for an alternative, disruptive, innovative solution that is initially unstable, have low performance, and require dedication to scale-up. Niche actors (such as entrepreneurs, start-ups, NGOs) work on alternative solutions that deviate from regime solutions, hoping to challenge (change or replace) the regime. Niches, according to the strategic niche management approach, require 'protected spaces' (subsidies, incubators, resources, networks) to compensate for the lack of infrastructure, regulations or consumer practices that support them. Due to the lock-in effect, niches do not automatically displace incumbent regimes, even when they are more efficient at solving systemic challenges.

**Landscape:** the wider context, which influences the dynamics of interaction between niche and regime. It highlights the technical and material backdrop, demographical trends, ideologies, values, world views, global changes, macro-level patterns - none of which could be influenced in a short run, but all of which influence society and regimes at large, often by putting pressure on regime and create openings for niches (e.g. climate change, aging population). As Chaffin and Gunderson (2016) adds, larger transformations are easier when a system is reorganizing and are more likely when the current situation is a crisis that requires major change.

Figure 3. provides an ideal-typical representation of the way these levels interact in an unfolding transition process: niche solutions build up momentum, landscapes create external pressure on the regime, leading to regime destabilization, which creates windows of opportunity for a radical change. Each of these phases can be linked to their unique phases and mechanisms, and can occur along several distinct, non-linear pathways (Geels 2005; Geels and Schot 2007). This way, MLP can help illuminate the relationship between small-scale initiatives, systems innovation and societal transformation, emphasizing that innovation occurs incrementally, with small steps accumulating into stable trajectories (Geels 2011).

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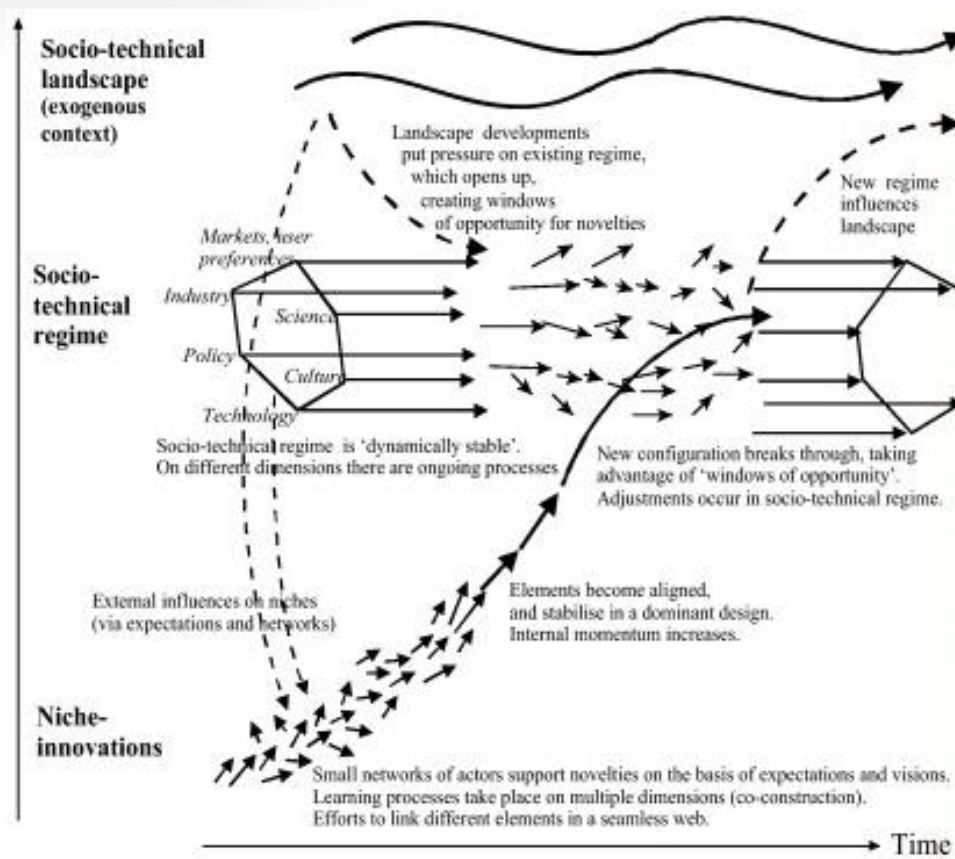


Figure 3. Multi-level perspective on socio-technical transitions (Geels 2011, adapted from Geels 2002)

One should be cautious about how far MLP can be applicable, because it is based on a framework that was derived from historical technological transitions (Grin et al. 2010), which might differ from the sustainability transitions with (presumably) less consumption, and new value systems. Regardless, MLP can serve as a boundary object between ongoing practice and different scientific fields that focus on change (history, social theory, evolutionary theory, innovation theory, behavioral economics), by highlighting precursors, coupled systems dynamics and complexity of both incremental and radical innovation (Grin et al. 2010). Recent studies fruitfully applied the MLP approach to contemporary sustainability issues, such as electricity systems, water infrastructures (van der Brugge et al. 2005) sustainable mobility (Van Bree et al. 2010), organic food, land use, or housing (Smith 2007).

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## 1.2. Transition management

While societal transitions in large scale systems are by definition complex, uncertain and contested, therefore it is not possible to be fully comprehended or managed from a traditional perspective (Loorbach et al. 2015), MLP and transition theory can depict transitions in a way that may anticipate the pattern of change and inform us on how to influence it. Although it can't make claims about how individuals can, might or should act to re-orient trajectories towards pre-defined normative goals with deliberate interventions (Shove and Walker, 2007), the process can be adapted in such a way that the inevitable non-linear changes and crises provide openings for a shift towards sustainability (Loorbach et al. 2015). Therefore, it becomes possible *“to use the understanding of transition dynamics to influence the direction and pace of a transition of a societal system into a more sustainable direction”* (Frantzeskaki & de Haan 2009). Any such development needs to be in confluence with ongoing dynamics (Rotmans et al. 2001; Grin et al. 2010) directed at domains in which small, incremental steps can result in tipping toward larger changes and broader system innovation (in line with the threshold concept - Walker and Meyers 2004) resulting in a co-evolution, rather than swift revolution (Rotmans et al. 2001; Frantzeskaki et al. 2012), re-routing ongoing processes, while taking existing power-relations, path-dependencies and lessons from historical transitions into account (Avelino et al. 2011; Loorbach et al. 2015).

Transition management (Loorbach, 2010), as a form of “governance”, aims to address this tension between the uncertainty of an open-ended process and the ambition for governing such a process (Frantzeskaki et al. 2012). It refers to employing the insights of transition theory, enabling and empowering actors to better anticipate and adapt to change dynamics so as to influence its speed and direction (Loorbach et al. 2015), as well as to channel alternative solutions into institutional structures, and connect long-term goals with short-term actions (Loorbach et al. 2016). This relatively abstract approach can be translated into a practical management framework for systemic change, which offers space for experimental application as well as scientific reflection, based on the line of reasoning described earlier (Loorbach 2007; Loorbach et al. 2015). In this framework, four types of relevant governance activities are identified (Frantzeskaki and Tilie 2014):

- Strategic (includes setting long-term goals, planning, vision, values, identity),
- Tactical (includes designing steering activities, programs, funding, networks and partnerships),
- Operational (includes implementing and managing policy action plans, infrastructure plans and assets), and
- Reflexive (includes monitoring, assessing and evaluating existing policies and assets and their interaction with citizens).

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In practice, transition management uses transition theory as a lens to critically analyse a particular problem in a complex adaptive system (such as a sector, an issue, a neighbourhood, a city, a region, etc.), identify regime and niche actors, then selectively engage and bring them together in so-called ‘transition arenas’ (Loorbach, 2007; Grin et al. 2010, Loorbach et al. 2015). In these transition arenas and informal networks, actors are provided resources to develop new ideas, a shared language, a shared ambition and new joint projects through a social learning process (Neuens et al., 2013). Over a longer period of time, this ‘learning-by-doing’ process and shared agenda enables actors to translate outcomes to their own daily operating context, thus indirectly influencing policies, business decisions, research agendas and civil society.

Below is the summary of the key ingredients of a transition management process (not necessarily in specific sequential order), based on key literature (Grin et al. 2010; Loorbach et al. 2015; Neuens et al. 2013), as well as the review of key case studies and projects (e.g. Frantzeskaki and Tillie 2014; Frantzeskaki et al. 2014; Katona 2015; ARTS 2016):

### **1. Establishing a transition team and analyzing the system**

A first step in changing a system is getting to know it by attaining an integrated, comprehensive perspective of the system under study. This entails determining the relevant players and their interrelations, key functions, analysis of formal and informal institutions using a balanced mix of quantitative data (statistics, historical data, document analysis, GIS analysis) and qualitative data (stakeholders, routines, power relationships, values) (Neuens et al. 2013). The transition team is in charge of bringing the first rough analysis of the transition at hand, analyzing historical trends, governance, actor-networks, selecting frontrunners, and managing the key milestones and phases of the transition management process, described below. A transition team needs to include people with firm local experience, thematic experts in the transition arena, and transition management experts (Loorbach et al. 2015).

### **2. Problem structuring and establishment of a transition arena**

Transition management creates transition arenas, which are informal networks for frontrunner niche- and regime-actors with different backgrounds (Loorbach 2010). Transition arenas are sustainability partnerships that identify and reframe a persistent problem, commit to a vision of sustainable development, and develop a common perspective, a terminology and sensitivity towards inherent complexity through participation from and interaction between actors (Loorbach et al. 2015).



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Systematically mapping and structuring the situation enables key actors to look beyond their daily routines and perspectives, put their personal interests and aspirations aside (or forward), open up for understanding the interrelations within the system (Nevens et al. 2013) as well as gain insight about how small scale interventions through cumulative impact, might alter system trajectories over a long period of time (Loorbach et al. 2015).

### **3. Developing sustainability visions, pathways, and transition agendas**

Change can be initiated by an appealing, shared, and inspiring vision about desirable systems. Envisioning and participatory scenario building with actors is employed to create an appealing vision by reflecting on their daily routines, then establishing criteria for future pathways and identifying ideal future visions ('transition images') for the system (Nevens et al. 2008). A coherent vision can provide long-term direction, connect and commit actors, as well as to mobilize support and resources for the rest of the subsequent phases of the transition management cycle (Smith and Stirling 2008; Nevens et al. 2013).

Starting from this vision, strategies on how to realize this desired future can be developed with a back-casting exercise. By strategically breaking down the long-term goals into actionable steps, back-casting results in clear transition pathways. This includes short-, mid- and long-term actions that should be taken in pursuing the desired vision, allowing prioritization and allocation of responsibilities in a participatory way (Dreborg 1996; Holmberg 1998; Kanyama et al. 2007; Quist 2007)

### **4. Experimenting**

Transition experiments are high-risk (in terms of failure) experiments in real-life societal context that are supposed to contribute to the transition process at the systems level and should fit within the envisaged transition pathway (Grin et al. 2010; Loorbach et al. 2016). The goal of the experiment is to link the envisaged future vision with action potential (Nevens et al. 2013), cultivate and consolidate shared resources and custodial common practices (Radywyl & Biggs 2013), and hence enable the take-off and acceleration of the desired transition – through iterative, deliberate experimentation and learning, the niche solutions can be improved and eventually mature to the position that can replace the prevailing regime (Markard et al. 2012).

### **5. Monitoring, evaluation and translation**

Monitoring should focus both on the transition process (physical changes, indicators, macro-developments, niche-developments, regime resilience, etc. (Grin et al. 2010)) as well as on the

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transition management process (reflection on all actions taken, events, activities, partnership forming, social and institutional learning process, milestones, barriers, etc. (Loorbach et al. 2015)). The assessment toolbox should include methods such as indicator systems, cycle assessments, multi-criteria analyses, and relevant project monitoring tools. In the transition process, monitoring and evaluation is not simply an ex-post measurement of impact, but an ex-ante construction of baselines that serve as starting point for constructing scenarios and transition pathways.

Transition management builds on the adaptive and transformative capabilities of actors (Loorbach et al. 2015), therefore, in order to actually initiate system change, experiences from all previous activities (envisioning, scenario-building, back-casting, experimenting) should be multiplied in change-inducing actions of the relevant stakeholders, thus incrementally displacing the whole system, leading to a new, more sustainable state of equilibrium (Grin et al. 2010; Nevens et al., 2012; Nevens et al., 2013.).

The full transition management cycle is visualized on Figure 4.

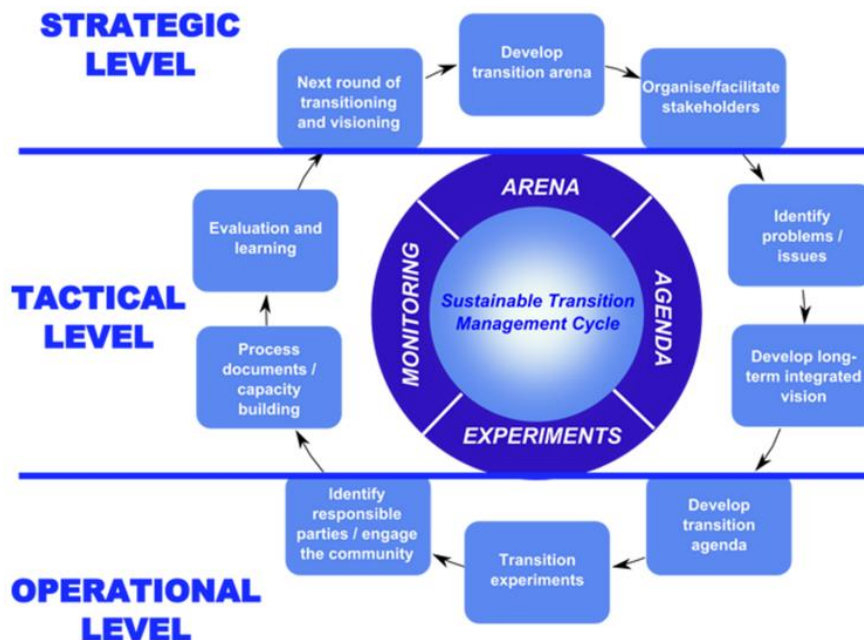


Figure 4. Transition Management Cycle (Duffy & Jefferies 2011)

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### 1.3. Implications of transition theory for governance in practice

As established in the previous chapters, there is a need for solutions-oriented research agendas in sustainability sciences that seek to understand, conceptualize and foster experiments in diverse, life-like contexts (Kates et al 2001; Miller et al. 2013). Changes in deployment of already existing technologies requiring only incremental innovation or no technological innovation received little attention in transition literature, despite the strong claims that not only specific solutions and technologies matter, but processes (governance, participation, co-creation, collaboration) are also crucial for success. Social innovation studies focus on new work and new forms of cooperation (e.g. business models) as well as the distinct needs and mechanisms of socially innovative processes (TEPSIE 2014).

Based on the review of relevant scholarly literature and ongoing projects, transition studies can be applied in a heuristic way, employing it as an analytical lens to describe and analyse past and ongoing governance processes in cities (e.g. Mizuguchi et al. 2016; Shiroyama and Kajiki 2016) as well as in an operational way, as a framework guiding the implementation of participatory processes, planning and action (e.g. Hölscher et al. 2016; Frantzeskaki and Tefrati 2016). The socio-technical transition literature can be used to explain the dynamics of innovation, to provide important new insights into the ways in which current conditions and practices in the regime maintain the use of usual solutions, and how the potential of alternative constellations can be unlocked by focusing on completed initiatives and transitions which appear to be heading the right direction, taking note of the relation between competing systems and practices. Evidence could be gathered on particular governance modes, participation models, citizen engagement, social processes, financing structures, and regulatory frameworks that support or hinder the deployment of innovations. The five transition perspectives should be used as stepping stones for crossing theoretical gaps, and utilized as an adaptable framework for observing good practices. Moreover, process tools, such as working with practitioners in a transition arena could shed some light on the way in which the potential of innovations can be unlocked, thus supporting the first steps towards their widespread use.

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