

Innovation Studies, Social Innovation, and Sustainability Transitions Research: From mutual ignorance towards an integrative perspective?

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ABSTRACT

Goal-oriented transformative change processes – that is, system-transforming processes that are guided by the ambition to resolve current or expected future societal challenges of various kinds – can only start once possible goals are considered by key stakeholders and the relevant actors are committed to act. Hence, there is a need for widening the scope of the current, partial conceptual models to consider the co-evolutionary interactions between technology, economy, and society to understand these changes. This claim is based on our review of Innovation Studies, Social Innovation research, and Sustainability Transitions research. The paper discusses the key conceptual elements of each strand; offers a definition of goal-oriented transformative change and building blocks for a new, integrative framework to analyse it; proposes directions for future research and draw tentative governance and policy implications.

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Keywords: Innovation studies; Social innovation research; Sustainability transitions research; Focussed literature review; Goal-oriented transformative change; A new, integrative analytical framework

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Üzleti és társadalmi innovációk, fenntartható fejlődés: Lehetséges-e a három elkülönült paradigma összekapcsolása?

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ÖSSZEFOGLALÓ

A már ismert és a jövőben kibontakozó átfogó, mély társadalmi, gazdasági és környezeti válságokat csak akkor lehet enyhíteni, illetve új gazdasági és társadalmi lehetőségeket teremteni, ha a nagy rendszereket célratorően, tudatosan próbálják átalakítani az érintettek. Ehhez el kell ismerni a probléma létét, vagy fel kell ismerni az új lehetőséget, meg kell egyezni az átfogó célban és az oda vezető út főbb állomásaiban, és elkötelezetten, a közösen elfogadott cél elérése érdekében következetesen kell mindenkinek a maga területén cselekednie. A válságok és a lehetőségek, valamint a szükségessé váló mélyreható átalakulási folyamatok megértéséhez, a gyakorlati cselekvés stratégiai megalapozásához az is szükséges, hogy a jelenlegi, korlátozottan érvényes elemzési kereteket meghaladjuk egy olyan új elméleti megközelítéssel, ami képes a műszaki-technikai, gazdasági és társadalmi folyamatok átfogó értelmezésére, a kölcsönhatásaik feltárására. A tanulmányban három elemzési keretet – paradigmát – vizsgálunk abból a szempontból, hogy azok hogyan elemzik az innovációs és átfogóbb változási folyamatokat. Ezek az iskolák eddig jelentős mértékben egymástól elkülönülve fejlődtek, a hármas kölcsönhatás – technológia, gazdaság, társadalom – helyett csak „párok” – pl. technológia–gazdaság, technológia–társadalom – egymásra hatását vizsgálták. Ezért azt javasoljuk, hogy szükséges egyrészt az átfogó, mélyreható, cél-orientált átalakítási folyamatok fogalmának definiálása, másrészt az eddigi fogalmi keretekre, elemzési módszerekre és eredményekre támaszkodva egy integrált elmélet kidolgozása, amelynek segítségével elemezni lehet ezek az átalakulási folyamatok. Ez az új elmélet hozzájárulhat a szereplők stratégiai terveinek és cselekvési programjainak jobb megalapozásához, az átalakulási folyamatok pontosabb nyomon követéséhez és az átalakulás hatásainak átfogó értékeléséhez, s ezzel a stratégiák, szakpolitikák finomításához vagy jelentősebb módosításához. A tanulmányban az új elmélet négy fontos elemére teszünk javaslatot, megjelölünk jövőbeni kutatási irányokat és feladatokat, illetve gyakorlati ajánlásokat is megfogalmazunk.

JEL: B52, H12, L31, O30, O31, O33, O35, O38, O44, P11, Q01, Q50, Q54, Q55, Q58

Kulcsszavak: Innovációs rendszerek elemzése; Társadalmi innovációk kutatása; A fenntartható fejlődést szolgáló átalakulási folyamatok kutatása; Átfogó, cél-orientált átalakítási folyamatok; Új, integratív elemzési keret

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Abstract

Goal-oriented transformative change processes can only start once possible goals are considered by key stakeholders and the relevant actors are committed to act. Hence, there is a need for widening the scope of the current, partial conceptual models to consider the co-evolutionary interactions between technology, economy, and society to understand these changes. This claim is based on our review of Innovation Studies, Social Innovation research, and Sustainability Transitions research. We discuss the key conceptual elements of each strand, offer a definition of goal-oriented transformative change and four building blocks for a new, integrative framework to analyse it.

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1 Introduction

Transformative change has become the focus of various strands of innovation research in recent years. In this paper we focus on the confluence of three main strands of innovation research – namely innovation studies (IS), social innovation (SI), and sustainability transitions (ST) studies – and their contributions to better understanding goal-oriented transformative change processes in society. This focus on transformative change is particularly relevant in the context of the “normative” or “strategic” turn in innovation policy, set on about ten years ago (Daimer *et al.* 2012; Weber and Rohrer 2012). By evolving sometimes in conjunction and sometimes in separation from one other, the three strands of innovation research might provide complementary underpinnings for a more integrative approach to better understand transformation processes.

The notions of transformation and transition, as well as their differences have been debated extensively (Hölscher *et al.* 2018; Truffer *et al.* 2022). For the purposes of this paper, we prefer to speak of *goal-oriented transformative change in society*, defined as system-transforming processes that are guided by the ambition to resolve current or expected future societal challenges of various kinds (see section 6). This term is sufficiently open to capture a variety of normative goals, which innovation and transformation are meant to contribute to, as well as different conceptual understandings of how changes come about. With this, we want to stress that these goals are subject to political and societal negotiations and thus should not be taken for granted. Currently, the notion of sustainability is widely used as an umbrella goal, for good reasons. Yet, not only may there be alternative ways of formulating societal goals and visions, but also our understanding of what we mean by sustainability evolves and is permanently re-negotiated. For instance, for a few years now, the UN Sustainable Development Goals have tended to supersede the previous three-dimensional framing of social, environmental, and economic sustainability. Further, we also prefer to speak of transformations rather than transitions, because we want to include in our perspective disruptive and paradigmatic changes, too, that are largely out of control and escape the understanding of transitions, understood as comparatively smooth and purposefully governed change processes. In other words, transitions are – in our view – a specific type of transformations.

Our work is guided by three research questions. What are the similarities, differences, and complementarities in the conceptual underpinnings of these three strands of innovation research? What conceptual building blocks of transformation are used? What building blocks of an integrative analytical framework to study transformative change can be derived from these three strands?

The paper is structured as follows. First we briefly outline the analytical approach and methods used to address these research questions (section 2). It is followed by an overview of the mutual positioning of the three main streams of innovation research (section 3). Then we discuss the main propositions of each stream regarding key aspects of innovation and transformation (sections 4 and 5). By assessing IS, SI, and ST research, we claim that on its own none of these strands can capture all fundamental aspects of goal-oriented transformation in society, and thus, as a first step towards developing an integrative analytical framework, we propose four building blocks for future theorising (section 6). To conclude, we highlight directions for future research and draw tentative governance and policy implications.

2 Analytical approach and methods

As already stressed, the main aim of our paper is to offer conceptual contributions. Hence, it is based on a focussed literature review, composed of two main blocks. First, we draw on the results of several major research projects on social and business innovation (TRANSIT, SI DRIVE, and CrESSI) that relied on extensive literature surveys which we had contributed to. These literature surveys had conceptualised social innovation vis-à-vis business innovation, and thus covered the systems of innovation approach, too (Havas 2016a, 2016b; Butzin *et al.* 2014).

Second, we also captured the most recent discourses on social innovation, in particular in relation to wider processes of societal change. Hence, we carried out a systematic, but focussed search in ScienceDirect in July – August 2021. The combination of search strings “social innovation” and “societal transformation” in the full text of the papers resulted in 79 papers on social innovation in the years of 2016 to summer 2021, which we collected in a literature data base. A screening of these papers combined with inward and outward citations yielded a mind map of papers, projects, and reports on social innovation but with different thematic foci.¹ We have set three main criteria for selecting papers to be analysed in-depth:

- Social innovation is in the centre of the paper: either appears in the title or has a prominent role in the abstract.
- Review papers and conceptual papers have been given a priority over case studies.
- A meta-perspective on social innovation and its role in transformation processes have been of special interest.

As our analysis is not a bibliometric one,² from these articles we have identified conceptual foundations on the role of social innovation in transformation processes and main observations on these issues. Finally, we have selected the key features of innovation processes to characterise the three strands of literature along these lines in section 4. These are: the motivations to innovate, the principal aim of innovations, the objects and the levels of change induced by innovation, the main actors and their interactions during an innovation process, the sources and types of knowledge (co-)produced, utilised and exchanged during the innovation processes, how success and impact are defined and measured. Diffusion mechanisms and transformation dynamics are discussed in section 5. Section 6 is more exploratory in nature as it proposes building blocks for a new integrative analytical framework to study goal-oriented transformative change.

3 Goal-oriented transformation: three perspectives from innovation research

The three strands of innovation research we compare differ in their perspectives on innovation. These differences have their origins in the underling ambitions of these strands, their historical evolution, and the associated key questions they address.

Innovation Studies has emerged as an inter-disciplinary approach in the second half of the 1960s, subsequently inspired and enriched by insights from evolutionary economics of innovation, management, and science and technology studies. The field has gained coherence from the 1980s onwards through the influence of evolutionary thinking, the recognition of the non-linearity of innovation processes and of the systemic nature of innovation. Importantly, this growing coherence provided the basis for developing standards of data collection and indicator development by statistical offices, primarily in the OECD countries,

¹ A figure indicates the distinguishing features of the clusters of these papers, see Supplement.

² For thorough bibliometric analyses consult van der Have and Rubalcaba (2016) on social innovation and Fagerberg *et al.* (eds) (2012) on business innovation.

thus establishing a shared understanding, a common research framework, and an extensive infrastructure for harmonised data collection and comparable empirical analyses across countries. It led to a nuanced understanding of how innovations emerge and diffuse.

Recently, these foundations have been opened up to new influences, to give room to a broader understanding of innovation. Initially being characterised by a strong emphasis on technological innovations and their impacts on competitiveness, economic growth, and employment, this has given way to i) a more prominent consideration of organisational, managerial, marketing, financial, and business model innovations, as well as social implications of business innovations; and ii) more attention to the role of innovation in addressing social and environmental concerns.

The bulk of the IS literature had been firmly embedded in the growth paradigm, considering innovation as the key driving force behind economic growth. This positive interpretation of the growth-enhancing function of innovation came under pressure with the growing recognition of harmful environmental consequences of many innovations and of growth-orientation in general.

It led to new theoretical (and policy) debates regarding the directionality and normative purposes of innovation activities and the need for transformative change in view of both increasingly pressing societal challenges and potentially disruptive S&T developments. It was tied to the recognition that innovation and transformation should not be understood merely as research-driven ('science push') phenomena but that demand-side ('market pull') factors play an equally important role. This attention to the demand side had been a major issue in environmental (innovation) economics for a long time already, with a great deal of attention paid to regulatory forces driving innovation and systemic change through the creation of lead markets (Walz and Köhler 2014). These aspects received even more attention with the emerging debate on transformative innovation and transition policies (Geels *et al.* 2019).

While innovation studies also recognise the importance of other allocation mechanisms, markets continue to be considered crucial in understanding how innovation translates into transformative change. This focus on transformation has led to a broadening of this translation process. Yet, this new approach is not looking well beyond the initial emphasis on the diffusion of business innovations.

Social innovation research was initially inspired by severe societal problems, such as poverty, inequality, housing, limited access to education, and other forms of marginalisation and exclusion. These kinds of problems were particularly pressing in developing countries, but they were and still are also present in advanced countries. As social innovation is chiefly driven by societal needs, it is no surprise that the evolution of social innovation research has been mainly driven by practitioners rather than by academics. S&T aspects played at best a secondary role in otherwise novel social and organisational practices, also because solutions had to be developed under severe resource constraints, leading to a frugal approach to innovation. Under these conditions sometimes even very basic social needs could hardly be satisfied. Tied to such precarious conditions, empowerment of disadvantaged groups in society is often a principal ambition of social innovation.

In the meantime, several types of novel (social) practices are subsumed under the broad headline of social innovation. What is common to them is the focus on social ends and/or social means of innovation. This stands in stark contrast to the growth paradigm that dominated innovation studies for long. Economic growth has practically been a non-issue in social innovation research, because the focus has been on pressing social challenges. In recent years, social innovation has attracted growing attention as an essential, complementary element in innovation and transformation processes; a phenomenon that can be observed mainly in advanced economies (Boelman and Heales 2015).

Another important distinctive feature of SI research refers to the main mechanisms through which SI gets propagated, institutionalised, and embedded to give rise to transformative change (Sengers *et al.* 2021). Market mechanisms are also very important for some segments of SI activities (in particular for hybrid forms at the intersection with business innovation like social entrepreneurship, social housing, water supply, poverty alleviation through providing micro credit etc.), but much less relevant in others (e.g., in areas like workplace innovation and education). Social change as the guiding ambition of SI tends to rely to a large extent on the consolidation of very specific local solutions, their replication, and adaptation in other local contexts and on institutionalisation processes that open up the space for novel social practices to be adopted more widely. The self-reinforcing power of commercialisation dynamics and economies of scale – which are key to most business innovations – are not relevant for SI.

(Sustainability) Transitions research has put the emphasis on matters of transformative change from its inception in the early 2000s. Initially, it had a strong technology-centric orientation, with much work focusing on technological niches and how they might mature through learning processes, scale, replicate and eventually influence the prevailing regime. With the multi-level perspective, a very influential conceptual model was developed to inspire further theoretical and empirical research, complemented by other frameworks such as Technological Innovation Systems or (more recently) challenge-oriented Regional Innovation Systems (Tödtling *et al.* 2021). Historical and empirical case studies have played an important role in shaping and refining the conceptual frameworks of transitions research and have consolidated our understanding of how and why transitions succeed or fail. Surprisingly, while social, organisational, and institutional changes often served as important ingredients of transition studies, social innovation as a core subject of investigation found its way into transitions research only in recent years. In parallel, constructive and policy-oriented approaches were developed to inform and guide managerial and policy strategies to trigger and govern transitions, for instance under the labels of Strategic Niche Management and Transition Management.

In normative terms, ST promotes a departure from fostering economic growth and calls for an orientation towards Sustainable Development Goals (SDG), even if the earlier (historical) works on transitions were rather agnostic regarding the direction of change. It also needs to be acknowledged that the idea of transitions leading to a departure from a growth-oriented socio-technical regime is very common in transition studies. The most explicit departure from growth-orientation is evident in the notion of deep transitions (Kanger and Schot 2019), which suggests a long-term transition from a growth-oriented economic system to an SDG-oriented one, based on a new set of meta rules. It thereby combines elements of the Multi-level Perspective (MLP) on socio-technical transitions and the Techno-economic Paradigm (TEP) framework.

As regards the prevailing conceptual understanding of transitions, it is worth noting three features. *First*, the emphasis is put on bottom-up processes of learning and emergence, with less attention paid to top-down driving forces of change. *Second*, the attention to sustainability transitions has tended to favour the environmental dimension of transitions over others that may have received more attention in SI research (e.g., marginalisation, social exclusion, equity). More recently, though, the notion of just transitions has gained importance. *Third*, a key characteristic of ST is the focus on rather smooth change processes: transition policies are about governing systemic and long-term change processes in society rather than about tackling major disruptions and crisis. This is somewhat different in IS where more attention has been paid to emerging technologies, platforms, and business models with a disruptive potential.

4 Key features of innovation: basic similarities and substantial differences in the three strands of research

A fundamental common property of IS, SI, and ST research is that they all analyse innovation processes, often as the starting points for wider-reaching change processes. Further, innovation and change are often analysed from the vantage point of desirable outcomes and impacts. Understood as ideal-typical abstractions from a more differentiated real life, where it is often not so clear what is desirable and what is not, this is an acceptable and productive simplification. We should keep in mind though that policy implications derived from these streams need to be handled with caution.

Beyond these, their further key features are distinct: (i) the impetus to innovate, and thus the principal aim of innovations, as well as the main actors and their interactions in innovation processes; (ii) the objects and the levels of change; (iii) the sources and types of knowledge (co-)produced, utilised and exchanged during innovation processes; and (iv) how success and impacts are defined and measured. We discuss below how these issues are addressed in the IS, SI, and ST strands of literature.³

4.1 The principal aim of innovation

Although many scholars studying SI tend to juxtapose social and technological innovations, for a sound analysis a different distinction would be appropriate in our view, one based on the *primary purpose* of innovation activities. When the primary purpose is improving the performance of a firm, we can speak of *business innovation* (Havas 2016a; Windrum *et al.* 2016).⁴ When innovation is aimed at tackling a societal problem or creating new societal opportunities, actors are engaged in *social innovation*.⁵ A societal problem, in turn, is caused and reproduced by social forces.⁶ For example, being handicapped is not a social problem on its own, but in societies where handicapped people are marginalised, it is a social problem, and as a structural phenomenon it is a societal problem.

Besides business and social innovation, *hybrid innovations* – that apply a business logic, and thus use business organisational forms, methods and approaches when addressing societal problems – are also of vital importance in real life. Examples include goods and services provided on a market basis by a firm, but – on purpose – employing people suffering from various types of disadvantages. These firms are social enterprises. For-profit firms can also aim at serving the needs of disadvantaged people or addressing other societal challenges with new goods, processes, and services (Anderson *et al.* 2013; Andries *et al.* 2019; Finsterwalder and Kuppelwieser 2020).⁷

³ Given space limits, we neither cover models of innovation in the three strands of literature, nor the concepts of innovation systems and innovation ecosystems.

⁴ Despite its somewhat ‘all-embracing’ label, the subject of innovation studies is business innovation, that is, not all sorts of innovation.

⁵ Following a slightly different argument, business and social innovations are also distinguished e.g., by Pol and Ville (2009). Havas and Molnár (2020) defines social innovation as follows: “*Social innovations are novel initiatives or novel combinations of known solutions, aimed at tackling a societal problem or creating new societal opportunities, applied in practice.*” It is worth noting that we are faced with a plethora of rather diverse definitions of social innovation. For example, 76 definitions are reviewed in Edwards-Schachter *et al.* (2012), 252 definitions, published between 1955 and May 2014, are identified in Edwards-Schachter and Wallace (2017), 12 “archetypal definitions” are considered in Benneworth and Cunha (2015), while 10 definitions are presented in Bulakovskiy (2021). Clearly, we cannot offer an overview of this abundance of SI definitions, let alone a thorough analysis of them.

⁶ These social forces – institutions (‘the rules of the game’), social networks, and cognitive frames – are key building blocks of the extended social grid model developed to analyse social innovations (Ziegler *et al.* 2019).

⁷ Space limits prevent us from discussing hybrid innovations in the remainder of the paper, but we will refer to them at certain points.

Finally, as the name of ST literature clearly indicates, the main aim of innovation activities studied by this stream is to serve sustainability transitions, which are comprehensive change processes of entire socio-technical systems, oriented towards the goal of sustainability. It is worth noting that business innovation as well as social innovation can also lead to far-reaching societal change, driven, for instance, by disruptive technologies, technological paradigm shifts or path-breaking socio-organisational changes.

Hence, we distinguish the *purpose* of innovation (the ambition pursued) and its *nature or object* (what is being changed by innovation activities). Both technological changes (new products and processes) and non-technological ones (new organisational and managerial solutions, routines, marketing, and financial methods, entering new markets, changing existing social networks and structures, the ‘rules of the game’, etc.) can serve business or societal objectives, as well as sustainability transitions.⁸ Institutions (rules of the game) often co-evolve with new technologies and business models, but also change – and indeed, need to be changed – through social innovation and sustainability transition processes. Social innovations and sustainability transitions aim at altering social practices, social structures and networks, and cognitive frames. Although cognitive frames are rarely considered explicitly in business innovation studies, cognitive frames are of relevance when the subjects of analysis are innovation strategies, perceptions of innovations by actual or potential customers (users), the mindset of policy-makers, or the rationales used to justify policy measures.

The *principal actors* in business innovation processes are those – existing or newly established – firms that introduce modified or new goods, processes, organisational forms, financial or marketing methods, or business models.

In contrast, there are no archetypal actors in SI processes: various types of actors need to cooperate to tackle a societal problem (Havas and Molnár 2020). At the local level these can include: the social group in need (affected by the given problem); other social groups that could be potentially targeted by or initiating a SI; social innovators: architects and/or leaders of an SI initiative; other SI practitioners involved, e.g., staff members of organisations conducting SIs and volunteers; local politicians and other decision-makers; local business people; NGOs; opinion leaders, both within and outside the affected social group; and the media. Politicians and other decision-makers play a decisive role in setting the formal rules, but also influence the emergence and use of informal rules, at all levels: micro, meso, and macro.

In ST research a wide range of actors and stakeholders are considered who contribute to innovation activities at niche and regime levels. This widening of the range of actors is coherent with the learning-based approach to innovation and the perspective that several co-evolving elements need to be changed for transitions to materialise (Jørgensen 2012; Suleiman 2021). Typically, ‘outsiders’ and other non-incumbent actors are in the driving seat of niche innovations. Yet, the relationship between ‘outsiders’ and incumbent actors representing the dominant regime is also of crucial importance (Steen and Weaver, 2017).

4.2 The objects, types, and levels of change

The IS community has developed various classification concerning *the types and levels of change*. One of the best known was already developed back in the late 1980s (Freeman and Perez 1988; Perez 1983, 1985, 2010). Business innovations at the level of goods (products and

⁸ From a different angle, when analysing business innovations, we should consider both technological innovations and non-technological ones. Thorough empirical analyses of business innovations show that technological innovations are introduced rarely – if at all – without organisational innovations. Quite often marketing innovations are also required and entering – or even creating – new markets is also crucial, especially when introducing radically new products (Pavitt 1999; Tidd *et al.* 1997).

services) can be *incremental* or *radical*. Although this distinction is not applied to analyse process, organisational, marketing, financial or business model innovations, it can be readily extended to characterise those as well. At a deeper level, a ‘bundle’ of radically new products, services, and/or production equipment and processes are introduced, which can be termed as the emergence of a *new technological system*. A new technological system deeply affects several existing sectors at the same time or creates new sectors. The diffusion of technological innovations necessitates financial and organisational innovations, new cognitive frames, behavioural changes, and modified or new curricula for the education and training system. Hence, a new technological system is a system, indeed: its elements on their own, or in isolation, would not be sufficient to induce significant changes. When all crucial elements of an economic system – the major materials and inputs, the decisive technologies, business models and processes, the structure of the economy (both in terms of its sectoral composition and the structure of supply and demand), the interactions among businesses, the mindset of decision-makers, the behaviour and preferences of consumers – are being fundamentally changed, we speak of the emergence of a *new techno-economic paradigm*. Clearly, that is a lengthy and cumbersome process, with substantial economic and social costs.

Other classifications also stress that technological change occurs at different levels and are associated with different structural dynamics, notably the key technology concept (Foster 1986); architectural innovation (Henderson and Clark 1990), and general purpose technologies (Bresnahan 2012; Lipsey *et al.* 2005).⁹

As for SI research, the distinction between different levels of change is somewhat ‘subsumed’ in several definitions, ranging from the micro to the macro level.¹⁰ While the level of change is not considered systematically as a separate analytical issue yet,¹¹ attempts to summarise definitions under typologies of social innovation try to compensate for this (Schartinger *et al.* 2020). Despite some more recent attempts (Turker and Altuntas 2017; van Wijk *et al.* 2019) the issue is far from solved and needs attention and scrutiny in future research to separate definitions of SI and levels of change. As for the latter, different angles are to be taken. Considering the micro, meso and macro levels is a must, no doubt. It is also self-explanatory that different types of societal problems can be tackled at different levels: at the levels of a community, a town or city, a region, a country, or groups of countries. Thus, the interrelated angles of governance levels and geography need to be considered.

ST research draws extensively on the multi-level perspective (MLP) that analyses changes at three distinct levels: niche, regime, and socio-technical landscape (Geels 2002, Geels and Schot 2007). This framing has a major advantage: it allows investigating interactions between change processes at two levels, while the third (landscape) level is largely considered as the external environment with its own dynamics. This provides a very useful inroad to analysing the relationship between innovation processes (in niches) and transformation processes (of regimes). However, the notion of ‘levels’ has also been contested, because it does not reflect a micro-meso-macro ordering, but rather a distinction by temporal scales.

A second influential conceptual framing of innovation dynamics can be traced back to the notion of technological innovation systems (Carlsson and Stankiewicz 1991; Hekkert *et al.* 2007). The Technological Innovation Systems (TIS) framework, and the structural-functional research approach that is associated with it, has its strengths in the analysis of early-phase

⁹ General purpose technologies (GPTs) can be characterised by three key properties: GPTs (i) are used widely by different types of users; (ii) can be continuously improved; and (iii) enable complementary innovations in a large array of sectors and application areas.

¹⁰ Changes at the micro (and/or meso) level are specified in the SI definitions offered, for example, by Andries *et al.* (2019), Rehfeld *et al.* (2015), the Young Foundation (2012); at the meso and macro level by Heiskala (2007); at the micro and macro levels by Moulaert *et al.* (2013); and in the macro level structures by Drucker (1957) and Godin (2012).

¹¹ The lack of clarity on the level of analysis in SI research is also noted by Cajaiba-Santana (2014).

innovation dynamics, but is less explicit concerning the link to transformations or transitions. More recently, attempts have been made to extend the TIS approach to analyse missions as boundary objects in transformative arenas (Janssen *et al.* 2021).

4.3 Sources and types of knowledge (co-)produced, utilised, and diffused

An essential claim of the innovation systems approach is that a successful innovation process requires many different types of knowledge, stemming from various sources (from formalised R&D activities conducted by the innovating firm and/or its different types of partners, as well as from practical activities) and these pieces of knowledge and experience are rarely – if at all – possessed by a single actor. Co-operation among these actors is, therefore, indispensable (Caraça *et al.* 2009; Jensen *et al.* 2007) and can take many forms, ranging from a variety of B2B and business-academia relationships (Havas 2015; Perkmann *et al.* 2013) to value networks in more ecosystem-type of interactions (Clarysse *et al.* 2014; de Vasconcelos Gomes *et al.* 2018).

Identifying the types and sources of knowledge is not a major issue in SI research¹² but we can safely generalise that both S&T and practical – often tacit – types of knowledge are crucial for SI processes as well, in many cases probably with a stronger emphasis on practical knowledge. Clearly, in this domain scientific knowledge should include social science knowledge on societal challenges and their root causes. Further, in many cases a rather diverse set of knowledge and experience is required to tackle a societal problem, and thus a broad array of actors need to collaborate in an SI process.

In ST, the sources of knowledge are as diverse as the actors involved, from different domains. In line with the co-evolutionary model of change underpinning ST, co-creation of knowledge plays a decisive role. Given the high level of complexity of these inter-dependent learning processes, experimentation and joint learning are key, which is also why approaches from design thinking are popular in this strand. This does not exclude, though, the use of codified, scientific knowledge or collaboration with businesses who possess domain specific, relevant knowledge.

4.4 Defining and measuring ‘success’

A closely related issue to the principal aim of innovation activities is success: what is considered success – and, in turn, who and how defines criteria for success. As for *business innovations*, the IS literature, as well as the management of innovation literature (Dodgson *et al.* 2014), is straightforward: success at the micro level is improved firm performance, thanks to innovations. Success can materialise in many different forms: enhanced productivity, increased sales, higher market share, entering a new market or even creating a new one, and higher profits. Success criteria are determined by a business logic, without subjective, value-laden elements. An important dilemma persists even in this domain, though: the tension between short-term vs. long-term performance. Improved performance in the longer run is certainly relevant from a strategic angle. Yet, financial markets apply a strong pressure on managers to pursue short-term objectives to satisfy shareholders or other investors. Thus, it is a crucial issue what performance metrics are used by the owners of a given firm and what weight is attached to indicators measuring short-term vs. long-term performance. At a macro-level, IS assumes that innovation activities enhance the international competitiveness of a given economy. It is not accepted by all economists, though, that competitiveness can be a relevant concept beyond the level of products or

¹² A few authors, however, emphasise the role of universities, e.g., Benneworth and Cunha (2015) and the presentations at the session on “Social innovation and the Role of Universities” at the XIVth International Triple Helix Conference, held in Heidelberg on 26–27 September 2016.

firms.¹³ A more direct measure of innovation activities at a national level are the various composite indices, such as the Summary Innovation Index derived from the European Innovation Scoreboard and the Global Innovation Index.¹⁴

It is worth distinguishing ‘success’ vs. impacts, both intended and unintended impacts: what is success for a firm, might have negative repercussions for other firms, people – employees or other social groups –, or the environment. The IS literature has assumed for long that business innovations have favourable impacts. This view is shared by many policy-makers, beyond the STI policy domain as well. Business innovations are supposed to lead to improvements in the properties of goods; productivity and performance of firms; health conditions of people; the use of inputs and so forth. Ultimately, all these changes amount to an increase in the wealth of nations. It should be added, however, that business innovations, characterised as creative destruction, have a destructive element as well: incumbent firms need to adjust by abandoning some of their previous activities, shedding labour, reorganising their processes, changing management and other practices, etc. It is a crucial feature of market economies that firms are driven out of business by more efficient competitors. The net impact is still assumed to be positive, given the advent and subsequent rise of the new entrants.

This still widely held, optimistic assumption concerning business innovations has been questioned more recently.¹⁵ Probably the most widely known cases of destructive business innovations by now are those financial ones that have been introduced in the name of ‘dispersing the risk’, but in essence allowing a few, well-informed and well-positioned actors to realise substantial profits while putting a huge burden on society as a whole (Soete 2013: 141–142). The environmental burden of new products and technologies is also rather high in many cases.

As for *social innovations*, the bulk of SI definitions postulates a success, that is, positive societal impacts (Havas and Molnár 2020). It is a rather severe methodological flaw: a) the impacts of any social innovation should be assessed *ex post*, on a case-by-case basis; and b) these definitions exclude the existence of unsuccessful social innovations. Social innovation may also have a ‘dark side’ (Nicholls *et al.* 2015: 5–6). Clearly, no society is homogenous, not even those social groups that are marginalised and disempowered: their members still have their own values and views, and thus might perceive a certain change process and its effects in different ways. Moreover, a particular solution that improves the situation of some groups can, in fact, affect other groups negatively – and not just because they perceive the improvement for other social groups as a relative worsening of their situation, but in some cases as an actual, ‘neutrally measurable’ impact, e.g., when their access to certain support schemes or services becomes more limited. Inadequate interventions can even further aggravate the position of marginalised groups.¹⁶ For these reasons the measurement of social innovation activities and their impacts is a much more demanding task than measuring business innovations (Havas 2016b). Hence, it is not surprising that we do not have even partially satisfactory methods, let alone a widely used set of indicators to measure SI processes (inputs, throughputs, and outputs), their outcomes, and impacts. This issue is in the focus in Krlev *et al.* (2021).

¹³ To recall just a few, dissenting views, see, e.g., Aiginger *et al.* (2013); Fagerberg (1996); Krugman (1994), (1996); and Siudek and Zawajska (2014).

¹⁴ These composite indices are criticised on methodological grounds by Edquist *et al.* (2018), Grupp and Schubert (2010), and Havas (2014), (2019). These methodological weaknesses also imply that relying merely on composite indices, without a thorough analysis, can lead to misleading policy conclusions.

¹⁵ For a short overview of the literature stressing negative societal and environmental impacts of business innovations, see, e.g., Havas and Molnár (2020).

¹⁶ Two such examples are discussed in more detail in Havas and Molnár (2020), namely the negative impacts of microcredit schemes on poor people in several continents and the failed intervention to cease segregated education of Roma pupils in Hungary.

Ultimate success is understood in *ST research* to achieve transitions to (more) sustainable socio-technical or even socio-economic systems. It has been shown in a range of historical studies that such transitions are in principle possible (cf. the extensive body of work by Geels and collaborators). Contemporary studies mainly focus on early phases of sustainability transitions, implying that ‘success’ needs to be understood more modestly, often in terms of the potential that an emerging experiment or niche development process may pave the way towards a real sustainability transition. The concept of transformative outcomes is helpful in this regard, as it focusses on short- to medium-term effects and processes that are essential for triggering subsequent transformative dynamics (Ghosh *et al.* 2021).

5 Key features of diffusion and transformation dynamics

The level of change, diffusion, and system transformation are related issues: it is possible and necessary to disentangle these phenomena, but it is equally important to understand their interlinkages. An obvious illustration of this claim is the Freeman-Perez typology of levels of change induced by business innovations, already introduced in section 4.2. Further, it is important to note that innovations do not only impact on the firms and other organisations that introduce these new solutions, but incremental changes are also required to adapt innovations to the new context when they are diffused. Transformation denotes changes at the level of systems. In this section first we discuss the diffusion of innovations – how it is understood and treated in the IS, SI, and ST literature – and then present what types of transformation mechanisms are identified and analysed in these three strands that can lead to sustainability transitions.

5.1 Diffusion of innovation

Business innovations can only have impacts on entire economic sectors, regions or national economies when they are diffused, that is, introduced by more and more actors, not only by their ‘inventors’. Thus, diffusion is an important subject both in mainstream and evolutionary economics. The former paradigm focusses on economic incentives of producers (to adopt a new production equipment, buy a licence or a new input) and consumers. It is a dynamic analysis as it examines a temporal process, but somewhat static in terms of the product characteristics and the set of capabilities needed to use a new product, be it a production or consumer good. The latter paradigm, on which the IS literature draws heavily, in contrast, stresses not only adoption but also the adaptation required when a new product, service, process or method is introduced in a new environment or customers start using a new consumer good. Thus, it is a truly dynamic approach: both learning by the adopters¹⁷ and the changing properties of the new goods, processes, and methods are analysed. In sum, the main features of diffusion processes can be captured by three stylised facts: (i) diffusion is a time-consuming process; (ii) its speed differs substantially by the innovations in question and also across countries; and (iii) an unknown, but probably significant proportion of innovations, even when introduced by some initial adopters, never diffuses widely, and thus ultimately ‘vanish’ (Dosi and Nelson 2010).

¹⁷ That aspect also underlines the interrelatedness of the level of change and diffusion: introducing an incremental innovation is likely to require minimal learning efforts, as opposed to radical innovations that necessitate considerable learning and possibly ‘unlearning’ of old routines and obsolete pieces of knowledge as well. From a different angle: when developing absorptive capacities is a demanding task and production processes, management methods, organisational arrangements also need to be changed to introduce a new production equipment and reap its economic benefits, these are severe ‘retardation factors’ of a given innovation’s diffusion. See also section 5.2 on these issues from a different angle.

Given the noteworthy interest of economists in diffusion, several types of models have been developed.¹⁸ The advanced versions of these models take into account that new products are improved and adapted to new needs of new users in new contexts,¹⁹ and thus no ‘saturation point’ can be established. More generally, together with the major changes in product characteristics their prices also change, leading to significant changes in their market shares and eventually new producers enter the market in many cases.

Analysing the diffusion of *social innovations* is still in its infancy, compared to the IS literature, for understandable reasons.²⁰ SIs are rather complex and diverse change processes; they cannot be boiled down to 3–4 major types. Hence, it would take significant time and efforts to collect data on their diffusion processes, making it prohibitively expensive. SI practitioners are not driven by economic incentives to diffuse their new solutions, and thus financial considerations neither promote, nor hamper the diffusion of knowledge about these new initiatives. As opposed to business innovations, there is no intellectual property rights regime – patents, utility models, trademarks, copyrights – for SIs that would hamper their diffusion.

Diffusion of SIs still occurs, mainly driven by devoted SI practitioners. The main channels are SI practitioners’ networks (both at a national level and internationally), trainings, workshops, and other discussion fora of SI ideas. Governments – at local, regional or national levels – can also play a significant role. Other influential actors are NGOs and social enterprises. For SI, the context is decisive, and thus an ‘easy and smooth adoption’ of a solution that works in a given context is out of question: it has to be substantially adapted to any new context to make it effective in tackling an even seemingly similar societal problem. Clearly, that requires extra intellectual and financial resources, efforts, and time.

In the *ST literature* the diffusion of innovations is an important mechanism underpinning transitions but given the co-evolutionary nature of socio-technical change on which sustainability transitions reside, these diffusion processes are understood as being paralleled by complementary behavioural, organisational or even institutional changes. Major importance is therefore also attached to the processes of first and second order learning associated with the mutual adjustment of these co-evolving elements. The emphasis put on learning and shaping of innovations in niches is also tied to the ambition of exerting influence on, or even change, the prevailing regime (in the MLP parlance), i.e., either in terms of becoming embedded in that regime or in terms of destabilising it (Sengers *et al.* 2021). Hence, the diffusion of innovations is seen as a tightly intertwined process, even more so than in innovation studies, with further changes of the nature of the innovation in question.

5.2 Transformation dynamics in the innovation studies literature

We have identified four types of transformation dynamics in the IS literature: (i) a widespread diffusion of new products and technologies; (ii) social acceptance of ‘green’ technologies; (iii) evolutionary and complex self-reinforcing dynamics; and (iv) the emergence of new technical systems and techno-economic paradigms. As the latter mechanism (Freeman and Perez 1988; Perez 1983, 1985, 2010) are presented in section 4.2, we provide a brief overview only of the former three mechanisms below.

¹⁸ A brief overview of evolutionary models is offered in Dosi and Nelson (2010), while an entire chapter is devoted to mainstream (equilibrium) models of diffusion in the same handbook: Stoneman and Battisti (2010).

¹⁹ A classic example is hand-held calculators, originally developed for scientists and engineers, but as they had become cheaper, less sophisticated, and thus easier to use, eventually found their way to the mass consumer market, also being built into trolleys of certain supermarkets. One might also claim that these gadgets then evolved into PDAs (personal digital assistants) and eventually into smart phones, which now have a higher capacity than computers used in the Apollo programme.

²⁰ Some initial research results on SI diffusion processes are presented in Mulgan *et al.* (2007).

Business innovation leading to transformation

A lot of the discussions on transformation revolves around devices (e.g., cars, heating systems) and technologies (e.g., green technologies such as solar or wind power). This stream of literature assumes that transformation is achieved through the diffusion of environmentally friendly technologies, which eventually become dominant. Diffusion occurs through market mechanisms and hence is based on rational decisions by individuals, following economic criteria (Rogers 2003). The underlying institutions, social, cultural, or spatial structures are not challenged fundamentally (Zijlstra and Avelino 2012), they remain largely the same but the technological artefacts are replaced, by e.g. driving electric vehicles instead of cars with an internal combustion engine. Transformation can then be achieved by the sheer volume of replacement of key technologies (Foster 1986). Yet, this process of technology diffusion is rarely smooth. Apart from two ‘cracks’ – one between innovators and early adopters and another one between early majority and late majority –, there exists a ‘chasm’ between the early adopters and the early majority. This is by far the most formidable and unforgiving transition in the Technology Adoption Life Cycle (Moore 2002: 19). The characteristics of early adopters and early majority differ, and thus sales will not increase smoothly without further actions of the vendor. When early adopters buy a certain new product, they expect a radical discontinuity between the old and the new ways of use. They are also prepared to deal with the inevitable bugs and glitches that are part of any new technology coming to the market. In contrast, the early majority looks for a productivity improvement in existing processes (operations) with a minimal disruption of their old ways of ‘doing things’. They want the new technology to improve, not overthrow, the established ways. Further, they definitely do not want to debug these new products. In sum, the needs and expectations of early adopters and early majority are very different, and hence the ‘chasm’. Testimonials by other users are essential for early majority to adopt, but due to their special characteristics, early adopters may not serve as references. To avoid disruption, no potential early majority member will adopt the technology without having consulted several others with similar preferences.

Social acceptance

For several business innovations, citizens (i.e., not just consumers), NGOs, and the media play an important role in determining whether an innovation will evolve into transformation or not.²¹ Social acceptance, for instance regarding the sustainability or the ethical implications of innovations, represents an additional mechanism intervening in transformation pathways. Social acceptance has often been regarded as a factor hampering change processes. However, transformation processes can also be reinforced by paying special attention to their social rather than just their economic benefits, as demonstrated in the past by ‘green’ technologies. Social acceptance criteria can also be translated into economic incentives (e.g., through special subsidies) or regulatory requirements (e.g., emission standards). The focus of this stream of literature is often on the puzzling contradiction between a generally positive public attitude towards environment-friendly technologies, on the one hand, and their slow uptake in real life, on the other (Wolsink 2012; Wustenhagen *et al.* 2007).

Evolutionary and complex self-reinforcing dynamics

Independently of whether market-based diffusion or politically driven social acceptance of innovations is considered, innovation studies have always been looking more abstract models of how technoeconomic change comes about. As departures from neoclassical equilibrium thinking, evolutionary and more specifically Neo-Schumpeterian economics has

²¹ That is, social acceptance is not merely determined market forces, it is an outcome of political debates and selection.

inspired innovation studies by focusing on the interplay of variation, selection and retention mechanisms in relation to business innovations and firm organisation (Nelson and Winter 1982), and how they lead to the formation of institutions and (technological) trajectories, interpreted as processes of emergence (Dosi et al. 1988).

With the advancement of (computational) complex systems research, this (co-)evolutionary line of reasoning was further enhanced and enabled an integration of micro- and meso-level perspectives. A good example of a complex mechanism leading to emergent phenomena are network externalities and their impact on the diffusion of technological business innovations and the formation of stable trajectories and standards (or even lock-ins) (Arthur 1988); they can be seen as “demand-side economies of scale” (Katz and Shapiro 1986). More recently, the argument of network externalities is a crucial factor in analysing platform economics (Constantinides *et al.* 2018) or ecosystems (Hein *et al.* 2020; Thomas and Autio 2019).

Similar ideas had been proposed already earlier in relation to industrial dynamics. According to this industry life cycle perspective, industrial transformation is part of overall transformation processes. In the early stage of an industry, technology is still evolving and changing rapidly, uncertainty and risks are high, while entry barriers are low. There is no dominant design (Utterback and Abernathy 1975); many design solutions co-exist. The emergence of a dominant design is a turning point in the development of any industry (Abernathy and Utterback 1978; Brem *et al.* 2016; Utterback and Abernathy 1975): a single design becomes dominant – a *de facto* industry standard – as it is accepted by innovators, competitors, and users alike (Utterback 1994).

5.3 Transformation dynamics in social innovation studies

Social innovations are often embedded in agendas of changing social relationships more broadly, together with the institutional environments that shape these relationships. The pathways from individual social innovations to wider transformation have been addressed more systematically in research in recent years. We have identified four main lines of SI research addressing this issue, namely i) micro-level perspectives on how social innovations lead to more widespread changes in social practices, ii) spatial perspectives on how social innovations ‘travel’ and how they proliferate by getting embedded in novel contexts, iii) emphasis of changes in power relations as decisive lever for enabling the scaling of social innovations, and iv) meso-level perspectives that conceive institutional change as the primary aim of social innovations and thus as triggers of transformative dynamics.

Social innovation causes transformation via change of social practices

SI studies assume that the relationship between social innovation and wider transformative change occurs via changes in social practices. However, SI studies are not part of the social practice theory (SPT) *per se*, but largely build on an interpretation of the latter. SPT understands social practices as “the nexus of doings and sayings bound by collective understandings, procedures and engagements based on habits and routines” (Castelo *et al.* 2021: 2; Schatzki 2002; Southerton *et al.* 2012; Warde 2005). Often, the analysis of social practices concentrates on activities that are performed on a daily basis, e.g. eating, moving, shopping. Social practices are recognisable blocks or patterns of activity that are filled out or enacted by practitioners thereby reproducing, perpetuating, and transforming the practices they carry (Schatzki 2002; Shove and Walker 2014).

Some social practices cause conflicts because they are unsustainable: they have negative effects like air pollution, greenhouse gas emission, noise, or resource depletion. These are mainly mobility practices involving private car use and taking short haul flights at a massive scale. SPT posits that social practices can change in three different ways (Watson 2012). *First*, the elements comprising the practice can change. This does not only refer to the

development of the technologies underlying e.g. driving or cycling, but also the rise of testimonials of the new social practice. *Second*, the carriers of social practice can also change, the people who perform the practice, from early adopters and ‘influencers’ to early majorities (Rogers 2003). *Third*, the relation among practice bundles changes, as practices are contingent; e.g. mobility practices can change when another social practice changes (e.g. working, given a new job) and vice versa.

Social innovation scholars claim that underlying these changes in social practices is social innovation (Cajaiba-Santana 2014; Howaldt *et al.* 2015). SI and their actors depart from existing trajectories based on mental maps, rules, routines, pathways, and mental models on politics, business, and society. SI may, hence, be a starting point for further social dynamics that lead to altered social practices and lifestyles, and thus drive transformative social change (CLR1: 17; Howaldt *et al.* 2017; Krohn 2005; Tarde 2009). Merits of SI in this context are showing the way forward for novel solutions, thereby often overcoming or addressing conflicts, as they experiment with novel ways of assembling and re-assembling heterogeneous pieces of experience and knowledge, finding strategic allies and develop constellations that address challenges and conflicts on the way of a sustainability transition.

A ‘just’ and inclusive sustainability transition means, therefore, to take into account conflicting values and interests and enable citizens to co-shape transition processes. Empowerment and participation of citizens are understood as central elements of social innovation and main avenues for achieving sustainable developments.

Special attention is paid in various streams of literature, including SI, to infrastructure (and infrastructure technology) as an enabler of transformation. Existing infrastructure shapes impacts on social practices and perpetuates them: “The physical landscape (urban structures with a separation of work and home, roads) has been shaped around the car and stabilizes it” (Geels 2012: 477). The social practice theory (SPT, Barr 2015) sees them as ‘choice architectures’. The social practice of using a bike instead of the car is thereby influenced by a choice architecture like cycle lanes, racks, secure cycle storage or showers at the workplace. More generally, existing infrastructure builds on technology and sends signals to use certain technologies. Transformation is a lengthy process: immaturity of novel infrastructure stabilises existing routines and social practices (SPT logic) and hinders diffusion of novel green technologies (technology diffusion and acceptance logic); yet, it is simply impossible to introduce mature novel infrastructure at once and for all, without learning and by doing and using. This experimentation is a must to improve novel infrastructure.

Translocal diffusion of SI: adaptation and learning processes

Social innovations often start as grassroots innovations in a local context, like local sustainability initiatives of some form, hence they are bound to their geographic context and local perspective of problems. but at the same time some of these SI are also connected to other local initiatives across the world. Loorbach *et al.* (2020) coined the term “translocal diffusion” for local initiatives and networks that exchange, translate and diffuse ideas across the globe. (Pel *et al.* 2020) see their strength in the translocal connectivity which is stronger than their local embeddedness. They transport and circulate ideas and novel solutions over wide distance, and hence form an international network held together by global movements, NGOs, associations, and scientific communities. They form a globally spread critical mass and translocal identity. Knowledge exchange happens more fluently compared to mere local initiatives, infiltrating local networks across continents via strong and weak ties. The translocal identity is a source of legitimacy and hence strength, at the same time they challenge, alter, or replace existing social structures (Avelino *et al.* 2019; Haxeltine *et al.* 2017; Loorbach *et al.* 2020) and may thus contribute to transitions as well.

Change of power relation: empowerment and disempowerment

Transformation is related to changes in power structures (cf. Avelino *et al.*, this issue). Empowerment is a distinguishing element (Windrum *et al.* 2016) or a crosscutting issue (SI Drive) in the SI literature. Empowerment is a strength of SI initiatives in the realm of environmental issues (DuBois *et al.* 2005), also in the transformative SI perspective. Citizens are provided with alternatives (“make the environmental-friendly choice the easy choice”), hence empowered to choose what and how they perform and change practices, thus mitigating their negative impact on the environment.

Empowerment of citizens and new actors goes along with disempowerment of incumbent actors. Disempowerment of actors and renunciation of structures involved in harmful activities to the environment is another important factor in achieving transformation (Avelino *et al.* 2019; Wittmayer *et al.* 2019). Certain types of SI ecosystems facilitate empowerment (Pel *et al.* 2020). SI is understood by them as the introduction of new social relations, while the notion of SI ‘ecosystems’ stresses the distributed nature of SI agency. SI ecosystems can empower by local embedding, translocal connectivity, or via discursive resonance. The latter refers to the circulation of organisational models, framings and new narratives, practice formats and evidence. It can involve key actors and organizations in leading the discourse.

Institutional change

Institutions are analysed in the SI literature in diverse ways. In the so-called extended social grid model of SI it is at the core, in a close interactions with networks and cognitive frames (Ziegler *et al.* 2019). As already mentioned, without sufficient changes in these three “social forces”, an SI is bound to fail (Molnár and Havas 2019). In other studies, institutional change has been analysed as an impact – that is, not as a tool – of social innovation (van Wijk *et al.* 2019). More recent contributions frame institutions as the main object of change in social innovations. While some analysts put the actors and their characteristics in the focus, others stress the decisive role of context, especially its structural contingencies. By integrating these perspectives, that is, agency and structure, Cajaiba-Santana (2014) interprets social innovation as the result of interactions among agency (actors), social systems (structures), as institutions. Institutions let actors identify and reflect upon societal problems, initiate new ideas, frame and evaluate their own resources and strengths and then search for partners to compensate weaknesses and add to their strengths. Successful social innovations create momentum and change institutions and even systems (Nicholls and Ziegler 2019; Turker and Altuntas Vural 2017).

5.4 Transformation dynamics in sustainability transition studies

ST research has put an explicit emphasis on conceptualising transformative dynamics, thereby drawing partly on insights from evolutionary economics and complex systems thinking, but also from science and technology studies. A co- and quasi-evolutionary understanding processes of social and technological change, but also of institutional development have been of central importance in ST. Next to i) the multi-level perspective (MLP) on transitions, ii) systems approaches like TIS (Technological Innovation Systems) with its focus on structural and functional analysis have inspired the understanding of how transition processes evolve. More recently, these meso-level frameworks have been embedded in a macro-level framework on deep transitions, multiple interconnected transitions and global innovation systems. These approaches, however, are always tied to a specific normative orientation towards – mostly environmental – sustainability, thus leaving alternative normative framing largely aside.

Transitions from a multi-level perspective

The MLP emphasises socio-technical and institutional dimensions of sustainability transition, and it argues that sustainability transitions cannot be achieved as a merely bottom-up or top-down processes but requires an interplay of micro-level niche developments and meso-level regime changes. The necessity to overcome path dependence is a key concern. Policy-makers and (business) innovators make often part of informal coalitions of incumbent actors who tend to pursue traditional ways of addressing and regulating climate and environment issues resulting in path dependences and lock-ins (Geels 2004; Geels and Schot 2010; Grin *et al.* 2011; Markard *et al.* 2012).

The MLP stream explicitly frames transitions as long-term processes that are non-linear, meander forth and back and address a multitude of conflicts and problems. Transitions are meant to overcome established and often path-dependent socio-technical system pathways; challenges that cannot be overcome within prevailing governance structures and processes, but for which learning spaces need to be created in a bottom-up fashion, both for specific technological options and for wider institutional conditions. They require the interaction of social groups at different levels including local citizen initiatives, social movements, user groups, and policy-makers, as well as businesses that develop more sustainable solutions and business models, which can contribute to such a transition (a ‘whole of society’ approach). Geels and Schot (2010) characterise transitions as co-evolutionary and encompassing changes in socio-technical systems at multiple levels. The *niche* level provides space for experimentation; it is the locus where it is possible to deviate from an existing path and obtain knowledge about user preferences. The *regime* level provides more stability in that there are institutions, infrastructures, and a common understanding of problems and possible solutions. Moving novel socio-technical solutions from the niche to the regime level is not just a matter of diffusion and scaling but requires the embedding of novel solutions in institutional environments that may equally require major changes. The destabilisation and redefinition of what is called socio-technical regimes is thus an important element of transition strategies (Turnheim and Geels 2012), as is the need to find exit strategies (‘exnovation’) for technologies and companies that are not in line with the emerging new regime. New actors gain ground, while incumbents lose influence and are disempowered as part of this process. The third level, the socio-technical *landscape* provides even stronger structuration but is beyond the influence of single actors and considered mainly as a slowly changing context for innovation and socio-technical transformation (Geels 2002).

This broad picture of transition dynamics was refined in many regards in the last two decades, for instance in terms of characterising different types of transition contexts and pathways (Smith *et al.* 2005; Geels and Schot 2007). A more detailed account of the mechanisms that are underpinning the uptake and embedding of novel solutions has been provided by Sengers *et al.* (2021), who distinguish four main types of ‘generalisation pathways’: replication & proliferation, expansion & consolidation, challenging & reframing, circulation & anchoring. A different take on how to address the challenge of moving from niches to regime changes has been proposed by Ghosh *et al.* (2021), who stress the importance of creating transformative outcomes as steppingstones towards both niche development regime change: opening up & unlocking regimes, building & nurturing niches, expanding & embedding niches.

These lines of reasoning reflect the strong emphasis of ST studies on bottom-up learning processes, co-creation, and experimentation. Their wider uptake depends on aligning with and/or destabilising the existing regime to create space for alternative solutions. Top-down strategies of changing regimes, e.g., by way of major institutional reforms is given less attention in ST.

Cumulative causation in technological innovation systems

An alternative conceptualisation of (early) phase goal-oriented transformation dynamics has been developed drawing on the functions of Technological Innovation Systems (TIS) (Hekkert et al. 2007; Bergek *et al.* 2008). By analysing the suitability of structural and functional conditions for enabling (sustainable) innovations, this framework provides a useful basis for policy advice. Initially a rather static perspective, it has been ‘dynamised’ by proposing mutual reinforcements between the different TIS functions (‘motors of sustainable innovation’, cf. Suurs and Hekkert 2009). Conceptually, this builds on the notion of cumulative causation, as a simplified interpretation of complexity-inspired mechanism.

Apart from its obvious focus on technological innovation, the TIS perspective is mainly suitable for studying early phase transformation processes rather than far-reaching transitions; a deficit in need of being addressed (Bergek 2019). More recently, a first attempt has been made to extend this framework to analyse ‘transformative’ missions as specific examples of goal-oriented transformations (Hekkert *et al.* 2020).

Embedding in wider contexts of deep transitions

At the confluence of the multi-level perspective in ST research and techno-economic paradigm shifts in IS, the concept of deep transitions has been proposed as a macro-level transformation envelope for socio-technical system transitions (Kanger and Schot 2019). These deep transitions are characterised by dominant meta-rules that guide the directionality of socio-technical system change over longer periods of time, similar to long waves. Deep transitions also open up the possibility of investigating multi-system dynamics, the linkages between transformation of different socio-technical systems, and how their coherence could be achieved with the help of meta-rules.

By opening up the black box of socio-technical landscapes in the MLP framework and by drawing on techno-economic paradigm shifts, deep transitions are a bridge between IS and ST. However, this promising inroad is still at an early stage of development, with several unresolved issues to be addressed by further research.

6 An integrative perspective to analyse transformative change

We define *goal-oriented transformative change* as a closely interrelated set of radical changes at the level of an entire socio-economic system, with changes simultaneously affecting its underlying technologies, business models, cognitive frames, institutions, business and social networks, as well as business and social practices, initiated by a set of – possibly various types of – actors to achieve a major overall goal. No doubt, these radical changes are complemented by radical innovations “below” the system level, as well as millions of incremental changes at all levels. It must not be part of the definition to prejudge if the intended overall goal has been accomplished. That should be established by a thorough evaluation of a given goal-oriented transformation. That evaluation should also consider the likely different impacts on different social groups and business actors, at different stages of the change process. Another separate analytical task is to identify the intended and unintended elements of change in an overall transformative change process.

If we want to capture the variety of possible aims and innovation activities within a broad goal-oriented transformative change process, as well as their cumulative impacts, an integrative analytical framework is needed. Yet, this framework is missing yet. A few conceptual models have been developed so far in the IS, SI, and ST strands of literature to capture transformative change. They are all based on a limited number of underlying common claims of how change comes about. Both IS and ST have built sophisticated theories of (transformative) change that draw on either evolutionary or complexity-based conceptual

models. The evolutionary tradition of IS has focused on *technology–economy* interactions to capture the emergence of novel trajectories and paradigms (Arthur 1988; Dosi 1982; Freeman and Perez 1988). Complex adaptive system models have also been developed in recent years (Anderson *et al.* 1988; Foster and Pyka 2014; Lane *et al.* 2009). In ST research, too, co- and quasi-evolutionary models, both conceptual and quantitative, have been proposed to capture *technology–society* interactions and the interplay between niche developments and regime changes, with economic considerations being sub-ordinate to sustainability goals (Köhler *et al.* 2020; Schot 1992). The SI research strand has proposed various types of models, including stage models of SI, closely resembling the linear model of business innovation (Cunha and Benneworth 2013; Mulgan 2006), as well as co-evolutionary ones, highlighting the interactions among agency, social-political structures, and institutions (Cajaiba-Santana 2014; Lawrance *et al.* 2014). The extended social grid model (Nicholls and Ziegler 2019; Ziegler *et al.* 2019), another co-evolutionary model of SI, stresses that institutions, social networks, and actors’ cognitive frames all need to be changed in an orchestrated, conscious way to make social innovation successful.

In line with our integrative ambition, we argue that there is a need for widening the scope of these (partial) conceptual models by combining the respective lenses and consider the co-evolutionary or complex interactions between *technology, economy, and society* in goal-oriented transformative change processes. This claim is crucial because transformative change requires a thorough consideration a broad range of possible societal goals, as well as the commitment and actions of the full spectrum of actors (businesses, public sector and civil society organisations, and researchers in all sectors) to achieve the overall major goal. These actors are bound to have rather different ambitions, interests, and worldviews that need to be captured, analysed, and explained in an integrative perspective on goal-oriented transformative change.

As a first attempt, we offer four building blocks for a new, integrative framework to analyse goal-oriented transformative change processes, keeping in mind that for an actual goal-oriented transformative change process, there is a strong interdependence among the goal(s), types and levels, and processes of change. These should be understood as complementary elements or ‘lenses’ that together serve as a ‘focussing device’ (Lundvall 2007; Robinson *et al.* 2021), through which analysts can explore and explicate change processes, rather than a standard ‘process model’ or a unitary ‘normative’ theory of transformative change.

Rationales, overall goal, and specific objectives of change

By definition, a goal-oriented transformative change process can only start when major actors recognise the need for change and can agree on an overall goal. This complex process is composed of business, social, and hybrid innovations. Hence, fora and channels need to be created for dialogues and negotiations among the various types of actors and other stakeholders on i) what overall goal to set and ii) how to accomplish their diverse – partly complementary, partly conflicting – objectives in the frame of the overall major goal. Both analysts and policy-makers, therefore, need to perceive transformative change processes both as knowledge creation and purpose production, or sense-making processes that guide transformation.

As for the ‘individual’ innovations, *the initial impulse* comes from different sources. For business innovations the main driver is competition: firms feel the pressure to improve their products and services, as well as their production and management processes and practices, and/or introduce new goods and business models, enter new markets, or create new ones by offering radically new goods. For SIs the main driver is perceived societal needs or possibilities to create new societal opportunities. From a different angle, new initiatives – ideas to change – can come from a wide range of actors: internally from business and social innovators or externally from consumers of goods and services, beneficiaries of SI, NGOs

caring about societal and environmental issues, as well as regulators and other policy-makers. Both IS and ST research recognise the importance of technological as well as non-technological opportunities as important inspirations for innovation.

As for *the goals of 'individual' innovations*, in section 4 we have already stressed the different purposes of change processes identified in the IS, SI, and ST literatures. Business innovations either react to new demands, or create new demand, and thus new markets, while SI is directed towards (societal) needs (Hodgson 2008). From a different angle, business innovations can be best understood in the frame of the growth paradigm, while for social innovations and sustainability transitions growth is a non-issue. Moreover, in many cases the explicit goal is degrowth. Further, social innovations often address the dark sides of growth, e.g., housing problems and social tensions caused by mass industrialisation, leading to fast urbanisation, and thus declining quality of education, health, and social services, organised crime, on the hand, and abandoned, declining regions, suffering from many types of socio-economic problems, on the other.

As for the *types and sources of knowledge* to be utilised, innovators – be they social or business innovators, or ‘change agents’ of sustainable transitions – can draw on their own ideas and knowledge, including tacit knowledge, codified knowledge stemming from the results of various types of research organisations, practical knowledge of other external actors, as well as various combinations of these sources.

Objects, types, and levels of change

As for the objects, types, and levels of change, a new, overarching taxonomy can be elaborated by drawing mainly on the concepts developed in the SI and ST strands. The *objects of change* can be goods (products and services), social and business methods and practices, organisational arrangements in various sectors. As for the *type of change* it can be incremental or radical. Change can occur *at the level* of a single good, social and business method and practice in niches; a technological system (a set of interrelated goods) or a regime; and a techno-economic paradigm (more generally: an entire socio-economic system, with its underlying technologies, business models, cognitive frames, institutions, business and social networks).²² Transferability of innovations is a separate, but interrelated dimension. From that angle we can distinguish ‘sticky’ vs. easy-to-transfer innovations: the former ones are being less dependent on a specific context compared to the latter types. Clearly, the ‘deeper’ and more complex an innovation is, the ‘stickier’ it becomes.

These distinctions offer a comprehensive way to categorise innovations.

Processes and mechanisms of change

To analyse *processes of change*, we need to consider the actors engaged in different roles and capacities, the nature of processes, as well as the mechanisms that determine the nature of these processes.

The IS strand claims that while firms are in the driving seat of innovation processes, different types and pieces of knowledge are required for a successful business innovation, possessed by different types of actors, and thus co-operation is also a must among these actors. The main driver of business innovations is competition among businesses, and thus market mechanisms play a decisive role. Yet, non-market mechanisms must not be neglected, either, especially when we want to understand knowledge creation processes and the diffusion of knowledge. The main feature of business innovation processes is i) pressure on the actors and ii) a productive tension between cooperation and competition among them. We should also keep in mind that the introduction of radical business innovations is a social process, *per se*,

²² As for the latter, we can also refer to it as ‘deep transition’.

inside a firm, implying major organisational and procedural changes internally, as well as externally, among the users. Further, even a single radical business innovation can induce major changes inside a business sector, in other sectors, as well as in society. Changes are more fundamental and far-reaching when a new technological system or a new techno-economic paradigm is emerging.

In SI, the change process seems often initiated by civil society actors or even 'heroic entrepreneurial individuals', who then need to mobilise a network of local actors. Often, these actors are highly perceptive of tensions and frictions in the system, have a strong view on the prevailing institutional setting and can identify or even create windows of opportunity and win-win situations for different types of stakeholders. In many cases there are tensions among the major players at the local level, especially when the SI initiative is not firmly embedded into the local social networks and/or strongly challenges the cognitive frames of influential local actors. Besides, there might be tensions between i) centrally set policy goals and tools vs. local needs; ii) actors at different governance levels, as well as iii) micro- and macro-level institutions. These tensions might more often be caused by diverse views on possible solutions (what to do) and their implementation (how to do) rather than on the underlying objectives of an SI.

SI processes are driven by societal incentives for social innovators: they want to respond to societal needs. As business incentives do not play any role, there is no competition among SI actors, and thus market mechanisms do not guide these change processes. Most SIs aim at diffusing a novel solution as widely as possible for the benefit of the social groups in need, not at excluding other SI actors from applying a new solution in other localities. While IPR and other methods are aimed at preventing the imitation of business innovations because easy, and thus fast and wide-spreading imitation undermines economic returns of innovators, social innovators often encourage imitation (Windrum *et al.* 2016). However, as reputation plays a role for many social innovators, reference to their solution is still of importance.

The ST literature considers a wide spectrum of mechanisms underpinning transition processes. They range from the entrepreneurship of inspired individuals via protective societal incentives to interactive learning in early phases of niche development. Resource-based considerations (Musiolik *et al.* 2012), market competition, along with collaboration also play a prominent role, as well as regulatory and other demand-side forces in later phases of a transformative change. ST demonstrates the richness of mechanisms at play when moving from innovation to goal-oriented transformative change, though with an emphasis on a specific normative orientation towards sustainability.

In sum, these three strands provide complementary insights into processes and mechanisms that contribute to explaining goal-oriented transformative change, and in particular the ambition to break existing path-dependences and create and stabilise new paths with their respective novel institutional and structural characteristics. IS stresses competition and the importance of the diversity of knowledge for innovation and transformative change, SI puts the emphasis on societal needs and the diversity of actors and their goals, while ST highlights the diversity of transformative mechanisms leading from innovation to institutional and structural change. For an integrative perspective, all these different ingredients are needed.

Common to all three strands (IS, SI, ST) is the idea that path dependence is a major force to slow down or block (transformative) change. The concept of path-dependence highlights the practical importance and repercussions of incremental changes along a given pathway that represents at the same time an approach, a framing, a regime, and a paradigm. Path-dependence implies contingent and non-reversible processes (David 2001). Path dependence is tied to institutions, as pathways are associated with a set of established institutions in place. Also, most agents stick to established institutions by mainstreamed ways of framing and acting. IS, SI, and ST all argue for a need to overcome path-dependences, and hence for

path-breaking and path-creating. The initial sparks that unleash processes of path-breaking and path creation are often systemic tensions resulting in major pressures, together with opportunities through new framings, technologies, and negotiations of win-win situations. Radical *business innovations*, for instance, are pathbreaking by definition and their diffusion creates new trajectories. The mode of organisation for this is the market. For *social innovations*, path-breaking institutional change is a fundamental aim (Nicholls and Ziegler 2019; Terstriep *et al.* 2020; Ziegler *et al.* 2019). This is enacted by networks of actors where the combination of different approaches by these actors allows to develop new narratives of change and socially innovative concepts in ‘discursive resonance’ (Pel *et al.* 2020). The formation of networks is the dominant mode of organisation to achieve path-breaking institutional change (i.e. ‘social means’ (BEPA 2010)). *ST* frames and facilitates path-breaking through multi-level governance processes that allow distributed learning and self-organisation processes along visions and missions, but without discarding the importance of market mechanisms and regulation for changing dominant regimes. The corresponding mode of organisation gives elements of soft governance a prominent role but suggests using this mode also for preparing harder governance instruments. For an integrative perspective, markets, networks, and hybrid governance (top-down and bottom-up; soft and hard) in combination are instrumental to effect transformative change,²³ but their relative importance may vary in the course of the transformation process.

A set of criteria to assess change

Business innovations are driven by business logic, and thus outcomes and impacts are traditionally assessed by business considerations: whether productivity and efficiency are enhanced, and thus profits and shareholder value increased. More recently, though, aspects of corporate social responsibility, especially environmental impacts, are becoming important criteria when evaluating business innovations. In some cases, however, these criteria are used in a tokenistic, superficial way.

Justice and equity, including global justice, are issues for social innovators, as social innovations aimed at addressing unmet social needs, advancing social inclusion via fighting injustice and marginalisation. Bringing these social ambitions of innovation to the fore has certainly been one of the most important contributions of SI research, and they are now playing a key role in the assessment of innovations and transformations. Social innovations are also inevitable to tackle environmental challenges, where justice should also be a major concern (Boelman and Heales 2015). Lately, just transition have become an issue of growing interest in *ST*, implying that *ST* is opening up its normative agenda and becoming more integrative.

From a new, integrative perspective we need to recognise that most change processes have major social impacts, either intended or unintended ones, and thus these aspects should be considered when they are assessed. Yet, it always depends on the vested interests, values, and worldviews of major actors what aspects are included in the set of criteria to assess the outcomes and impacts of transformative change processes.

Finally, we should keep in mind that the set of criteria to assess change is likely to be modified at least to some extent by the actors for various reasons – changes in the context, emergence of new technological opportunities, tensions during the implementation, noticing unintended impacts – during the transformation process.

²³ The triangle of markets, networks, and hybrid (public) governance re-frames the more traditional interpretation of markets, networks, and hierarchies as the three dominant modes of coordination of social life (Thompson *et al.* 1991).

7 Conclusions

Three strands of literature: an assessment

We have revisited the origins and evolution of three distinct strands of literature, that is, Innovation Studies (IS), Social Innovation (SI), and Sustainability Transitions (ST) research in this paper, with the intention to identify their main – similar and divergent – features in their approach to different types of innovation. Our ambition has been to stress the need, and show the possibilities, for constructing an integrative perspective to analyse and better understand transformations as intentional change processes. For that purpose, we have considered the main conceptual frameworks – the key notions and approaches – used in the IS, SI, and ST literatures. We distinguished different types of change processes by their principal purpose. We discussed the typical main actors and their interactions during innovation processes; the ‘objects’ and the levels of change; the sources and types of knowledge (co-)produced, utilised, and diffused during the change processes; and how success and impact are defined and measured in the three strands. We have also considered how diffusion and transformation mechanisms are understood.

For historical and sociological reasons these three strands so far have evolved in rather loose, sporadic interactions with each other, and thus possibilities for mutual learning have been seized to a limited extent only – despite their common fundamental intellectual quest to describe and understand intentional change processes. Our attempt to provide a structured characterisation and a ‘friendly’ critique of the three strands has yielded several lessons. While they each provide a perspective on goal-oriented transformations in society, these perspectives are partial. Further, each has its particular deficits.

Innovation studies still concentrates its analytical efforts first and foremost on business innovations, despite its ‘all-encompassing’ label. It is yet to be seen if efforts to open up and diversify can take roots, strengthen and find home in this paradigm. While there have been non-negligible advances in service innovation research, analysing non-marketable innovations is still at the fringe. Compared to the other two strands, this paradigm would need to put more emphasis on considering a widening range of actors – investors, managers, researchers and engineers, users as co-producers of innovations, consumers, and policy-makers – and their respective cognitive frames as major drivers shaping innovation processes. As its firmly rooted in the business logic, the focus is on innovations as sources of commercial success. More recently, however, some studies consider the normative dimension, too: recognise and assess – the often unintended – social and environmental impacts of business innovations; analyse their role in development; notice and critique ‘destructive creation’, beyond fanfaring ‘creative destruction’.

Social innovation research still lacks the conceptual sophistication of innovation studies and sustainability transitions research. It tends to downplay the role of science and technology as major drivers of social change, as well as that of top-down institutional changes in inducing innovation and transformation. Further, SI research does not distinguish different levels of change in a systematic, clear-cut way as the other two strands do. Measurement remains a largely unresolved task. This relative ‘underdevelopment’ is to a large extent due to intrinsic difficulties, namely the complex and complicated nature of SI processes and the social issues that SI initiatives attempt to tackle. We also need to realise that not everything that is important can be measured, and not everything that can be measured is relevant.

Sustainability transitions research pursues a strongly normative agenda and tends to underrate the multitude of societal and business objectives that may guide and shape goal-oriented transformations in society, and in particular the transformative role of generic and disruptive technologies. This goes hand in hand with over-emphasising bottom-up learning processes and down-playing the influence of top-down impulses in triggering transformation

processes. There is a greater variety of transformation strategies and pathways to be considered than the ones proposed by the ST literature.

These strengths and deficiencies strongly indicate that a meaningful combination of these three strands, as well as mutual learning among their scholars, is needed as a foundation of a deeper and more germane understanding of goal-oriented transformation processes in economy and society.

Normative implications

A new, integrative approach is likely to facilitate a better understanding of normative issues and then identify further meaningful, desirable ambitions other than sustainability. Earlier the parlance used to be “economically, socially, and environmentally sustainable development”. Nowadays these ideas are enshrined in SDGs, sustainable development goals. This evolution and reframing suggest that we should not just take “sustainability” as given, as an ambition carved in stone; there might be possibilities to arrive at more meaningful normative ambitions, in particular in times when sustainability may certainly continue be an important societal concern, but not the only vital one. To explore that we clearly need transparent, more appropriate – and cost-efficient – methods for organising normative dialogues, better serving societal needs. Those dialogues can identify inevitable tensions among countries and social groups with different experience, worldviews, values, and ambitions. Participatory, systematic deliberations can assist the actors to arrive at shared visions and specific objectives, and then take joint, effective actions.

Directions for future research

As a crucial step to construct an integrated theory, we would need to systematically analyse what models of innovation have been developed and favoured in the IS, SI, and ST literature. Drawing on evolutionary and complex systems models, a *problem to be tackled*, or a *new possibility/ solutions space* to be seized or created (Wanzenböck *et al.* 2020) would be the foundation stone of a future model of goal-oriented transformative change: what major issues are identified by the innovation actors and other stakeholders, using what fora, processes, and methods. Further modules of this theory would need to consider i) the *interactions among the actors* in their various activities: sensemaking; setting the overarching goal of transformative change; discussing and orchestrating specific objectives of business, social, and hybrid innovations; devising and introducing new solutions; learning, creating and disseminating new knowledge; assessing developments, revisiting – if necessary revising – the overarching goal of transformative change and the specific objectives of innovations; addressing the inevitable tensions among actors and between actors and other stakeholders; ii) the *interactions between the actors and the context* (the structure): the processes, mechanisms, activities; iii) the *institutions* guiding and framing interactions among the actors, as well as between the actors and the context; iv) *knowledge*: the available pool and the need to create new knowledge; as well as v) the subject, types, and levels of change. A set of evaluation criteria should also be compiled to for assessing goal-oriented transformative change processes.

The next step would be to compare the policy rationales – justification for policy interventions – distilled from the various models of innovation developed and applied in the three strands of literature. Together with a future model of goal-oriented transformative change, that would provide the basis to draw policy implications.

Tentative governance, policy, and practical implications

Our proposed integrative approach implies the strong need to i) orchestrate policy objectives and tools across policy domains, guided by the overarching goal of transformative change; ii)

create space and mechanisms for policy experiments; iii) establish fora for normative dialogues among various types of innovators, policy-makers, and other stakeholders; iv) develop the missing, but required capacities for transformative changes.

An integrative approach to goal-oriented transformations can also underpin more effective strategies and activities for various types of actors (most notably businesses, social innovators, NGOs, and citizens as individuals), as well as more effective public policies. The complementarities among them in terms of their capabilities and opportunities to act, e.g., when orchestration of changing technologies, infrastructures, social and business networks, cognitive frames, institutions, and social practices need to be mobilised to set in motion goal-oriented transformation processes. This is also why incumbent actors with their respective economic interests play a key role in transformation strategies, because they not only have the power to prevent change, but also the means to drive it at a large scale. This is a *practical implication* for change agents who need to take into account several, if not all types of approaches currently treated in isolated ways in the three strands of literature in terms of theorising, policy-making, and acting.

References

- Abernathy, W.J. and Utterback, J.M., 1978. Patterns of industrial innovation. *Technology Review*, 80, 40–47.
- Aiginger, K., Bärenthaler-Sieber, S., Vogel, J., 2013. Competitiveness under New Perspectives, WWWforEurope Working Papers no. 44, <https://www.econstor.eu/handle/10419/125699>.
- Anderson, P.W., Arrow, K.J., Pines, D. (eds), 1988. *The economy as an Evolving Complex System*, CRC Press, Boca Raton.
- Anderson, L., Ostrom, A.L., Corus, C., Fisk, R.P., Gallan, A.S., Giraldo, M., Mende, M., Mulder, M., Rayburn, S.W., Rosenbaum, M.S., 2013. Transformative service research: An agenda for the future. *J. Bus. Res.* 66, 1203–1210.
- Andries, P., Daou, A., Verheyden, L., 2019. Innovation as a vehicle for improving socially vulnerable groups' access to basic provisions: A research note on the development of a questionnaire module, *Research Policy*. 48, 281–288, <https://doi.org/10.1016/j.respol.2018.08.017>.
- Arthur, B., 1988. Competing technologies: an overview, in: Dosi, G. et al. (eds.): *Technical Change and Economic Theory*, Pinter, 590–607.
- Avelino, F., Wittmayer, J.M., Pel, B., Weaver, P., Dumitru, A., Haxeltine, A., Kemp, R., Jørgensen, M.S., Bauler, T., Ruijsink, S., 2019. Transformative social innovation and (dis)empowerment. *Technol. Forecast. Soc. Change* 145, 195–206.
- Barr, S., 2015. Beyond behaviour change: social practice theory and the search for sustainable mobility, in: Kennedy, E.H., Cohen, M.J., Krogman, N. (eds), *Putting Sustainability into Practice*. Cheltenham: Edward Elgar, pp. 91–108. <https://doi.org/10.4337/9781784710606.00015>.
- Benneworth, P. and Cunha, J., 2015. Universities' contributions to social innovation: reflections in theory & practice, *European Journal of Innovation Management*, 18 (4): 508–527.
- BEPA, 2010. *Empowering people, driving change: Social innovation in the European Union*. <https://data.europa.eu/doi/10.2796/13155>.
- Bergek, A., 2019. Technological innovation systems: a review of recent findings and suggestions for future research, in: Boons, F., McMeekin, A. (eds.): *Handbook of Sustainable Innovation*, Cheltenham: Edward Elgar, pp. 200–218.
- Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: A scheme of analysis, *Research Policy*. 37(3), 407–429.

- Boelman, V, and Heales, C. (eds) 2015. *Social Innovation Strategies – Regional Report*, SI-DRIVE Research Paper, TU Dortmund.
- Bresnahan, T., 2012. *Recombination, generality, and re-use. The Rate and Direction of Inventive Activity Revisited*. Univ. Chic. Press.
- Brem, A., Maier, M., Wimschneider, C., 2016. Competitive advantage through innovation: the case of Nespresso. *European Journal of Innovation Management*. 19, 133–148. <https://doi.org/10.1108/EJIM-05-2014-0055>.
- Bulakovskiy, M., 2021. *Building Local Ecosystems for Social Innovation: A Methodological Framework*. <https://doi.org/10.1787/bef867cd-en>.
- Butzin, A. et al. (2014): *Theoretical Approaches to Social Innovation – A Critical Literature Review*, SI-DRIVE Research Paper, TU Dortmund.
- Cajaiba-Santana, G., 2014. Social innovation: Moving the field forward. A conceptual framework. *Technol. Forecast. Soc. Change* 82, 42–51. <https://doi.org/10.1016/j.techfore.2013.05.008>.
- Carça, J., B-Å. Lundvall, S. Mendonça (2009): The changing role of science in the innovation process: From Queen to Cinderella?, *Technological Forecasting and Social Change*, 76 (6): 861–867, <https://doi.org/10.1016/j.techfore.2008.08.003>.
- Carlsson, B. and Stankiewicz, R., 1991. On the nature, function and composition of technological systems. *J Evol Econ*. 1, 93–118. <https://doi.org/10.1007/BF01224915>.
- Castelo, A.F.M., Schäfer, M., Silva, ME., 2021. Food practices as part of daily routines: A conceptual framework for analysing networks of practices. *Appetite*. 157, 104978. <https://doi.org/10.1016/j.appet.2020.104978>.
- Clarysse, B., Wright, M., Bruneel, J., Mahajan, A., 2014. Creating Value in Ecosystems: Crossing the Chasm between Knowledge and Business Ecosystems. *Research Policy*. 43, 1164–1176.
- Constantinides, P., Henfridsson, O., Parker, G.G., 2018. Introduction—platforms and infrastructures in the digital age. pubsonline.informs.org.
- Cunha, J. and Benneworth, P., 2013. Universities’ contributions to social innovation: towards a theoretical framework, paper presented at Cities as seedbeds for innovation, Annual Conference of the European Urban Research Association (EURA), Enschede, 3–6 July 2013.
- Daimler, S., Hufnagl, M., Warnke, P., 2012. Challenge-oriented policy making and innovation systems theory: Reconsidering systemic instruments, in: Fraunhofer ISI (ed.): *Innovation system revisited. Experiences from 40 years of Fraunhofer ISI research*, Fraunhofer.
- David, P.A., 2001. Path dependence, its critics and the quest for ‘historical economics.’ *Evol. Path Depend. Econ. Ideas Past Present* 15, 40.
- de Vasconcelos Gomes, L.A., Figueiredo Facin, L., Salerno, M.S., Kazuo Ikenami, R., Unpacking the Innovation Ecosystem Construct: Evolution, Gaps and Trends. *Technological Forecasting and Social Change*. 136, 30–48.
- Dodgson, M., Gann, D.M., Phillips, N. (eds) 2014. *The Oxford Handbook of Innovation Management*, Oxford: Oxford University Press.
- Dosi, G., Freeman, C., Nelson, R.R., Silverberg, G., Soete, L. (eds) 1988. *Technical Change and Economic Theory*, London: Pinter.
- Dosi, G., Nelson, R.R., 2010. Technical change and industrial dynamics as evolutionary processes. in: Hall, B.H. and Rosenberg, N. (eds), *Economics of Innovation*, Amsterdam: North-Holland, pp. 51–127. doi: 10.1016/S0169-7218(10)01003-8.
- Drucker, P.F., 1957. *Landmarks of Tomorrow: A report on the new “post-modern” world*, New York: Harper and Brothers.
- Dubois, B., Czellar, S., Laurent, G., 2005. Consumer Segments Based on Attitudes Toward Luxury: Empirical Evidence from Twenty Countries. *Market Lett* 16, 115–128. <https://doi.org/10.1007/s11002-005-2172-0>.

- Edquist, C., Zabala-Iturriagoitia, J.M., Barbero, J., Zoffio, J.L., 2018. On the meaning of innovation performance: Is the synthetic indicator of the Innovation Union Scoreboard flawed?, *Research Evaluation*. 27, 196–211, <https://doi.org/10.1093/reseval/rvy011>.
- Fagerberg, J., 1996. Technology and competitiveness. *Oxford Review of Economic Policy*. 12, 39–51.
- Fagerberg, J., Landström, H., Martin, B.R. (eds) 2012. Exploring the Emerging Knowledge Base of 'The Knowledge Society', special issue, *Research Policy*, 41, 1121–1282.
- Finsterwalder, J., Kuppelwieser, V.G., 2020. Intentionality and transformative services: Wellbeing co-creation and spill-over effects. *J. Retail. Consum. Serv.* 52, 101922.
- Foster, R.N., 1986. Working The S-Curve: Assessing Technological Threats. *Research Management*. 29, 17–20. <https://doi.org/10.1080/00345334.1986.11756976>.
- Foster, J. and Pyka, A., 2014. Introduction: co-evolution and complex adaptive systems in evolutionary economics, *Journal of Evolutionary Economics*. 24, 205–207.
- Freeman, C., and Perez, C., 1988. Structural crises of adjustment, business cycles and investment behaviour, in: Dosi et al. (eds), pp. 38–66.
- Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research Policy*. 31, 1257–1274. [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8).
- Geels, F.W., 2004. From sectoral systems of innovation to socio-technical systems - Insights about dynamics and change from sociology and institutional theory. *Research Policy*. 33, 897–920. <https://doi.org/10.1016/j.respol.2004.01.015>.
- Geels, F.W., 2012. A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. *Journal of Transport Geography*. 24, 471–482. <https://doi.org/10.1016/j.jtrangeo.2012.01.021>.
- Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways, *Research Policy*. 36, 399–417.
- Geels, F.W., Schot, J., 2010. The Dynamics of Socio-Technical Transitions: A Socio-Technical Perspective, in: Grin, J., Rotmans, J., Schot, J. (eds), *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*. Routledge, New York, London.
- Geels, F.W., Turnheim, B., Asquith, M., Kern, F., Kivimaa, P., Matti, C., Veenhoff, S., Frantzeskaki, N., Wittmayer, J., 2019. Sustainability Transitions: Policy and Practice, EEA Report 09/2019, European Environmental Agency, Copenhagen.
- Ghosh, B., Kivimaa, P., Ramirez, M., Schot, J. 2021. Transformative outcomes: assessing and reorienting experimentation with transformative innovation policy, *Science and Public Policy*, 48, 739–756.
- Godin, B., 2012. Social Innovation: Utopias of Innovation from c.1830 to the Present, Project on the Intellectual History of Innovation, Working Paper No. 11, Montreal.
- Grin, J., Rotmans, J., Schot, J., 2011. On patterns and agency in transition dynamics: Some key insights from the KSI programme. *Environ. Innov. Soc. Transit.* 1, 76–81.
- Grupp, H. and Schubert, T., 2010., Review and new evidence on composite innovation indicators for evaluating national performance. *Research Policy*. 39–78.
- Havas, A., 2014. Trapped by the High-tech Myth: The need and chances for a new policy rationale, in: Hirsch-Kreinsen, H. and Schwinge, I. (eds), *Knowledge-Intensive Entrepreneurship in Low-Tech Industries*, Cheltenham: Edward Elgar, pp. 193–217.
- Havas, A., 2015. Types of knowledge and diversity of business-academia collaborations: implications for measurement and policy, *Triple Helix*, 2 (1), Paper 12.
- Havas, A., 2016a. Recent economic theorising on innovation: Lessons for analysing social innovation, CRESSI Working papers No. 27/2016, Oxford: University of Oxford, <https://dx.doi.org/10.2139/ssrn.2938513>.
- Havas, A., 2016b. Social and business innovations: are common measurement approaches possible?, *Foresight and STI Governance*. 10 (2), 58–80.

- Havas, A., 2016c. Universities and social innovation, paper presented at Addressing Ecosystem Challenges in The Era of Crises, XIV International Triple Helix Conference, Heidelberg, 25–27 September 2016.
- Havas, A., 2019. Measurement of innovation: the use and misuse of indicators and scoreboards, KTI/IE Discussion Papers 2019/21, Budapest: Institute of Economics, Centre for Economic and Regional Studies.
- Havas, A., and Molnár, Gy., 2020. A multi-channel interactive learning model of social innovation. CERS-IE Working Papers 2020/24, <https://www.mtaki.hu/wp-content/uploads/2020/05/CERSIEWP202024.pdf>.
- Haxeltine, A., Pel, B., Wittmayer, J., Dumitru, A., Kemp, R., Avelino, F., 2017. Building a middle-range theory of Transformative Social Innovation; theoretical pitfalls and methodological responses. *Eur. Public Soc. Innov. Rev.* 2, 59–77.
- Hein, A., Schrieck, M., Riasanow, T., Setzke, D.S., Wiesche, M., Böhm, M., Krcmar, H., 2020. Digital platform ecosystems. *Electron. Mark.* 30, 87–98.
- Hekkert, M. et al. 2007. Functions of innovation systems: A new approach for analysing technological change, *Technological Forecasting and Social Change*, 74, 413–432.
- Hekkert, M., Janssen, M.J., Wesseling, J.H., Negro, S.O. (2020): Mission-oriented innovation systems, *Environmental Innovation and Societal Transitions*, 34, 76–79.
- Heiskala, R., 2007. Social innovations: structural and power perspectives, in: Hämmäläinen, T.J., Heiskala, R. (eds), *Social innovations, institutional change and economic performance*, Cheltenham: Edward Elgar, pp. 52–79.
- Henderson, R.M., Clark, K.B., 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Adm. Sci. Q.* 9–30.
- Hodgson, G. M., 2008. An Institutional and Evolutionary Perspective on Health Economics. *Cambridge Journal of Economics.* 32, 235–256.
- Hölscher, K., Wittmayer, J.M., Loorbach, D., 2018. Transition versus Transformation: What's the difference?, *Environmental Innovation and Societal Transitions.* 27, 1–3.
- Howaldt, J., Kopp, R., Schwarz, M., 2015. Social innovations as drivers of social change—Exploring Tarde's contribution to social innovation theory building, in: *New Frontiers in Social Innovation Research*. Palgrave Macmillan, London, pp. 29–51.
- Howaldt, J., Kaletka, C., Schröder, A., 2017. Social Entrepreneurs: Important Actors within an Ecosystem of Social Innovation. *Eur. Public Soc. Innov. Rev.* 1.
- Janssen, M., Wesseling, J., Colen Ladeia Torrens, J., Weber, M., Klerkx, L., Penna, C., 2021. Missions as Boundary Objects for Transformative Change: Understanding Coordination across Policy, Research and Stakeholder Communities, DRUID Conference 2021.
- Jensen, M.B., Johnson, B., Lorenz, E., Lundvall, B-Å., 2007. Forms of knowledge and modes of innovation, *Research Policy.* 36, 680–693. <https://doi.org/10.1016/j.respol.2007.01.006>.
- Jørgensen, U. 2012. Mapping and navigating transitions—The multi-level perspective compared with arenas of development. *Research Policy.* 41, 996–1010. <https://doi.org/10.1016/j.respol.2012.03.001>
- Kanger, L. and Schot, J., 2019. Deep transitions: Theorizing the long-term patterns of socio-technical change, *Environmental Innovation and Societal Transitions.* 32, 7–21. <https://doi.org/10.1016/j.eist.2018.07.006>.
- Kanger, L., et al. (2021): Research frontiers for multi-system dynamics and deep transitions, *Environmental Innovation and Societal Transitions*, 41, 52–56.
- Katz, M.L. and Shapiro, C., 1986. Technology adoption in the presence of network externalities. *J. Polit. Econ.* 94, 822–841.
- Köhler, J., Raven, R., Walrave, B., 2020. Advancing the analysis of technological innovation systems dynamics: Introduction to the special issue, *Technological Forecasting and Social Change*, 158, 120040.

- Krohn, W., 2005. Einleitung, in: Groß, M., Hoffmann-Riem, H., Krohn, W. (Eds.), *Realexperimente. Ökologische Gestaltungsprozesse in Der Wissensgesellschaft*. transcript, Bielefeld, pp. 11–26.
- Krugman, P.R. 1994. Competitiveness: A Dangerous Obsession. *Foreign Affairs*. 73, 28–44.
- Krugman, P.R. 1996. Making sense of the competitiveness debate. *Oxford Review of Economic Policy*. 12, 17–25.
- Lane, D., van der Leeuw, S., Pumain, D., West, G. (eds) 2009. *Complexity Perspectives in Innovation and Social Change*, Springer, Berlin.
- Lawrence, T.B., Dover, G., Gallagher, B., 2014. Managing Social Innovation, in: Dodgson, M., Gann, D.M., Phillips, N. (eds), *The Oxford Handbook of Innovation Management*, Oxford: Oxford University Press, pp. 316–334.
- Lipsey, R.G., Carlaw, K.I., Bekar, C.T., 2005. *Economic transformations: general purpose technologies and long-term economic growth*. OUP Oxford.
- 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>.
- Lundvall, B-Å. (2007): *Innovation System Research and Policy: Where it came from and where it might go*, GLOBELICS Working Paper Series, No. 2007-01.
- Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: An emerging field of research and its prospects. *Research Policy* 41, 955–967.
- Molnár and Havas 2019. Trajectories of Social Innovation: Tackling Marginalization with a Complex Approach, in: Nicholls, A., and Ziegler, R. (eds), *Creating Economic Space for Social Innovation*, Oxford: Oxford University Press, pp. 175–207. <https://doi.org/10.1093%2Foso%2F9780198830511.003.0007>.
- Moulaert, F., MacCallum, D., Hillier, J., 2013. Social innovation: intuition, precept, concept, theory and practice, in: Moulaert, F., MacCallum, D., Mehmood, A., Hamdouch, A. (eds), *The International Handbook on Social Innovation: Collective Action, Social Learning and Transdisciplinary Research*, Cheltenham: Edward Elgar, pp. 13–24.
- Moore, G.A., 2002. *Living on the Fault Line: Managing for Shareholder Value in Any Economy*, Revised Edition., New York: HarperBusiness.
- Mulgan, G., 2006. The process of social innovation, *Innovations: Technology, Governance, Globalization*, 1 (2): 145–162.
- Mulgan, G., Ali, R., Halkett, R., Sanders, B., 2007. In and Out of Sync: The Challenge of Growing Social Innovations. <https://youngfoundation.org/wp-content/uploads/2013/03/In-and-out-of-sync-the-challenge-of-growing-social-innovations-Sept-2007.pdf>.
- Musiolik, J., Markard, J., Hekkert, M., 2012. Networks and network resources in technological innovation systems: Towards a conceptual framework for system building, *Technological Forecasting and Social Change*. 79, 1032–1048.
- Nelson, R. and Winter, S.G., 1982. *An evolutionary theory of economic change*, Harvard University Press.
- Nicholls, A., Ziegler, R., 2019. The Extended Social Grid Model. in: Nicholls, A; Ziegler, R (eds) *Creating Economic Space for Social Innovation*, Oxford: Oxford University Press, pp. 3–31, doi: <https://doi.org/10.1093%2Foso%2F9780198830511.003.0001>.
- Nicholls, A., Simon, J., Gabriel, M., 2015. Introduction: Dimensions of Social Innovation, in: Nicholls, A., Simon, J., Gabriel, M. (eds), *New frontiers in social innovation research*, Basingstoke: Palgrave Macmillan, pp. 1–26.
- Pavitt, K., 1999. *Technology, Management and Systems of Innovation*, Cheltenham: Edward Elgar.
- Pel, B., Wittmayer, J., Dorland, J., Søgaard Jørgensen, M., 2020. Unpacking the social innovation ecosystem: an empirically grounded typology of empowering network

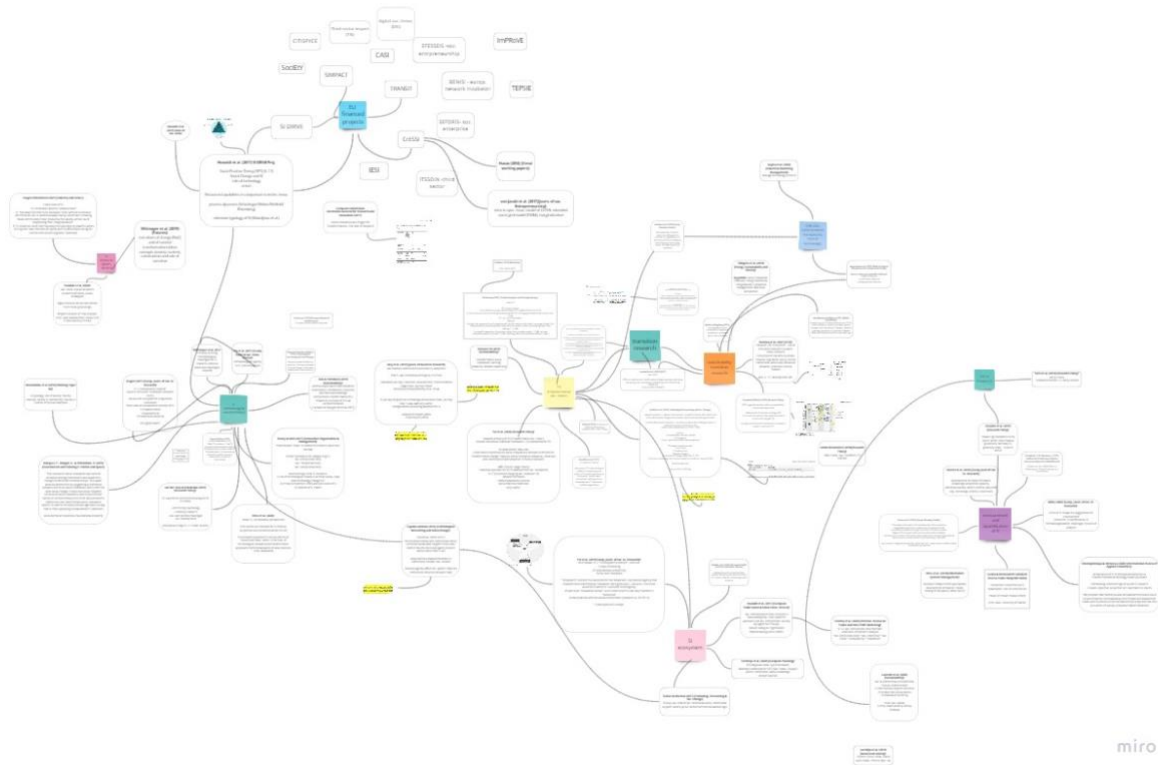
- constellations. *Innov. Eur. J. Soc. Sci. Res.* 33, 311–336.
<https://doi.org/10.1080/13511610.2019.1705147>.
- Perez, C., 1983. Structural Change and the Assimilation of New Technologies in the Economic and Social System, *Futures*. 15, 357–375.
- Perez, C., 1985. Microelectronics, Long Waves, and World Structural Change, *World Development*. 13, 441–463.
- Perez, C., 2010. Technological revolutions and techno-economic paradigms, *Cambridge Journal of Economics*, 34 (1), 185–202.
- Perkmann, M., Tartari, V., McKelvey, M., Autio E., Broström, A., D’Este, P., Fini, R., et al. 2013. Academic Engagement and Commercialisation: A Review of the Literature on University–Industry Relations. *Research Policy*. 42, 423–442.
<https://doi.org/10.1016/j.respol.2012.09.007>.
- Pol, E., Ville, S. 2009. Social innovation: Buzz word or enduring term?, *The Journal of Socio-Economics*. 38, 878–885, <https://doi.org/10.1016/j.socec.2009.02.011>.
- Rehfeld, D., Terstriep, J., Welschhoff, J., Alijani, S., 2015. Comparative Report on Social Innovation Framework, Deliverable D1.1 of the project Boosting the Impact of Social Innovation in Europe through Economic Underpinnings, SIMPACT, European Commission, 7th RTDI Framework Programme, http://www.simpact-project.eu/publications/reports/SIMPACT_D11.pdf.
- Rogers, E.M., 2003. *Diffusion of Innovations*. New York: Free Press.
- Robinson, D.K.R., Schoen, A., Larédo, P., Molas Gallart, J., Warnke, P., Kuhlmann, S., Ordóñez-Matamoros, G., 2021. Policy lensing of future-oriented strategic intelligence: An experiment connecting foresight with decision making contexts, *Technological Forecasting and Social Change*, 169, 120803.
- Schartinger, D., Rehfeld, D., Weber, M., Rhomberg, W., 2020. Green social innovation – towards a typology. *European Planning Studies*. 28 (5), 1026–1045,
<https://doi.org/10.1080/09654313.2019.1677564>.
- Schatzki, T.R., 2002. *The Site of the Social: A Philosophical Account of the Constitution of Social Life and Change*. Pennsylvania State University Press.
- Schot, J., 1992. The Policy relevance of the Quasi-evolutionary Model. The Case of Stimulating Clean Technologies, in: Coombs, R.; Saviotti, P.; Walsh, V. (eds.), *Technological Change and Company Strategies*, Academic Press, University of Twente, pp. 185–200.
- Shove, E., Pantzar, M, Watson, M. 2012. *The Dynamics of Social Practice: Everyday Life and how it Changes*. London: Sage.
- Shove, E. and Walker, G., 2014. What Is Energy For? Social Practice and Energy Demand, *Theory, Culture, Society*. 31, 41–58. <https://doi.org/10.1177%2F0263276414536746>.
- Sengers, F., Turnheim, B., Berkhout, F., 2021. Beyond experiments: Embedding outcomes in climate governance, *Environment and Planning C: Politics and Space*. 39, 1148–1171.
- Siudek, T. and Zawojcka, A., 2014. Competitiveness in the economic concepts, theories and empirical research. *Acta Scientiarum Polonorum. Oeconomia*. 13, 91–108.
- Smith, A., Stirling, A., Berkhout, F., 2005. The governance of sustainable socio-technical transitions, *Research Policy*. 34, 1491–1510.
- Soete, L., 2013. Is Innovation Always Good?, in: Fagerberg, J., Martin, B.R., Andersen, E.S. (eds), *Innovation Studies: Evolution and Future Challenges*, Oxford: Oxford University Press, pp. 134–144.
- Southerton, D., Díaz-Mendez, C., Warde, A. 2012. Behavioural Change and the Temporal Ordering of Eating Practices: A UK–Spain Comparison. *Int. Jrnl. of Soc. of Agr. & Food*. 19, 19–36.
- Steen, M. and Weaver, T., 2017. Incumbents’ diversification and cross-sectorial energy industry dynamics. *Research Policy*. 46, 1071–1086.
<https://doi.org/10.1016/j.respol.2017.04.001>.

- Suleiman, L., 2021. Blue green infrastructure, from niche to mainstream: Challenges and opportunities for planning in Stockholm. *Technol. Forecast. Soc. Change* 166, 120528.
- Suurs, R.A.A., Hekkert, M., 2009. Cumulative causation in the formation of a technological innovation system: The case of biofuels in the Netherlands, *Technological Forecasting and Social Change*. 76, 1003–1020.
- Tarde, G., 2009. *Die Gesetze der Nachahmung*. Suhrkamp, Frankfurt a. M.
- Terstriep, J., Rehfeld, D., Kleverbeck, M., 2020. Favourable social innovation ecosystem(s)? – An explorative approach, *European Planning Studies*, 28, 881–905, doi: 10.1080/09654313.2019.1708868.
- Krlev, G., Terstriep, J., Mildenerger, G. 2021. Pinning it down: Measuring innovation for sustainability, mimeo.
- The Young Foundation, 2012. Defining Social Innovation, Part 1, a contribution to D1.1 „Overview of Social Innovation”, TEPSIE project, The theoretical, empirical and policy foundations for building social innovation in Europe, Brussels: European Commission, DG Research.
- Thomas, L.D., Autio, E., 2019. Innovation ecosystems. Available SSRN 3476925.
- Thompson, G., Frances, J., Levacic, R., Mitchell, J. (eds) 1991. *Markets, Hierarchies & Networks. The Coordination of Social Life*, London: Sage.
- Tidd, J., Bessant, J., Pavitt, K., 1997. *Managing Innovation: Integrating technological, market and organizational change*, Chichester: John Wiley & Sons.
- Tödting, F., Trippel, M., Desch, V., 2021. New directions for RIS studies and policies in the face of grand societal challenges, *European Planning Studies*, <https://doi.org/10.1080/09654313.2021.1951177>.
- Truffer, B., Rohracher, H., Kivimaa, P., Raven, R., Alkemade, F., Carvalho, L., Feola, G., 2022. A perspective on the future of sustainability transitions research, *Environmental Innovation and Societal Transitions*. 42, 331–339.
- Turker, D. and Altuntas Vural, C., 2017. Embedding social innovation process into the institutional context: Voids or supports. *Technol. Forecast. Soc. Change*. 119, 98–113. <https://doi.org/10.1016/j.techfore.2017.03.019>.
- Turnheim, B., and Geels, F.W., 2012. Regime destabilisation as the flipside of energy transitions: Lessons from the history of the British coal industry (1913–1997). *Energy Policy*. 50, 35–49. <https://doi.org/10.1016/j.enpol.2012.04.060>.
- Utterback and Abernathy. W.J., 1975. A dynamic model of process and product innovation. *Omega*. 3, 639–656. [https://doi.org/10.1016/0305-0483\(75\)90068-7](https://doi.org/10.1016/0305-0483(75)90068-7).
- van der Have, R.P. and Rubalcaba, L., 2016. Social innovation research: An emerging area of innovation studies?, *Research Policy*, 45, 923–1935, <https://doi.org/10.1016/j.respol.2016.06.010>.
- van Wijk, J., Zietsma, C., Dorado, S., de Bakker, F.G.A., Martí, I., 2019. Social Innovation: Integrating Micro, Meso, and Macro Level Insights from Institutional Theory. *Bus. Soc.* 58, 887–918. <https://doi.org/10.1177/0007650318789104>.
- Wanzenböck, I., Wesseling, J.H., Frenken, K., Hekkert, M.P., Weber, K.M., 2020. A framework for mission-oriented innovation policy: Alternative pathways through the problem–solution space. *Science and Public Policy*, 47, 474–489. doi: 10.1093/scipol/scaa027.
- Walz, R. and Köhler, J., 2014. Using lead market factors to assess the potential for a sustainability transition, *Environmental Innovation and Societal Transitions*, 10, 20–41.
- Warde, A., 2005. Consumption and Theories of Practice. *Journal of Consumer Culture*. 5, 131–153. <https://doi.org/10.1177%2F1469540505053090>.
- Watson, M., 2012. How theories of practice can inform transition to a decarbonised transport system. *J. Transp. Geogr.* 24, 488–496.

- Weber, K. M, Rohracher, H., 2012. Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework, *Research Policy*. 41, 1037–1047.
- Windrum, P., Schartinger, D., Rubalcaba, L., Gallouj, F., Toivonen, M., 2016. The co-creation of multi-agent social innovations: A bridge between service and social innovation research. *Eur. J. Innov. Manag.* 19, 150–166. <https://doi.org/10.1108/Ejim-05-2015-0033>.
- Wittmayer, J.M., Backhaus, J., Avelino, F., Pel, B., Strasser, T., Kunze, I., Zuijderwijk, L., 2019. Narratives of change: How social innovation initiatives construct societal transformation. *Futures*. 112, 102433. <https://doi.org/10.1016/j.futures.2019.06.005>.
- Wolsink, M., 2012. The research agenda on social acceptance of distributed generation in smart grids: Renewable as common pool resources. *Renew. Sustain. Energy Rev.* 16, 822–835. <https://doi.org/DOI 10.1016/j.rser.2011.09.006>.
- Wustenhagen, R., Wolsink, M., Burer, M.J., 2007. Social acceptance of renewable energy innovation: An introduction to the concept. *Energy Policy*. 35, 2683–2691. <https://doi.org/DOI 10.1016/j.enpol.2006.12.001>.
- Ziegler R, Nicholls A, Aro J, van Beers C, Chiappero-Martinetti E, Edmiston D, Havas A, Heiskala R, von Jacobi N, Kubeczko K, van der Linden MJ, Maestripieri L, Mildemberger G, Molnár Gy, Schimpf G-C., 2019. The Extended Social Grid Model Revisited. in: Nicholls, A; Ziegler, R (eds) *Creating Economic Space for Social Innovation*, Oxford: Oxford University Press, pp. 341–362. <https://doi.org/10.1093%2Foso%2F9780198830511.003.0013>.
- Zijlstra, T., Avelino, T., 2012. A socio-spatial perspective on the car regime, in: Geels, F.W., Kemp, R., Dudley, G., Lyons, G. (eds), *Automobility in Transition? A Socio-Technical Analysis of Sustainable Transport*, New York: Routledge, pp. 160–179.

Supplement

Figure 1: A mind map of reviewed papers, projects, and reports on social innovation



Source: own compilation

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