

Systemic Innovation

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Introduction

The use of the term “systemic innovation” has been increasing in recent years. This chapter describes the meaning and significance of the concept in both streams of research and practice, with a potential for incorporating innovation and systems thinking scholarship. Systemic innovation has emerged and been predominantly used in the innovation studies and management field, with limited reference to the literature on systems thinking or systems science. Thus, this chapter explores the different uses of the concept in five different domains to understand and focus on systemic aspects of innovation in various ways. Second, the chapter aims to pinpoint ways to link innovation and systems thinking fields effectively through the systemic innovation concept (e.g., using an example of a recent model of systemic innovation). Third, the chapter identifies opportunities to enhance the theory and practice of systemic innovation by drawing upon the literature and the range of methodologies on systems thinking. At the same time, innovation activity can embed systems thinking into innovation as a leading change and transformation praxis today.

Systemic Innovation: Development and Use

Systemic innovation as a conceptual tradition of use has its origin in the emerging field of innovation studies in the 1980s and 1990s. Systemic perspectives and theories of innovation, which have become more common in the innovation science field today, developed from an increased critique of dominant linear, product-oriented, and firm-centric models of innovation and the initial development of more interactive, systemic, and networked alternatives [1–3]. Systemic innovation as a concept has been expressed in different ways, albeit in rather narrow and fragmented streams of research, and has become a carrier of a successively worked out paradigm shift in innovation science and management.

Systemic innovation as a concept emerged in innovation studies from the recognition of a particular systemic aspect of innovations—namely, the interconnectedness of different technological innovations and its context. Teece’s [4,5] original conceptualization of systemic innovation described innovations dependent on complementary innovations and adjustment in the larger product system, leading to challenges for innovating firms seeking to successfully appropriate value from it. Teece’s tradition of defining and using systemic innovation as a type of innovation that is not autonomous, but dependent on its environment is by far the dominant tradition [5–15]. This tradition challenged the closed, firm-centric paradigm, although it has been argued that a focal, presumably larger, firm is still in the best position to coordinate and manage the interdependencies of systemic innovations successfully [5,6,16]. This view has been challenged [17] and developed further in the open innovation approach [18], which is “a distributed innovation process that relies on purposefully managed knowledge flows across organizational boundaries” ([19]).

In this dominant use, systemic innovation focuses on innovation objects that cannot be separated from their surrounding system. This broader perspective led to the concept of national and regional innovation systems being introduced in innovation research [20], viewed as meta-systems supporting and enhancing the viability of innovation activities across many private, public, and third-sector actors in a defined geographical area [21]. This is a second area in which systemic innovation can be used to understand and, through policy measures, influence the innovation capacity of innovation systems and their output in the economic performance of geographically defined units [22–26]. The literature explores topics like policies [27], frameworks [28], methods [29], government interventions [30], and weaknesses in the innovation systems [31–33]. Here, systemic refers to the interaction and mutual evolution of factors, actors, and policy measures (e.g., academia, industry, and government as the main actors in the triple helix model of innovation [34], thereby shifting attention from “linear to interactive thinking of innovation” ([35], p. 97). Johannesson [36] distinguishes between economic innovation (i.e., value creation through the development of products and services) and institutional innovation (i.e., changes in the governance meta-system that enables and constrains economic activity), seeing systemic innovation as the design of institutional changes that shift the infrastructures and rules for economic innovations.

A third stream of research on systemic innovation has expanded the perspectives on innovation. This stream is related to the challenges of sustainability [37,38], the need for eco-innovation and sustainability transition in the face of dominant non-sustainable sociotechnical systems [39,40], or the effort to transform the way social problems are dealt with [41]. In this stream, systemic refers to the transformation of the societal, or even planetary, context of innovation [42]. It is often seen as prevailing socio-technical systems [40] restricting transitions to more sustainable systemic constellations. Through radical or disruptive innovation (e.g., eco-innovations with a more systemic character; [43]), multiple innovations often come together to move the context toward a transitional tipping point to a more sustainable pattern [44,45]. An example is the shift to a renewable, fossil-free society [46]. The contextual transformation also shifts the conditions and rules for innovation, which is game-changing in this sense [47].

A fourth more recent and expanding use of the concept of systemic innovation has emerged in the context of business, service, and innovation networks and ecosystems [48–52]. Because of the interdependencies among actors, often clustered in specific ecosystems, innovation is organized in “collaborative networks” [48]. Unlike the Teece tradition, the focus is not on technological interdependencies in complex product innovation systems, but rather on the business and value creation interdependencies urging actors to coordinate innovation activity. A movement is shifting toward a process understanding of innovation, its dynamics, and ways to innovate and design innovation processes, rather than the characteristics of innovations as objects or outcomes of innovation. It calls for an interactive business logic whereby firms innovate not only by developing and launching products and services, but also as an organizer and designer of value co-creation in complex business systems [53,54]. In this sense of systemic innovation, the end result extends beyond new product and service concepts to include new business models [55,56], thereby determining how value created by a complex network of actors will be captured and distributed [15]. Here systemic refers to the interdependency of actors in a business or community context, leading to the need to innovate in concert or in co-evolutionary dynamics. It is embedded in collaborative networks innovating by improving value co-creation through interaction in and the redesigning of ecosystems of actors (e.g., see the value flow model of [49]. This meaning of systemic innovation raises themes with which the systems studies field has long been engaged, like synergism [57,58] and the interaction of multi-stakeholder networks in systemic constellations.

Although systems studies and systems thinking fields have explored research and the management of change on many levels and in various areas, it is somewhat surprising that the explicit focus on “innovation” is still limited (there are exceptions, like [59]). The dominant not-so-systemic background of innovation studies and management focused on the development and commercialization of products and services from a linear, R&D, and firm-centric approach might be one reason that systems scholars have not found innovation as a concept of change and development to be so rewarding.

However, a fifth use of systemic innovation was recently introduced stemming more from systems and the systems thinking field. In this use, systemic innovation is viewed as a process that can be augmented with systems modelling embedded within stakeholder dialogue methods to support social learning, enabling those stakeholders to get a big picture understanding of the possibilities for, and potential consequences of, innovations to deal with wicked problems [60–64]. The innovation process is constructed in such a way that participants are supported in using practices, methods, and techniques to make their thinking and action more systemic. The language of systems in such processes are also conceptual tools for understanding and action. Systems’ boundaries are drawn from purposes and values of innovating actors [62,65–67]. In this fifth use, systemic innovation involves processes in which innovators and their stakeholders are thinking and acting systemically to co-create new or enhanced value, such as in systemic innovation labs [68]. Systems concepts and practices can empower innovation to change thinking, boundaries, relationships, interactions, and actions by creating new synergistic solutions and transformations [69].

Systemic innovation	Innovations dependent on complementary innovations and adjustment in larger system	National/regional system of innovation supporting/restricting micro level innovation initiatives	Transformative change, system transition	Collaboration in innovation networks and ecosystems	Processes enabling innovating actors to think and act systemically
Focus areas	Technological and innovation interdependencies	Innovation policy, triple/quadruple helix	Sustainability, social innovation, disruptive innovation	Complex, multi-actor constellation, value co-creation	Leading innovative processes empowered by systems thinking/systemic action
Aspects of innovation	Innovation objects and its environment	Governance and infrastructures for innovation	System and institutional innovation	Innovation agency and dynamics	Innovation process, innovation design/methodology
Literature	[4–15]	[23,25,27–30]	[37–41,43–47]	[48–52]	[60–64,68–70]

Table 1. Systemic innovation. Areas of use.

Table 1 summarizes the developments and uses of systemic innovation. In the fifth type of use, innovation activity and systems thinking come together and explicitly reinforce each other. Although few explicit uses of the concept exist in this use, numerous possibilities exist for empowering and “liberating” innovation understanding and practices through systems thinking [69]. Examples include:

- The analysis and management of stakeholder relationships and involvement [71,72]; boundaries of participation and relevant environments and framing often shift over time in innovation processes [73] and are accentuated in systemic innovation;
- The addressing of conflict, power, resistance, and marginalization [67] in innovation as processes of “creative destruction” [74], mediating between interests in the new, the prevailing, and different innovation futures;
- Support for transformational leadership by responsibly dealing with ethical dilemmas; through enhanced systemic awareness and wisdom, value conflicts and economic, social, and environmental consequences can be recognized and dealt with [42]; and
- The range of supportive methodologies offered for use in innovation processes as needed, such as when exploring and reframing purposes, values, and perspectives as well as reforming or designing organizational constellations, visioning far-sighted innovation scenarios, enabling and managing participation, and evaluating systemic impacts [75].

Although the uses of systems thinking in the first four understandings of systemic innovation are nearly non-existent in the literature, they are not irrelevant. Rather, systems thinking can contribute in various ways [75], such as supporting and engaging policymakers in enhancing the supportive role and dealing with barriers in national and regional innovation systems or identifying tipping points and increasing transformative potentials in transition to more sustainable energy or social constellations. The different use areas can also be beneficially connected. The interdependencies assumed in the main Teece tradition of understanding systemic innovation implying challenges for firms in appropriating value from innovation call for systemic inquiry and actions related to other uses, such as mediating among innovating, supporting, and affected actors in order to fairly share value in the design of sustainable, synergistic win-win ecosystems or when calling for policy measures to clarify or support value appropriation by innovators.

How do we innovate systemically? Lindhult and Midgley [70] used a recent synthetic attempt to consolidate the field into four systems thinking skills [76–78]: making distinctions (i.e., drawing boundaries), exploring interactions, appreciating multiple perspectives, and understanding phenomena as whole systems. The four different dimensions of systems thinking in Cabrera’s framework relate to different focuses in systemic innovation activity. The four rules of conceptualization can help organize the existing plurality of systems approaches and methodologies, thereby providing ways to realize them in practice and, thus, empower different forms of systemic innovation. The distinction dimension implies a focus on creating new boundaries between A and not A (“environment”), which also implies creating new identities for A according to the value-based judgment of the inclusion and exclusion of actors and issues. The system dimension implies new whole-part organizing, including different kinds of hierarchical and lateral relations structured by information, power, and resource configurations and flows. The relationship dimension points to the systemic innovation opportunities of new relations, interaction dynamics, and network structures, where connections are introduced, modified, or terminated. Relationship innovation can involve the emergence of coarse-grained structures from fine-grained human interaction dynamics based on simple rules that are simultaneously contained by the coarse-grained structures. The perspective dimension may involve innovation through new actor expression or paradigm innovation in the way the system is perceived. In addition, as Cabrera [79] pointed out, these dimensions are analytical distinctions that both conceptually and in reality interconnect and interact, resulting in many forms of hybrids between the dimensions.

Service and Business Model Innovation: An example of systemic innovation

One possible use of systemic innovation is empowering systems thinking through innovation activity and efforts as well as making innovation understanding and management more holistic by embedding systemic awareness and wisdom. I will describe an example of a praxis and methodology for achieving such integration. There are undoubtedly innumerable ways to merge the two scholarly areas, many of them not invented yet. I hope that this example can provide a sense of its meaning in practice and indicate a direction for further development. The process methodology is called “Rich Business Framing” (RBF; see Figure 1; [80]). It has been developed in the context of creating enabling practices for service and business model innovation with particular inspiration from soft systems methodology [81], systemic intervention [67], and service-dominant logic [82]. This is one of very few process models to date that explicitly integrates system thinking and innovation scholarship into an approach for systemic innovation. It is an example of the fourth and fifth uses of systemic innovation.

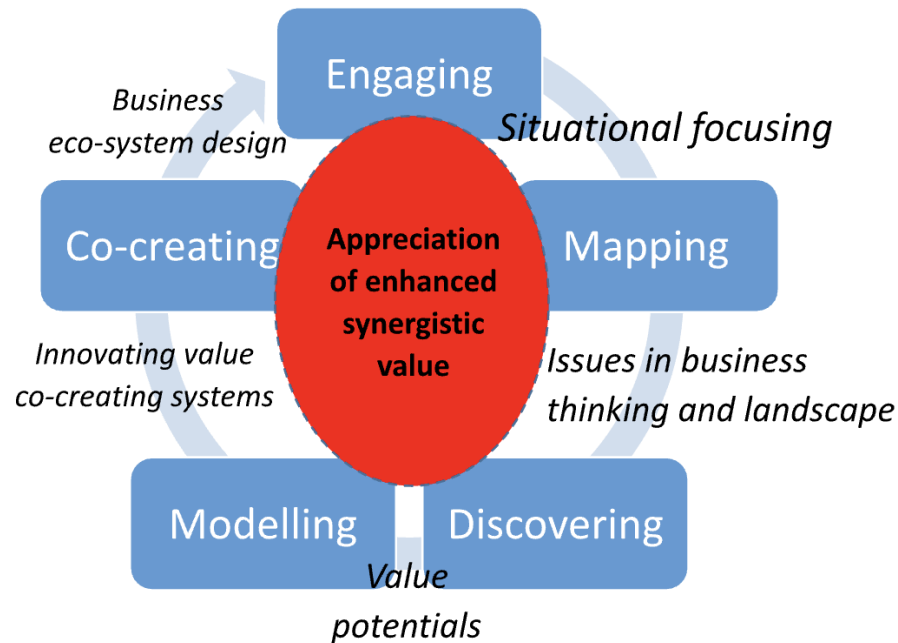


Figure 1. Rich Business Framing – a systemic innovation process model.

A point of departure is the framing and reframing of the business landscape in which participating actors create value (or have the ambition to create value if it is a new company or area of business) and where they can create value for themselves as well. This landscape is seen as a network of actors forming value co-creating systems [49,53,54,82]. Figure 1 depicts the core activities in RBF as processes of innovation searching for novelty that bring new value to be realized. These processes of creative inquiry focus on the appreciation of enhanced or new synergistic value [83]. The circles of learning that engage people iteratively and continuously go through the search for enhanced value for the business and themselves. Systemic innovation involves inquiring into business situations and landscapes in an effort to search for

improvements in value co-creating systems in which they are engaged as well as their varied thinking on these situations; it can also open up spaces and vistas for enhanced value (co-) creation.

The activity in systemic innovation requires that innovators and entrepreneurs engaged in innovation should be the ones initiating and driving the process. This is a precondition for innovation that often focuses on project organization and its steering and supporting network. In systemic innovation, the issue of who is (or needs to be) engaged is a core feature of innovation, where systems thinking supports stakeholder reflection and analysis and raises awareness of value-based judgment on the inclusion and exclusion of issues and actors and its implications [67,71]. In the process, it supports mediating dialogue among stakeholders.

Innovation often starts from innovators' existing ideas or idea generation. However, with a focus on innovating systemically, innovation objects are seen as being interconnected with their environment and factors in the situation. The mapping of the total situation or landscape in which participants are engaged or intend to create more value is an area where systems thinking scholarship can contribute. Rich picturing [84] has been predominantly used in RBF; other problem-structuring methods [85], like causal mapping or systems dynamics, may also be used. As business landscapes are fluid, dynamic, enacted, and influenced by complexity that limit comprehension, it is important to have the open, creative mobilization and combination of knowledge, ideas, and perspectives of different actors involved. The process is equally important as a result, and each contribution is a seed for further development. Mutual and joint learning and relationship building are keys for success. The activity aims to explore, communicate, and relate different ways of interpreting and thinking about the situation in the group and pinpointing key issues obstructing or enabling value creation.

An important innovation related activity is discovery, which requires the creative appreciation of innovation potentials, particularly the perception of enhanced or new values that innovative efforts might realize. Different innovation logics can be distinguished and used in this activity. Lindhult et al. [52] described four such logics: a product logic (the main one in the traditionally product-oriented innovation management field) in searching for capacity and tool development for increasing efficiency and performance in a targeted activity; a service logic search to relieve, enable, or experience improving measures for customers; a virtual logic using web and virtual capacities to enhance information processing and intelligence (e.g., through platforms) for more accurate and swift decision and activity; and a systemic logic searching for enhanced value by reconstructing value co-creating systems. The discovery phase can be carried out based on participants' available skills and knowledge or explored in depth by using existing guidelines and methodologies specific for each innovation logic, such as service mapping when exploring innovation through a service logic.

In the modelling activity, the most promising value potentials are chosen. A model formulation is developed by identifying the what (targeted value to be created), how (production/co-creation of value), and why (motivation or value appropriation by innovating actors) of the business model. The participants then pinpoint modelling parameters, such as listing the required activities and actors' roles and contributions, before linking and grouping them. This is reminiscent of systemic modelling in SSM. Both take a point of departure in a constructionist orientation in assuming the imaginative and action capacity of actors to conceptually, interactively, and physically frame reality. RBF is more specific in requesting unrealized value potentials to be targeted and relies on a stronger element of (interactive) realism rather than the perspectivism of starting in worldviews. Systemic modelling is an area where ST scholars can

make various contributions to systemic innovation (e.g., exploring additional systemic parameters when appropriate), like monitoring, control, or boundary reflection.

In the co-creation phase, organizing actors' required activities and value co-creating system investigates and is designed for realizing the business (or value) model. It is important to focus on the analysis and specification of actors and their roles in the system as contributors and beneficiaries and on who is doing what in order to achieve a viable and high total value co-creating system of business collaboration. Engaging important stakeholder representatives in the analysis, innovation, and design is also crucial in testing and developing viability, building trust and relationships, and promoting the value-enhancing capacity [49]. Different scenarios for actors and their interaction in terms of value entities, financial information, and intangible value can be made to envision design alternatives. Intangible value flows, not only financial flows, should also be depicted, and the co-creative and synergistic value-creation dynamics are often crucial for success. Based on the business ecosystem design, mutual value offering as well cost sources is depicted, and an operational purposive activity system exists where value flows are balanced so that a win–win and win more–win more system of interaction is achieved [86]. In this sense, such a system is both viable and sustainable. Systems thinking has a number of methodologies that can be employed, when appropriate, to enhance system awareness, process efficiency, realization potentials, and transformative capacities, such as for understanding systems dynamics or improving participant dialogue and mediation [75].

Concluding Reflections

This chapter has outlined the scope of an emerging landscape of systemic innovation. Possibilities exist for systems thinking to expand engagement with systemic innovation. First, I showed the landscape of uses of systemic innovation, highlighting the potential of a fifth use where ST has an explicit enabling role in innovation processes. Second, I indicated that ST has considerable potential in other more dominant uses of the concept that have not yet been developed in the literature. Third, with the help of a synthetic framework for systems thinking [77], a way to understand the meaning of innovating systemically can be clarified. It is to innovate not only products and service, but also boundaries and identities, relations and interaction dynamics, whole–part organization, and perspectives and framings in processes aimed at enhanced synergistic value creation. This is often a precondition and additional dimension in the effective management of the innovation of products and services; it also opens up a wider area for innovating systemic parameters. Fourth, the methodological example of the process model illustrates ways to combine and integrate innovation and ST scholarship in practice—an area that needs more research and creativity.

By drawing upon scholarships of systems thinking, both the theory and practice of systemic innovation can be enhanced. Innovation first and foremost includes activities of people pursuing, managing, and enabling innovations as realized results in terms of novel, value-enhancing practices, arrangements, and tools. The mainstream product logic of innovation has its strength in reducing complexity, binding the production of value, and increasing the potential for value appropriation by innovating actors, such as through intellectual property rights or other knowledge-protection practices. However, autonomous, stand-alone innovation has its limits. By empowering people to think and act systemically, systems thinking can provide skills and scholarship in understanding and dealing with interdependencies in innovation and its results. It can help avoid the suboptimizing of value creation through egocentric focuses. It can critically deal with the positive bias in innovation by balancing the search for the creation

of new value with concern for its dark side of the always present value destruction and alternative costs in implications and consequences beyond the immediate purpose. It can support the envisioning and realization of more holistic (i.e., systemic) innovation paths, such as moving toward a circular economy and one planet living.

The emerging theory and practice of systemic innovation can also contribute to the still vaguely conceived, open-ended, and emerging fourth wave of systems thinking that builds on previous waves. Interconnectedness, complexity, and wicked problems challenge people to think and act systemically. The first wave developed ways to describe and analyze systems in reality and their dynamics. The second wave served as a starting point for systems thinking, recognizing systems as a way to interpret and think about the world to offer people mental tools to model and appreciate problem situations individually and collaboratively. The third critical and value sensitive wave pointed to the role of values, interests, conflicts, power, and marginalization as crucial dimensions of ST processes, thereby adding to the complexity and wickedness, implying that no actor can achieve full understanding of situations. There are always diverse and never complete perceptions of systems and situations as well as a plurality of methods for analyzing and dealing with them [67]. Although pluralism can be liberating, it also creates confusion and difficulty in understanding and learning systems thinking. Cabrera recently argued that it is possible to integrate the diverse ST community and practice by pinpointing four basic skills related to systems thinking [77,87]. The proposal provides a basis for a fourth wave, where the field can reach a new level of dissemination, competence development, and use. Systemic innovation emphasizing seeking, pursuing, and realizing innovation adds a focus on enabling processes and agency for innovating systemically. Systems thinking is then set in the context of people who, by thinking and acting systemically, use basic thinking skills to innovate our interconnected world to the better. Such a paradigmatic shift can draw on constructivism and pragmatism concepts of creative inquiry understood in a Deweyan sense [88,89]; people transforming problematic situations in which they are immersed can resolve the situations through processes including rational and emotional dimensions as well many forms of knowing [90].

Systemic innovation can help further a praxis-oriented development, where systems thinking is embedded in a transformative and innovative praxis of innovating boundaries, systems, relationships, and perspectives in co-creative, synergistic value-creation processes mediating between interests and value orientations in order to reach enhanced value. These are important dimensions of democratic processes, complex business co-creation, and sustainable development to work effectively in being oriented to mutual and common advantage and concern for larger wholes. Such an approach also furthers a stronger focus on innovation activity as an enabler of the realization of uses of systems thinking knowledge and skills while also empowering actors in systemic transition and transformation [68].

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