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Systemic Innovation Labs: A Lab for Wicked Problems

Abstract

Purpose – Questions the appropriateness of current Lab types for addressing wicked problems. A new Lab type, a Systemic Innovation Lab, is proposed which combines the features of existing Labs that are suited to addressing wicked problems.

Design/methodology/approach – Characteristics of initiatives that are considered appropriate for addressing wicked problems and existing Lab types that contain any of these characteristics are identified. These Lab types are Social Innovation Labs, Living Labs, Urban Living Labs, Urban Transition Labs and Public Sector Innovation Labs. The proposed new Lab type is reasoned by combining the features of existing Labs that are suited to addressing wicked problems. How the new Lab would work in practice is illustrated with a case study.

Findings – When addressing wicked problems, Labs need to take a systemic design and not a service design approach. They also need to: focus on addressing complex problems, take a place-based and transition approach, enable coherent action by diverse actors, involve users as co-creators, support a networked governance approach and recognise government as an enabler of change.

Practical implications – Provides a new Lab type designed specifically for addressing wicked problems. This new Lab supports practitioners that take a systemic design, solution ecosystem and systemic innovation approach. Systemic design is based on a core set of principles that are a crossover between design and complexity theory.

Originality/value – For the first time, analyses different Lab types to determine their appropriateness for addressing wicked problems. Proposes a new Lab type whose sole purpose is addressing wicked problems.

Introduction

'Wicked problems' are complex social policy problems that societies face which cannot be definitively described and that do not have definitive and objective solutions (Rittel and Webber, 1973, p. 155). Examples of wicked problems include: terrorism, environmental degradation, poverty (Krawchulk 2008, p. 69), climate change, obesity and indigenous disadvantage (Australian Public Service Commission 2007). While the range of problems that are classified as being 'wicked' are quite diverse, they all share the same characteristics, including: they have multiple causes, they have many interdependencies, different stakeholders have a different understanding of what the problem is and therefore they have conflicting goals, they have no clear solution, attempts to address them often leads to unforeseen consequences and they are context specific (Australian Public Service Commission, 2007).

Labs are increasingly being used to address societal problems. There are many different forms of Labs, both within and outside of government, that are created for the purpose of solving social problems (Puttick, 2014, p. 7). While some authors consider the different terms used to describe Labs is just a matter of semantics, others consider the different names given to Labs highlight the different types of Labs that occur in practice (Schuurman & Tõnurist, 2017). The different types of Labs include: Social Innovation Labs, Living Labs, Urban Living Labs, Urban Transition Labs and Public Sector Innovation Labs.

Many of these Lab types are underpinned by a service design methodology. Both Social Innovation Labs and Public Sector Innovation Labs consider design thinking from a service design perspective is the most popular methodology for Labs (Tracey and Stott, 2017). Similarly, Living Labs are considered to share tools and methods from design thinking (Almirall and Wareham, 2011, p. 90). The relationship between Living Labs and service design is highlighted in the evaluation criteria for Living Labs that are seeking membership into the European Network of Living Labs. One of the evaluation criteria is the adoption of user driven service design methods (ENoLL, 2018). Despite this popularity of using a service design approach, the discipline of design is starting to question the suitability of service design for addressing wicked problems: instead a systemic design approach is being proposed as the most appropriate approach when addressing wicked problems (Jones, 2014).

By referring to the literature on addressing wicked problems and existing Lab types, this paper provides an original contribution to the literature by positing a more appropriate Lab type for addressing wicked problems. This new Lab is a hybrid Lab as it incorporates features for addressing wicked problems that are characteristics of existing Labs but are not all currently included in the one Lab type. The new Lab is named a Systemic Innovation Lab as it supports systemic design, solution ecosystem and systemic innovation approaches.

This paper is structured as follows. After discussing the shift to systemic design for addressing wicked problems, the paper describes key features of approaches that are recommended for addressing wicked problems. These features are: focus on addressing complex problems, take a place-based transition approach, enable coherent action by diverse actors, involve users as co-creators, support a networked governance approach and

recognise government as an enabler of change. The paper then identifies which existing Lab types have these identified characteristics as defining features. The paper concludes by describing a new Systemic Innovation Lab that focusses on addressing wicked problems and incorporates the features required to address wicked problem. A brief analysis of the Systemic Innovation Lab at the macro, meso and micro level is provided. To illustrate how the new Lab would work in practice a Systemic Innovation Lab methodology is described.

The shift to systemic design

Design is defined as 'the ability to imagine that which does not yet exist, to make it appear in concrete form as a new, purposeful addition to the real world' (Nelson & Stolterman, 2012, p. 12). While design has its legacy in craft and industrial production, Buchanan's (1992) paper 'Wicked Problems in Design Thinking' is considered to have been instrumental in moving design theory towards a more generalized 'design thinking'. (Kimbell, 2011, p. 292). Despite the term design thinking originating with academics that conducted research within the design disciplines, the academic design literature has been mostly ignored in the books and papers that have been responsible for popularising the idea of design thinking (Kimbell, 2011, p. 293).

According to Buchanan (1992), there are four broad areas of design thinking: symbolic and visual communications, artefacts and material objects, activities and organized services, and complex systems or environments. The design of symbolic and visual communications includes the traditional work of graphic design and communicating information, ideas, and arguments. The design of material objects is the customary design of products including clothing, domestic objects, machinery and vehicles. The design of activities and organized services includes how design thinking can contribute to services that are more intelligent, meaningful, and satisfying. The fourth area, the design of complex systems or environments includes urban planning, the functional analysis of the parts of complex wholes, the integration of complex wholes into hierarchies and the shaping of environments.

In a similar vein to Buchanan (1992), Jones (2014, p. 93) distinguishes systemic design from service design. He considers systemic design to be 'a next-generation practice developed by necessity to advance design practices in systemic problems' (Jones, 2014, p. 94). Systemic design is suited to the problem space of wicked problems, which is described by Jones (2014, p. 95) as 'problem systems'.

Jones (2014, p. 104) argues that a crossover of principles between systems and design theory is required for addressing problem systems. While complexity science is included as a branch of systems thinking in the systemic design approach (Jones, 2014, pp. 93-94), there are key differences between complexity science and systems thinking: while they both consider it important to take into account whole systems (Senge, 1990; Sturmberg et al, 2014), they do differ in how they see the relationships between cause and effect within complex systems. Systems thinking considers there to be clear relationships between cause and effect, whereas complexity science recognises that there are not clear relationships between cause and effect (Snowden and Stanbridge, 2004). The type of systemic design advanced by this paper aligns to a complexity and design theory approach.

The crossover of principles proposed by Jones (2014, p. 105) provide a core set of principles for systemic design. These principles are: compelling collective action toward a desirable outcome, appreciating complexity, purpose finding, boundary framing, feedback coordination, system ordering, generative emergence, continuous adaptation, self-organizing and requisite variety (Jones, 2014, p. 106).

The systemic design principle of compelling collective action toward a desirable outcome is supported by the complex systems leadership theory of 'generative leadership'. Generative leadership emphasises the need for goal alignment: it promotes the need for goals to be specified in advance so that interactions can be aligned towards them and the knowledge gained through interactions can be selected and applied to problem solving (Surie and Hazy, 2006, p. 17).

The principle of appreciating complexity when addressing wicked problems is essential, as different types of problems need to be addressed in different ways (Snowden & Boone 2007, p. 4). It is well recognised that complex problems cannot be addressed using epistemologies that are based on mechanistic explanations (Schlindwein and Ison, 2004, p. 27).

The systemic design principle of purpose finding aligns with the complexity concept of solution ecosystems. Solution ecosystems consist of all the initiatives in a geographical area that are addressing any of the interdependent causal factors that underpin a wicked problem. Together these initiatives, as a complex open system, self-organise to create an ideal future state that addresses the complex problem (Eggers and Muoio, 2015).

Systemic design's boundary framing principle is a key consideration when taking a complexity approach. The boundary that is chosen needs to be firm enough for self-organisation processes to occur but permeable enough to allow exchanges of information and resources with the environment (Snowden and Boone, 2007, p. 6; Goldstein, 1994, p. 49). Such boundaries prevent the energy of diverse stakeholders from dissipating and enable the collective energy of stakeholders to be channelled to the challenge at hand (Schultz, 2008, p. 90).

The feedback coordination systemic design principle highlights that positive feedback loops can be used to amplify and negative feedback loops can be used to stabilise action when addressing wicked problems. Intervention characteristics that amplify action include: enabling safe fail experimentation (Snowden et al., 2011, p. 124), enabling rich interactions in relational spaces (Lichtenstein and Plowman, 2009), supporting collective action (Lichtenstein and Plowman, 2009), partitioning the system (Surie and Hazy, 2006, p. 18), establishing network linkages (Uhl-Bien et al., 2008, p. 206) and framing issues to match diverse perspectives (Uhl-Bien et al., 2008, p. 206). Characteristics of interventions that stabilise feedback include: integrating local constraints (Lichtenstein and Plowman, 2009, p. 625), providing a multiple perspective context and system structure (Surie and Hazy, 2006), enabling problem representations to anchor in a community (Surie and Hazy, 2006) and enabling emergent outcomes to be monitored (Surie and Hazy, 2006).

Systemic design's system ordering principle supports the view that complex adaptive systems can be manipulated (McKelvey and Lichtenstein, 2007). Complex systems leadership theories consider that systems can be ordered to undertake transitions towards a more desirable state by creating the enabling conditions of create a disequilibrium state, amplify action, encourage self-organisation, stabilise feedback and enable information flows (Lichtenstein and Plowman, 2009; Zivkovic, 2015, p. 3).

Emergence is a characteristic of complex systems where structures, patterns and properties arise during the process of self-organization (Goldstein, 1999). In order for the emergence to be generative, systemic design's generative emergence principle requires that the emergence be intentionally sparked by agency (Lichtenstein, 2016, p. 45). Empirical research has shown that large complex systems, such as communities, require enabling conditions to be created in order to maintain the coordination required for emergent self-organisation and adaptive capability (McKelvey and Lichtenstein, 2007).

Systemic design's continuous adaptation principle emphasises the need to support a system's continual adaptation. The enabling conditions of create a disequilibrium state, amplify action, encourage self-organisation, stabilise feedback and enable information flows (Lichtenstein and Plowman, 2009; Zivkovic, 2015, p. 3) support the continuous adaptation of a system while maintaining a preferred purpose and objectives.

The self-organizing principle of systemic design recognises that self-organisation is a defining characteristic of complex adaptive systems. Self-organisation involves agents recombining in new patterns of interaction and working arrangements that improve the functioning and the performance of a complex adaptive system (Lichtenstein and Plowman, 2009, p. 620). This occurs without a master plan as 'it is never possible to control a complex adaptive system entirely' (Ostrom, 2007, p. 172). Instead, the process of self-organisation can be encouraged by incorporating into initiatives characteristics that support self-organisation (Zivkovic, 2015).

The systemic design principle of requisite variety is the basis of a law when working with complex adaptive systems. The law of requisite variety states that 'only variety can destroy variety' (Ashby, 1956) which suggests that to control the variety of a system, such as all of the causal factors and interdependencies of a wicked problem, the approach to address the wicked problem needs to have as much variety as the wicked problem. Complex adaptive systems can have as much variety as wicked problems. By definition complex adaptive systems are complex, which implies a great number of connections between a wide variety of elements (Zimmerman et al., 1998). Communities and solution ecosystems within communities are complex adaptive systems (Amadei, 2015, p. 4). Therefore, according to the law of requisite variety, solution ecosystems are ideally suited to addressing wicked problems.

Features appropriate for addressing wicked problems

Approaches that are identified in the literature as being appropriate for addressing wicked problems have a number of distinguishing features. These features include a focus on

addressing complex problems, taking a place-based approach, taking a transition approach, enabling coherent action by diverse actors, involving users as co-creators, supporting a networked governance approach and recognising that governments need to create enabling conditions.

Focus on addressing complex problems

When addressing wicked problems, the approach taken needs to be appropriate for addressing wicked problems. Wicked problems are a special type of complex problem: they have the characteristics of complex problems and they are the subject of social policy (Rittel and Webber, 1973).

The crossover of principles that have been proposed by Jones (2014, p. 104) focus on addressing complex problems. Complex problems are significantly different to simple and complicated problems (Westley et al. 2007). They are unpredictable, they do not have a right answer as the problem is constantly changing, and relationships between cause and effect can only be determined in retrospect (Snowden & Boone 2007). Complex problems are considered to be more than the sum of their parts (Snowden & Boone 2007): there is an essence in the interacting relationships between the people, experiences and moments in time that constitute the problem (Westley et al. 2007). Addressing complex problems has been likened to raising a child: every child is different, following rigid protocols generally does not work and is often detrimental, and raising one child successfully does not guarantee success with raising a second child (Westley et al. 2007). As suggested by the law of requisite variety (Ashby, 1956), solution ecosystems are an appropriate approach for addressing complex problems.

While a solution ecosystem approach is suitable for addressing the complexity part of a wicked problem, consideration needs to also be given to addressing the policy part of the problem. It has been argued that a systemic innovation approach is the most appropriate form of social innovation for addressing wicked problems (Davies, et al., 2012, p. 17). Systemic innovations are 'a set of interconnected innovations, where each is dependent on the other, with innovation both in the parts of the system and in the ways that they interact' (Davies, et al., 2012, p. 4). This approach recognises the need to address the interface with government policy and argues that governments need to create the enabling conditions for systemic innovation to occur (Davies et al., 2012).

Take a place-based approach

Given that wicked problems are context specific (Westley et al. 2007), they need to be addressed through place-based approaches. Place-based approaches are defined as 'stakeholders engaging in a collaborative process to address issues as they are experienced within a geographic space, be it a neighbourhood, a region, or an ecosystem' (Bellefontaine and Wisener, 2011, p. 6). They are an evolving process that incorporates adaptive learning and the interests of stakeholders; they try to achieve synergies by integrating across silos and dimensions of sustainability (social, economic, environmental, cultural); they use their

shared ownership of the approach to leverage their assets and knowledge; and they frequently try to achieve behavioural change (Bellefontaine and Wisener, 2011, p. 5).

Collaborative place-based approaches are considered to have emerged as a means of addressing wicked problems (Bellefontaine and Wisener, 2011, p. 5). According to Marsh et al. (2017, p. 443), 'Place-based approaches seek to break down the 'wickedness' of broad and complex problems – like poverty for example – by dealing in detail with its different manifestations in different places at a very fine-grained local level'. Approaches that are place-based have been described as complex adaptive systems (Bellefontaine and Wisener, 2011, p. 10) and, according to the law of requisite variety, are therefore appropriate for addressing wicked problems.

Take a transition approach

Transitions are 'non-linear movements or leaps from one stable level to another' (De Roo, 2012, p. 149). The field of social entrepreneurship is interested in addressing wicked problems through community transition processes that are based on an understanding of complex adaptive systems (Goldstein et al., 2008; Goldstein et al., 2010). This complexity-informed social entrepreneurship approach recognises the need to create conditions that support community transitions: the conditions for transitioning from an original attractor representing the current way of working in the community to a new attractor that represents the systemic social innovation (Goldstein et al., 2010, p. 104). An attractor shows the stable patterns of a complex system (Svyantek and Brown, 2000, p. 71): the range of possible actions in the system set by their circular, nonlinear structure of beliefs, actions and results that strengthen each other and act as a non-permeable barrier and attractor (Goldstein, 1994, pp. 76-77).

From a complexity perspective, transition processes are considered to follow a well understood path: 'a new order appears if forces at play exert tension on the system; a small change, if amplified, leads to a transformative process which, fuelled with the new imported resources and positively reinforcing forces, leads to a new equilibrium' (Thietart and Forgues, 2011, p. 59). Conditions promoted by a complexity-informed social entrepreneurship approach that encourage transitions include: fostering the emergence of innovation, allowing self-organising social processes to occur, and promoting coherence between diverse community stakeholders (Goldstein et al., 2008, p. 12).

In a similar vein to the social entrepreneurship approach, spatial planning has an interest in creating conditions for transitions (Boelens and De Roo, 2014, p. 11). Transition planning is a relatively new spatial planning approach based on complexity sciences (De Roo and Boelens, 2016, p. 7; De Roo, 2012, p. 152). To support this new planning approach, the role of a transition manager has been proposed for complexity-informed spatial planners (De Roo and Boelens, 2016, p. 6) that acknowledge evolving processes (De Roo, 2012, p. 152). Transition managers are not controllers of development but are managers of change that support and guide diverse urban and rural community stakeholders to find their most appropriate positions (De Roo and Boelens, 2016, p. 6). In this new role, the planner's focus is not the content and process of planning but rather the conditions for possible

developments (Boelens and De Roo, 2014, p. 19): the conditions for encouraging transitions (Boelens and De Roo, 2014, p. 11).

Enable coherent action by diverse actors

For a particular geographical area, addressing wicked problems requires the combined insights and actions of multiple diverse actors (Bradford, 2005, p. 4). These stakeholders need to be diverse as a range of different expertise is required to ensure the complexity and interconnectedness of the wicked problem is understood, possible solutions can collectively be identified, and any required behaviour change is understood, discussed, and owned by the people whose behaviour needs to change (Australian Public Service Commission, 2007).

The need for coherent action by diverse stakeholders has been described by Glenn and Gordon (2004) who state: '*common platforms are needed that connect governments, corporations, NGOs, universities, and international organisations in collaborative decision making*'. In their report they quote the following statement from a speech by former UN Secretary-General Kofi Annan: *'The most creative agents of change may well be partnerships among governments, private businesses, non-profit organisations, scholars and concerned citizens such as you'* (Glenn & Gordon, 2004). Conklin et al. (2007, p. 5) explains the importance of diverse stakeholders taking coherent action when addressing wicked problems: 'You don't so much 'solve' a wicked problem as you help stakeholders negotiate shared understanding and shared meaning about the problem and its possible solutions. The objective of the work is coherent action, not final solution'. Solution ecosystem and systemic innovation approaches support diverse stakeholders to take coherent action.

Involve users as co-creators

Systemic innovation, which is considered the most appropriate form of social innovation for addressing wicked problems (Davies, et al., 2012, p. 17), 'requires co-operation between and across organisations and sectors' in order to bring about systems change (Davies, et al., 2012, p. 6). These users, who are part of the solution ecosystem that is addressing the wicked problem, need to be involved as co-creators throughout transition processes in order to achieve the coordinated and coherent response that is required (Davies, et al., 2012, p. 8).

Involvement of users as co-creators is especially important during the amplifying action and self-organisation stages of transitions. Intervention characteristics at the amplify action stage that support users as co-creators include: enable rich interactions in relational spaces (Lichtenstein and Plowman, 2009), support collective action (Lichtenstein and Plowman, 2009), partition the system (Surie and Hazy, 2006, p. 18), establish network linkages (Uhl-Bien et al., 2008, p. 206) and frame issues to match diverse perspectives (Uhl-Bien et al., 2008, p. 206). At the self-organisation stage, intervention characteristics that support users as co-creators include: create correlation through language and symbols (Lichtenstein and Plowman, 2009; Surie and Hazy, 2006, p. 17), encourage individuals to accept positions as role models for the change effort (Lichtenstein and Plowman, 2009), enable periodic

information exchanges between partitioned subsystems (Surie and Hazy, 2006, p. 17), and enable resources and capabilities to recombine (Lichtenstein and Plowman, 2009).

Support networked governance approach

Network governance is considered the most appropriate form of governance for addressing wicked problems (Meuleman, 2011, p. 104). Traditionally, the aim of governance networks has been the creation of self-organising governance settings where operationally autonomous but interdependent diverse actors 'develop and pursue common goals through sustained interaction that involves open-ended deliberation as well as hard-nosed bargaining' (Sørensen and Torfing, 2016, p. 448). In this traditional conception of governance networks, the term 'self' in self-organisation refers to 'do-it-yourself' (Rauws, 2016, p. 341). This type of self-organisation is considered important for traditional governance networks because if governments become too intrusive and constraining and do not let the governance network 'do-it-themselves', the members of the network could disengage from participating in the network or fiercely oppose the government's attempts at control (Sørensen and Torfing, 2016, p 445).

The term 'self' in self-organisation has a different meaning than 'do-it-yourself' when a complex adaptive systems approach is taken to address a wicked problem. As a complexity science concept, the term self-organisation refers to the emergence of organisation 'by itself' (Rauws, 2016, p. 340) without the organisation being controlled by anyone. The solution ecosystem approach to addressing wicked problems aligns to this complexity type of self-organising governance network.

Recognise government as an enabler of change

While for complexity type self-organising governance networks, emergence of organisation occurs spontaneously out of the interactions of the diverse actors, empirical research has shown that large complex systems, such as communities, require enabling conditions to be created in order to maintain the coordination required for emergent self-organisation and adaptive capability (McKelvey and Lichtenstein, 2007). Bentley and Wilsdon (2003, p. 26) argue that governments need to take on this enabling role.

Despite communities being complex adaptive systems (Amadei, 2015, p. 4) and taking a complex adaptive systems approach being recommended for addressing wicked problems (Klijn 2008, p. 314; Australian Public Service Commission 2007, p. 14; Bentley & Wilsdon 2003, p. 26), governments have been reluctant to treat communities as complex adaptive systems (Mulgan 2001, p. 1). This reluctance is due to government challenges which are more easily met when there are clear relationships between cause and effect, such as time pressures for making government policy and the requirement of governments for simplicity, repetition, clarity, and accountability (Mulgan 2001).

To address this hesitation of governments, it is recommended that the adaptive capacity of governments be built and that governments be enabled to support multi-level governance

approaches (Duit and Galaz, 2008, p. 318). The adaptive capacity of governments can be built by building their capacity to balance two roles: the unplanned exploration of solutions with communities and the planned exploitation of community knowledge, ideas and innovations (Duit and Galaz, 2008, p. 319).

Existing lab approaches

There are a variety of Lab types discussed in the literature including: Social Innovation Labs, Living Labs, Urban Living Labs, Urban Transition Labs and Public Sector Innovation Labs. None of these existing Lab types incorporate, as defining characteristics, all of the features for addressing wicked problems that were described in the previous section. Each of these Lab types does however have as defining characteristics some of the features for addressing wicked problems. The defining characteristics for addressing wicked problems for each of the individual Lab types is shown in Table 1.

Table 1: key defining characteristics of individual Lab types

FEATURES FOR ADDRESSING WICKED PROBLEMS	LAB TYPE				
	Social Innovation Lab	Living Lab	Urban Living Lab	Urban Transition Lab	Public Sector Innovation Lab
Focuses on addressing complex problems	✓			✓	
Takes a place-based approach			✓	✓	
Takes a transition management approach				✓	
Enables coherent action by diverse actors	✓	✓	✓	✓	
Involves users as co-creators		✓	✓	✓	
Supports networked governance approach			✓	✓	
Focuses on government as enabler of change					✓

Social Innovation Labs

Social Innovation Labs have the key defining features of focusing on addressing complex social problems and enabling coherent action by diverse stakeholders. Social Innovation Labs are defined as a process, one that is intended to 'support multi-stakeholder groups in addressing a complex social problem' (Westely et al., 2014). They have three core characteristics: they are social, experimental and systemic (Hassan, 2014, p. 3). Social Innovation Labs bring diverse stakeholders together to work in a collaborative team. They address social challenges through iterative experimentation that focus on the systemic nature of the problem (Hassan, 2014, p. 3). While Social Innovation Labs emphasise the need for stakeholders to understand challenges from a user perspective, involving users as co-creators is not a defining feature (Westely et al., 2014, p. 4).

Several antecedent trajectories have been linked to the advent of Social Innovation Labs (Westley et al., 2014, p. 9). While 'complex adaptive systems theory to social innovation' is recognised as one of these trajectories (Westley et al., 2014, p. 9), the 'design thinking to design lab' trajectory is considered the dominant methodology (Tracey & Stott, 2017, p. 54). The type of design thinking that has gained prominence with Social Innovation Labs is that which has been popularised by design consultancies (Westely et al., 2014, p. 11).

Living Labs

Living Labs are 'physical regions or virtual realities where stakeholders form public-private-people partnerships (4Ps) of firms, public agencies, universities, institutes, and users all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts' (Westerlund and Leminen, 2011). This definition highlights that Living Labs enable coherent action by diverse stakeholders. It also suggests that while Living Labs can be used to address complex social policy problems and can take a place-based approach, they are not defining characteristics: Living Labs are also used to test new technologies and they can occur in virtual realities.

Another defining feature of Living labs is that they involve 'users as co-creators on equal grounds with the rest of participants' (Almirall and Wareham, 2012, p. 12). While the European Network of Living Labs (2018, p. 2) specifically 'place the citizen at the centre of innovation' (ENoLL, 2018, p. 2), Eriksson et. al, (2005) consider Living Labs can involve users, consumers or citizens.

Urban Living Labs

Urban Living Labs have the defining features of being place-based and enabling coherent action by diverse stakeholders. Many of the projects that are using living lab methodologies focus on urban areas (Voytenko et. al, 2016, p. 45). In response to this interest, a range of stakeholders, including city planners, universities, and technology companies view urban areas as ideal places to develop Living Labs: Urban Living Labs (Juujärvi and Pesso, 2013, p 22) and these users engage as co-creators.

Urban Living Labs are also characterised as taking a networked governance approach. While there is no uniform definition of Urban Living Labs, they are characterised as a form of collective urban governance and experimentation (Voytenko et. al, 2016, p. 45) that captures opportunities and addresses challenges created by urbanisation (Voytenko et. al, 2016, p. 53). They are considered to be a progression of the geographically embedded partnership-based modes of urban governance from the 1990s onwards that bring together diverse stakeholders (Voytenko et. al, 2016, p. 47).

Addressing complex problems is not a distinguishing feature of Urban Living Labs. Urban Living Labs aim to address urban problems of varying complexity (Juujärvi and Pesso, 2013, p 22). They have a range of uses including serving as technology-assisted research environments with the goal of improving an urban environment or local services; the co-creation of local services and urban artifacts; the development of new kinds of urban planning that facilitate vision-making, planning procedures, and support collaborative working; and addressing challenges such as low carbon cities, promoting economic growth and enhancing social inclusion (Voytenko et. al, 2016, p. 47).

Urban Transition Labs

Urban Transition Labs are place-based, have a focus on complex problems and involve diverse actors: they are described as 'the locus within a city where (global) persistent problems are translated to the specific characteristics of the city' (Nevens, et al., 2013, p. 115). They incorporate a transition management approach (Nevens, et al., 2013, p. 111) and have a focus on local urban governance (Nevens, et al., 2013, p. 116). Transition management is considered 'a new mode of governance based on complexity thinking' that has 'the explicit aim of redirecting and accelerating transitions to a more sustainable society' (Loorback, 2007, p. 27).

Urban Transition Labs are described as 'co-creative collaboration between actors and researchers' (Nevens, et al., 2013, p. 111). In 'genuine' Urban Transition Labs, actors are considered to include end-users (Nevens, et al., 2013, p. 115).

Public Sector Innovation Lab

Public Sector Innovation Labs focus on addressing the 'perceived shortcomings of standard approaches to policy and service design' (McGann et al., 2018, p. 2). They are considered to act as change agents within the public sector (Tõnurist, et al., 2015, p. 2). Common activities of Public Sector Innovation Labs include problem definition and analysis and the generation and testing of solutions (McGann et al., 2018, p. 14).

An empirical analysis of 20 prominent Public Sector Innovation Labs identified that they were 'predominantly engaged in service design work' (McGann et al., 2018, p. 16). This is what differentiates Public Sector Innovation Labs from other kinds of knowledge actors in the public sector (McGann et al., 2018, p. 15).

Public Sector Innovation Labs are considered to be structurally separated from the rest of the public sector and to have a great deal of autonomy in determining their work methods and targets (Tõnurist, et al., 2015, p. 2). While they are considered to be structurally separated, they can actually exist inside or outside of government and they can be subject to high or low levels of government control (McGann et al., 2018, p. 10).

The need for a Systemic Innovation Lab

Given that no existing Lab type has all of the identified Lab characteristics for addressing wicked problems as their defining features, it is proposed that a new Lab approach be developed that does. This new Lab is coined a Systemic Innovation Lab as it supports systemic design, solution ecosystem and systemic innovation approaches. The proposed Systemic Innovation Lab incorporates and synthesises all of the key features recommended for addressing wicked problems: it will focus on addressing complex problems, take a place-based transition approach, enable coherent action by diverse actors, involve users as co-creators, support a networked governance approach and recognise government as an enabler of change.

Schuurman (2015) highlights that the analysis of Living Labs can occur at the macro, meso and micro level. The macro level consists of the public-private-people partnership that carries out the Living Lab activities (Schuurman, 2015, p. 184). For the meso level, the focus is on the Living Lab projects (Schuurman, 2015, p. 184). The micro level is the specific methodology used by a Living Lab (Schuurman, 2015, p. 185) which is traditionally a user driven service design methodology (ENoLL, 2018).

Similarly, the proposed Systemic Innovation Lab can be analysed at the macro, meso and micro level. At the macro level, the Systemic Innovation Lab consists of a collaboration of diverse stakeholders, including users, that are organised to take coherent action to address a targeted wicked problem through a transition management approach in a given place. At this macro level, the Systemic Innovation Lab takes a systemic innovation and networked governance approach that is enabled by government.

The meso level of the Systemic Innovation Lab is the solution ecosystem of initiatives and the organisations that are collaborating on those initiatives. Each of these initiatives is addressing one or more of the numerous causal factors that underpin the targeted wicked problem.

At the micro level the focus is the specific Lab methodology that is used by the Systemic Innovation Lab to undertake research and address wicked problems. For Systemic Innovation Labs this methodology would be based on systemic design: a core set of principles that are a crossover between design and complexity theory.

Systemic Innovation Lab Case Study

During the evaluation of the pilot of its Complex Systems Leadership Program, Wicked Lab identified the need for a Lab type that has features for addressing wicked problems. The evaluation identified a desire by government to use the program as professional development for staff before establishing a Lab to address wicked problems. In response to this need, Wicked Lab has developed the FEMLAS process as a Lab methodology. This methodology aligns to principles of systemic design and is therefore well suited as a Systemic Innovation Lab methodology.

The FEMLAS process incorporates the systemic design principle of appreciating complexity (Jones, 2014, p. 109). It is informed by complex systems leadership theories and recognises that wicked problems are a special type of complex problem that have a policy focus. A solution ecosystem approach is taken to address the complexity of targeted problems and the interface between community and government systems is strengthened to address the policy interface. Taking a solution ecosystem approach to address wicked problems satisfies the purpose finding principle of systemic design (Jones, 2014, p. 109), is appropriate according to the law of requisite variety, and hence fulfils the requisite variety principle of systemic design (Jones, 2014, p. 11).

FEMLAS is an acronym for the six stages of the process: Form, Explore, Map, Learn, Address and Share. At the Share stage of the process there is an iterative loop: after completing the Share stage, the four stages from Map to Share are repeated periodically. The incorporation of an iterative loop into the FEMLAS process supports systemic design's continuous adaptation principle (Jones, 2014, p. 11). The South West Food Community, a collaborative network in Western Australia supported by Edith Cowan University, has recently commenced using the FEMLAS process to improve food security in their community.

Form Stage

Key tasks at the Form stage of the Lab methodology include: forming the core team, defining the solution ecosystem boundary, framing the solution ecosystem, undertaking the initial mapping of the initiatives and organisations in the solution ecosystem, and developing a briefing paper. The core team is formed with a diverse range of stakeholders, including user and government representatives, to ensure that the complexity and interconnectedness of the wicked problem is represented. As a coherent collective, the diverse members of the core team take a complexity-informed place-based network governance role for the solution ecosystem: the core team recognises that the solution ecosystem is a complex system and therefore cannot be controlled (Rauws, 2016, p. 340).

The core team of the South West Food Community includes stakeholders working in nutrition, Aboriginal health, environmental health, food production, education, social work and town planning. These stakeholders include state government, local government, university, non-profit, business and community representatives.

One of the core team's first tasks is to define the solution ecosystem boundary for the problem that they are addressing. This boundary consists of the wicked problem and the geographical place that will be the focus of the Lab. Defining the solution ecosystem boundary aligns with systemic design's boundary framing principle (Jones, 2014, p. 111). It also supports the complex systems leadership principles of managing initial starting conditions (Snowden and Boone, 2007, p. 6), specifying goals in advance (Surie and Hazy, 2006, p. 17) and establishing appropriate boundaries (Snowden and Boone, 2007, p. 6; Goldstein, 1994, p. 49). The boundary of the solution ecosystem for the South West Food Community consists of the South West region of Western Australia and the wicked problem of food security.

Next, the core team frames the solution ecosystem into sub-systems. Such partitioning into sub-systems is a complex systems leadership principle for amplifying action (Surie and Hazy, 2006, p. 18). It also aligns to the systemic design principle of feedback coordination (Jones, 2011, p. 109) as the partitioning produces positive feedback due to the energy in the sub-system being prevented from dissipating (Schultz, 2008, p. 90). The pillars of food security have been used by the South West Food Community to frame their boundary.

With the solution ecosystem defined and framed, the core team undertakes an initial mapping of the initiatives and organisations in the solution ecosystem that are addressing any of the problem's underpinning causal factors. This initial mapping is just based on the core teams' knowledge and experience. Wicked Lab's online tool is used to map each of the initiatives in the solution ecosystem to initiative characteristics that aid transitions and that strengthen the solution ecosystem and government interface (Zivkovic, 2017). This mapping is consistent with systemic design's system ordering principle (Jones, 2014, p. 109) as the mapping process orders the solution ecosystem according to enabling conditions for transitions and strengthening the solution ecosystem – government interface. This recognition of a 'set of conditions that compels action towards a desirable outcome' also aligns with the systemic design principle of compelling collective action toward a desirable outcome (Jones, 2014, p. 108). The core team of the South West Food Community have used Wicked Lab's Tool for Systemic Change to undertake an initial mapping of the initiatives and organisations in their solution ecosystem that are addressing any of the causal factors underpinning food security in their community.

At the end of the Form stage a briefing paper is prepared that is used during the Explore stage to disseminate information about the Lab to potential users. Complex systems leadership theories recognise the need for information to be continually disseminated throughout a system to aid its transition (Zivkovic, 2015, p. 4).

The briefing paper describes why the Lab is required and the logic behind the boundary and frame that have been chosen by the core team. These points are expressed to match the diverse perspectives of users: an approach used by complex systems leadership theory to amplify action during transitions (Uhl-Bien et al., 2008, p. 206). The briefing paper also contains complex systems leadership characteristics that support the disruption of current ways of working. These include: highlighting the need to organise communities differently, cultivating a passion for action (Goldstein, Hazy & Lichtenstein, 2010, p. 53; Lichtenstein and

Plowman, 2009, p. 618); embracing uncertainty, surfacing conflict and creating controversy (Lichtenstein and Plowman, 2009, p. 621).

Explore Stage

At the FEMLAS Explore stage, the core team's key task is to engage with users: the initiatives and the organisations in the solution ecosystem that are collaborating on these initiatives. The FEMLAS methodology takes a systemic innovation approach: it focuses on both the systemic innovation characteristics of the individual initiatives and in the way that the initiatives interact with each other to create systems change (Davies, et al., 2012, p. 4).

A detailed mapping of the solution ecosystem is undertaken by the core team throughout the Explore stage. This mapping takes place during key informant interviews and sub-system focus groups. In addition to disseminating the briefing paper, a crosswalk survey instrument is used to aid user engagement. This instrument converts the thirty-six initiative characteristics of Wicked Lab's mapping tool (Zivkovic, 2017) into plain English. The South West Food Community is currently developing their survey instrument.

During the interviews and focus groups, the users are asked to participate as co-creators with the core team. This continual user engagement is required to ensure that the action taken to support the solution ecosystem's transition process is coordinated and coherent (Davies, et al., 2012, p. 8) and informed by user experience.

These users include public administrators and elected members. It is vital that government users are co-creators throughout the transition process, as government needs to create enabling conditions for transitions (Bentley and Wilsdon, 2003, p. 26). Wicked Lab's tool has two focus areas that are targeted at public administrations and two focus areas that centre on elected members (Zivkovic, 2017).

The FEMLAS process recognises that the involvement of users as co-creators is especially important during the amplify action and the self-organisation stages of transitions, as according to complex systems leadership theories co-creation by diverse users can aid enabling conditions at these stages. At the amplify action stage the involvement of diverse users enables rich interactions to occur (Lichtenstein and Plowman, 2009) and assists issues to be framed to match diverse perspectives (Uhl-Bien et al., 2008, p. 206). At the self-organisation stage, diverse user involvement assists the language and symbols used to support correlation, it encourages a range of users to take on positions as role models for the transition process, and it enables the assortment of resources that belong to the core team and users to recombine (Lichtenstein and Plowman, 2009). This recognition of the importance of self-organisation is also a principle of systemic design (Jones, 2014, p. 111).

Map Stage

At the Map stage of the FEMLAS process, the main tasks are to enter into the online tool the mapping data that was collected during the Explore stage, and to use the tool to create a

transition card for the solution ecosystem. The transition card displays each of the identified initiatives in the solution ecosystem and highlights how each initiative is contributing towards systemic change: how each of the initiatives maps to the initiative characteristics for system transition and strengthening the interface between the solution ecosystem and government. For the South West Food Community, the transition card will showcase the initiatives in the South West region of Western Australia focusing on food security, all of the organisations working on these initiatives, and how these collectively contribute towards systemic change.

Learn Stage

The Learn Stage focuses on analysing the transition card to determine where in the solution ecosystem there are gaps in effort for achieving systems change. These identified gaps are used to guide future action. The guiding of future action to achieve desired system affects aligns to the systemic design principle of feedback coordination which recognises that negative and positive feedback loops can be used to guide the desired effects of systems (Jones, 2014, p. 109).

At the Learn stage, a second briefing paper is produced that informs users of the results of the mapping process. This briefing paper contains an image of the transition card and describes where gaps currently exist in the transition process.

Address Stage

The second briefing paper is distributed at the beginning of the Address stage. During this stage users are invited to participate in a large group intervention process to co-create initiatives that address the identified gaps. Bringing all of the users together for this process enables information exchanges between the partitioned subsystems. Enabling periodic information exchanges between partitioned subsystems is a complex systems leadership characteristic for encouraging self-organisation during transitions (Surie and Hazy, 2006, p. 17). This engagement process also incorporates complex systems leadership characteristics for amplifying action during transitions: enabling rich interactions in relations spaces (Lichtenstein and Plowman, 2009) and establishing network linkages (Uhl-Bien et al., 2008, p. 206). These characteristics encourage new ideas to emerge and therefore support systemic design's generative emergence principle (Jones, 2014, p. 106).

During the large group intervention process, users identify if their organisations and initiatives can address the identified gaps in effort by amending their existing initiatives or creating new initiatives. Users are encouraged to co-create new initiatives with other users and to take a safe fail experimentation approach. These characteristics of supporting collective action (Lichtenstein and Plowman, 2009) and enabling safe fail experimentation (Snowden, 2008) are recognised in complex systems leadership theories as assisting in the amplification of action during transition processes.

Share Stage

At the commencement of the FEMLAS Share stage the transition card is updated to incorporate any amended and new initiatives from the Address Stage. Next, the transition card is embedded on the Lab's website so that it can be viewed, discussed and shared by all of the initiatives and organisations that are participating in the solution ecosystem. The South West Food Community is embedding its transition care into a purpose-built food security platform that includes a website and app. At the end of the FEMLAS Cycle a completion report is prepared and disseminated to stakeholders.

After the FEMLAS cycle, when new solution ecosystem initiatives are established, and existing initiatives change their transition characteristics, users complete an online form on the Lab's website to inform the core team of the changes. The core team then updates the transition card. Periodically the FEMLAS iterative loop is repeated to re-engage users.

Conclusion

It has been argued in this paper that a more appropriate Lab type is required for addressing wicked problems: an approach that incorporates the features for addressing wicked problems that are identified in the literature. It has also been highlighted that a user centred service design approach is not suitable as a Lab methodology when addressing wicked problems and that a systemic design methodology that combines design and complexity theory is required.

In response to this analysis, a new Lab type has been proposed: a 'Systemic Innovation Lab'. The name chosen for this Lab represents the proposed Lab's alignment with systemic design, solution ecosystem and systemic innovation approaches for addressing wicked problems. To illustrate how a Systemic Innovation Lab works in practice, Wicked Lab's FEMLAS process and its early stage adoption by the South West Food Community has been described.

Illustrating the practical application of the Systemic Innovation Lab through only one early stage case study is a significant limitation of this paper. In order to understand the potential of the Systemic Innovation Lab for addressing wicked problems, further and more advanced case study investigations are required.

Many of the world's most pressing problems are wicked problems. If we are to tackle these systemic problems effectively, greater thought needs to be given to choosing appropriate approaches for addressing them. This paper is a contribution towards that endeavour.

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