Observatory of
Public Sector Innovation

From Transactional to Strategic: systems approaches to public service challenges

ALPHA VERSION: FOR DISCUSSION AND COMMENT

Authors: Justin W. Cook and Piret Tõnurist

The Observatory of Public Sector Innovation collects and analyses examples and shared experiences of public sector innovation to provide practical advice to countries on how to make innovation work.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 671526.

Co-funded by the Horizon 2020
Framework Programme of the
European Union

OECD
BETTER POLICIES FOR BETTER LIVES

From Transactional to Strategic: systems approaches to public service challenges

Table of Contents

Executive Summary

Complexity and uncertainty are now the norm—they are *contexts*—not just risks. The world seems to operate by a new set of rules that are difficult to observe directly. The defense and intelligence communities have called this the VUCA world, which originally described the Volatility, Uncertainty, Complexity and Ambiguity left behind by the end of the ordering function provided by the Cold War. Today, technology, decentralization, the rise of non-state actors and other factors have accelerated the rise of VUCA in every domain. Labor markets and financial systems are more and more interconnected which means that it becomes increasingly difficult to identify causes and effects of complex problems. For instance, a transformative referendum such as Brexit seemed unlikely even three years ago, let alone that it would pass. Its total impact to both the UK and Europe (and indeed the rest of the world) is all but impossible to predict, yet will certainly be profound. The public sector as a whole is contending with VUCA, even if administrations do not understand how, where and why.

So the question today is: *how do we account for uncertainty while managing greater complexity and still deliver effective services?* To a degree, the answer lies in how public policy makers can make decisions that lead to resilient systems and adaptive structures. The decisions themselves will depend on how completely we understand the problem and its context and how well we anticipate the interaction between interventions and context. Public policy makers need to understand that there is path dependency in all of our public sector institutions and policy interventions which may not serve us well, or worse, lead to predictable outcomes. However, changing the dynamics of a well-established and complicated administrative system is not easy. A new and necessary complex process of seeing, understanding and deciding fundamentally challenges our institutions; this is the makings—the foundational conditions—of a *governance crisis*. Our 19th Century institutions are outmoded by 21st Century problems stemming from interconnectivity, cyber threats, climate change, changing demographic profiles and migration. Traditionally, public policy makers have dealt with social problems through discrete interventions that are layered on top of one another. However, these may shift consequences from one part of the system to another or continually address symptoms while ignoring causes. It is within this *complexity gap* (the disconnect between institutional capacity and the problems they face) that systems thinking and other systems approaches such as design have gained traction.

Design, systems engineering, systems innovation, systems thinking and design thinking have interlinked philosophical foundations and share in some cases, methodologies.[1] For this analysis we will use an umbrella phrase *systems approaches* to describe a set of processes, methods and practices that aim at affecting systemic change. Using systems approaches in public service delivery can be very difficult due to siloed structures and narrow remits, but in fact they can be operative here too. Public interventions need to move beyond a narrow input-output line of relationships. Of course depending on the

[1] A useful shorthand is to think of the phrase "systems thinking" as describing the ability to understand the properties and dynamics of complex systems. Its increasingly popular twin, "design thinking" generally describes the processes of ordering information in complex systems in a way that leads to action.

maturity of the system it may be easier or more difficult to change public service delivery systems, but new developments are already on the way: new urban transportation systems, e-healthcare systems, learning ecosystems, etc. The OECD has previously (2015) drawn attention to this topic in the "*Systems innovation: synthesis report*" which discussed the public sector challenges through a systems innovation lens. While the 2015 report relied on very specific systems approaches – systems dynamics and socio-technical systems used often in sustainability analyses – to look into the role of systems thinking in innovation policy, this report broadens the lens. In this report we discuss more specifically how public policy makers can use a multitude of systems approaches across different policy areas.

While organizations such as NESTA have raised the topic of using systems approaches in the public sector, it is far from an established field. There are no systematic overviews on the use of systems approaches in the public sector nor is the process in practice formalized. Furthermore, little empirical research has been done on the strategies policy makers use to deal with uncertainty in practice. In our initial research, we found only a few well documented cases of systems approaches in the public sector. The small number indicates that governments insource systems capabilities and thus, tend to rely heavily on outside consultants and designers to lead and instigate systems level changes. Uncertainty cannot, however, be managed in spurts – public sector organizations must build the capacity to become internally adaptive to the continuously changing circumstances of a VUCA world. This requires reflective practices *and* practitioners that acknowledge the possibility of outcome variety; unpredictable events and consequences that require systems to adapt to unforeseen events.

Yet, governments initiate policy reforms of large systems – education, healthcare, public safety etc. – every day. Politicians are expected to demonstrate decisiveness and thus, policy solutions are pursued even in conditions with very high uncertainty of outcomes. Often these reforms are carried out based on static assumptions: specific explanations of complex problems resulting in policies that are not approached holistically. It must be stated clearly that this is a kind of *coping mechanism,* not a strategy. We aim to shed light on how public sector managers can take a systematic approach to understanding and addressing complex problems. In this report we describe how a systems approach can enable systems change that can make public services more effective and resilient.

Systems approaches work in two very different contexts typical for governments: first, *a static condition of near paralysis* or predominantly administrative mode managing well defined objectives where a change mandate does not exist; second *a crisis event* where a change mandate exists but an understanding of the architecture of the resultant challenge may be fleeting and a transformation process may be unclear. We encourage the public sector to acknowledge that systems change is necessary in nearly every domain, and that it is possible. But, in both static and crisis conditions, *administrations must move away from a procurement-driven policy of using external consultants and contractors to occasionally employ systems approaches, toward allocating the resources to make systems approaches an integral part of the public organizations' everyday practice*.

In the static condition, we demonstrate how a systems approach can make transactional or discrete interventions more strategic, and capable of accruing toward systemic effect. Following a crisis event, we explore how a systems approach can yield a better understanding of the emerging structural condition and enable more robust decision making, stakeholder inclusion and stewardship. In each case, systems transformation, not modelling or analysis is the end goal of these efforts.

The key takeaways common for all levels of government officials include the following:

- Systems approaches lost prominence in the latter half of the 20th Century because they became increasingly academic. But today, they are reemerging as tools especially appropriate for complex problems.
- Systems approaches work for the public sector precisely because of the class of complex, multi-dimensional, multi-stakeholder problems (wicked problems) administrations are responsible for and because piecemeal reforms produced with traditional analytical tools and problem solving methods are no longer producing results in many areas.
- The disconnect between the complex problems of today and the tools organizations used to solve them (19th Century Institutions versus 21st Century Problems) is called the *complexity gap* and is increasingly an area of study and innovation.
- Systems approaches have achieved success across a range of problems, from education to aging, healthcare to mobility, but are not systematically applied in the public sector.
- Because of the nature of today's problems, full diagnosis of "what went (or what is going) wrong" may not be possible. Systems approaches provide a way to make progress in spite of ambiguity and uncertainty and build more resilient governance systems.
- Systems change in the public sector is difficult in part because the system itself cannot be turned off, redesigned and restarted. They must be continuously available. Systems approaches can help navigate the difficult challenge of "changing the tires while the car is driving".
- Systems practices are on the rise (both inside and outside government) around the world providing an ever deepening evidence base about what works in the public sector.
- Systems approaches, especially coupled with design, enable organizations to better manage complexity by striking a balance between simplification and complexification.
- Many of the problems governments face today are wicked, which means that to some extent, they are unknowable. Systems approaches provide the tools for governments to work with relative precision (i.e. taking productive decisions before all the facts are known).
- A set of principles and practices exist that can be deployed by government agencies either unilaterally or with partners to work toward systems change.
- In order to effect systems change, administrations must develop a vision for a desired future outcome, a definition of the principles by which that future system will operate, and a portfolio of interventions that can begin to transition the existing system toward a future system.

Exploratory case studies on how public sector organizations have applied systems approaches will follow in the second stage of the research.

System Approaches in the Public Sector

The complex and interconnected nature of today's problems challenges existing approaches to problem solving and the institutions mandated to implement them. Public administration systems based on command-and-control model have proven to function well in stable systems with linear cause-and-effect relationships. However, bureaucratic organizations have proven ill-fitted to provide effective responses to problems that are hard-to-predict, difficult to diagnose, of unclear nature, and involving multiple stakeholders.

This reports looks at the value of systems approaches when dealing with complex problems in the public sector. Systems thinking has a long history, but only in recent years has there been a call to adopt systems approaches such as design more rigorously in the public sector. We will look at if, when and why systems approaches can deliver value to governments (Chapter 1) and what are the key principles and tactics of systems approaches (chapter 2). There is unfortunately no clear overview of how frequently governments use systems approaches, but emerging evidence seems to suggest that they have a role in instigating public debate, redefining government objectives and dealing with policy uncertainty in very complex situations. We aim to provide a platform for discussion that enables decision makers and public services managers to consider the kinds of challenges they face, the resources available to them and what can be expected while engaged in a rigorous problem solving process using systems approaches. It must be emphasized that there is no one-size-fits-all solution to complex challenges or systems methodology. Solutions—or more accurately, interventions—and methodologies are highly contextually dependent. The case studies shed light on the types of specific preconditions that have enabled some public sector actors to engage systems approaches.

Over this chapter, Chapter 2 and the case studies, we hope to address the following questions: How can I examine my own system to see if we are ready for a systems approach? What are the conditions necessary? What are the variables to consider when developing a systems approach? As hinted above, there are no simple answers to these questions because each situation is different. But here in brief are some indicators:

- An "innovation" agenda has taken root in government or your department
- The inclusion of citizens in decision making has become a priority
- Citizen orientation is overtaking an institutional orientation
- There is trust (or demand) in government for experimentation
- Problems are no longer solved with traditional execution formats (in other words, the line between external stakeholder and government must be blurred to achieve impact)
- Variables include: having a champion committed to change, capacity to experiment, ability to engage internal and external stakeholders, resourcing (time, capital, etc.) sufficient to delay business as usual

New Approaches are Needed to Manage Complex Problems in the Public Sector

Governments that have spent decades perfecting systems that can successfully manage *complicated* problems (such as banking regulation, trade treaties, and healthcare systems), now find themselves immersed in a world of *complex* problems. A complicated problem is one that is ultimately predictable with sufficient analysis and modeling. They are linear, with some identifiable beginning, middle and end and while they may have many parts, it can be understood how the parts create a whole. Management systems such as Six Sigma have demonstrated value as tools to tackle complicated problems.[2] Complex problems on the other hand are inherently unpredictable. They are frequently called *wicked* or *messy* because it is difficult to assess the true nature of the problem and therefore how to manage it (see characteristics of wicked problem in the box below). Rather than having discrete parts bound together in linear relationships, complex problems are emergent: they are greater than the sum of their parts.

Traditional management tools have limited capabilities when applied to complex problems. For the sake of expediency, manageability, and clarity, traditional approaches simplify complex problems into what are considered to be its constituent parts and manage them through discrete interventions, layered one on top of another. However, by looking at actors and interventions in isolation or disconnected from past efforts, complex policy legacies may fail to be captured and addressed. Qualitative case studies have been used as analysis method of complex problems as they can treat quantitative and qualitative data comparatively in a narrative structure. However, case studies, or more sophisticated methods such as agent-based simulations are specific to the problem and context being analyzed thereby providing little that can inform decision makers on how to take action.[3]

As wicked problems continue to multiply, the digital revolution is delivering to individual citizens more power and voice than ever before. On one hand, citizens' expect more personalized services that focus on individual needs. On the other, countries have increasingly diverse populations which call for tailor-made approaches. For example, elderly care for migrant populations can be vastly different from standard care services.[4] Consequently, standardized, large-scale public service solutions delivered via command and control administrative systems[5] do not work anymore forcing government to rethink service delivery boundaries and design solutions which take into account a broader set of actors and their relationship.

As a result, stakeholder maps have been redrawn. Citizens are now at or near the center, not as a contingency but by necessity. Processes that are unable to contend with or adapt to citizen participation will need to be fundamentally reworked (e.g., the Food Standards Agency in the UK reworked its food safety supervisory model based on consumers'

[2] Kamensky 2011
[3] Ibid.
[4] Draulans and De Tavernier (2016) analyze the old age care needs of Turkish communities in Belgium to show that traditional public service delivery systems do not work for people from a different cultural background, leaving people out of the system. New policy networks and approaches are needed to reach people from different communities.
[5] Command and control administration refers to a traditional hierarchical planning model – see Seddon 2008.

reports[6]). Public services that are not meaningful or relevant to citizens may struggle to build coalitions of support.

Box 1: Characteristics of wicked problems

The idea of wicked problems first emerged in the 1970s from the perspective of systems theory, with the understanding that problems cannot be understood and addressed in isolation.[7] Wicked problems have many characteristics, but their principal challenge to governments stems from the fact that they cannot be solved only by partial or transactional solutions, but requires concerted, adaptive and carefully stewarded approaches. There may be classes of wicked problems (those arising from path dependencies, incumbent interests and structural lock-ins or accelerating change), but each problem has unique traits that stem from its context, history, stakeholders etc.

The key aspects of wicked problems include the following:

- The implication of multiple stakeholders, each acting to a certain extent within their own norms.
- Complete diagnosis or understanding is not possible—"there are no definitive definitions" because each perspective from which the problem is viewed provides a different understanding of its nature.
- There are no optimum solutions to wicked problems. Nevertheless, often future gets discounted for short term agreements.
- Liminality is inherent in the analysis and intervention in wicked problems. 'Liminality' denotes the condition that is 'betwixt and between the original positions arrayed by law, custom, convention and ceremony'.[8] In refers to a space where regular routines are suspended.
- Because wicked problems are impossible to directly observe, they are unpredictable and their behavior is uncertain.
- Efficacy of solutions is difficult to determine because of knock-on effects, self-adaptation and their inherent complexity. Attempts have been made with RCTs and other evidence-based instruments, but they are fundamentally challenged by the fact that they must be artificially bounded in order to manage complexity and make them feasible.[9]

Each characteristic on its own would pose significant challenges to traditional governance approaches. But when taken together, they form a disarmingly complex set of obstacles. So much so that it is the norm for rigid institutions and bureaucracies to avoid big problems in favor of achievable solutions to proximal issues. Wicked problems require coordinated action on the part of stakeholders (both public and private), adaptability, long term planning, sustained commitment and active management among other actions. In some cases, these actions are antithetical to administrations, who by design have limited their instruments to work in a linear, unidirectional relationship between problem and solution. However in an interconnected world where system boundaries are difficult to define, it may no longer be possible to treat any problem as discrete.

[6] Global Innovation Review call 2016.
[7] Rittel and Webber 1973; Head and Alford 2013.
[8] Turner 1977, 95.
[9] Hämäläinen 2015.

Policy makers must also contend with complex policy legacies. Traditionally reductionist approaches applied to social system have proven their limit to take into account complex social problems and its web of legacies. For the sake of expediency, manageability, and clarity, reductionist approaches simplify complex problems into what are considered to be its constituent parts and manage them through discrete interventions, layered one on top of another. By looking at actors and interventions in isolation or disconnected from past efforts, complex policy legacies may fail to be captured and addressed.

Systems approaches are appropriate for managing complexity

As policy problems have changed toward systemic, interdependent challenges, their understanding and analysis needs to change. In highly complex problems, the relationships between causes and effects are neither linear nor simplistic. It could be hard to establish whether reduced waste come as a result of improved industrial packaging or changing consumer habits or stricter controls. In the context of this boundless complexity, solutions can have serious unintended consequences. The construction of a simple road overpass in Somerville, Massachusetts (much needed from an infrastructure development perspective), led to a rise in childhood obesity rates.[10]

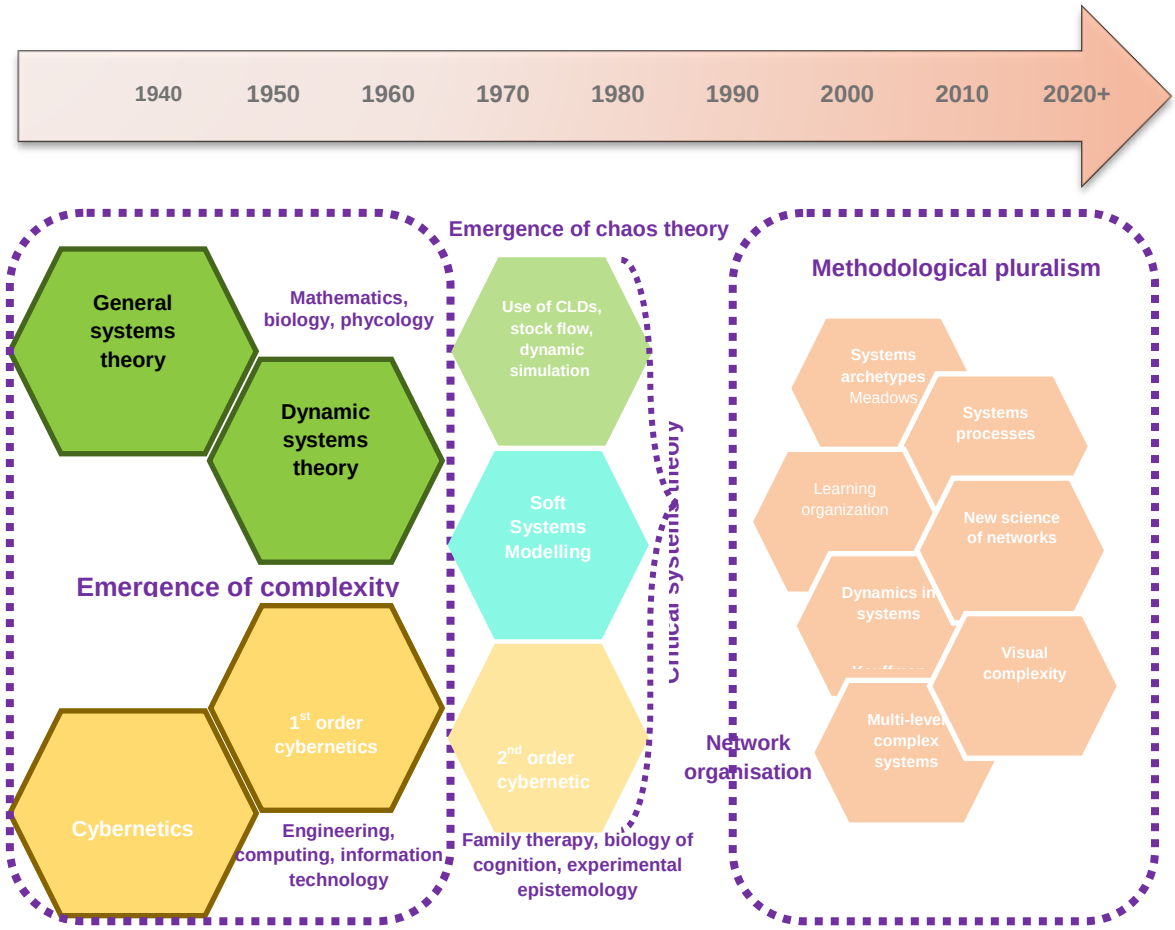
In essence, systems are elements joined together by dynamics that produce an effect, create a whole or influence other elements and systems (see for a more detailed account in box below). Systems exist on a spectrum of comprehensibility: from easily observed and analyzed (e.g. food chain) to highly complex or novel requiring postulation (e.g global climate systems). Systems share some common features: they are usually self-organizing meaning that system dynamics grow out of a system's internal structures; they are connected, thus, their parts affect each other; they are constantly changing and adjusting. They can be also counterintuitive meaning that cause and effect are distant in time and space. They are governed by feedback, are path-dependent, resistant to change and characterized by non-linear relationships.[11]

Box 2: Defining systems[12]

Applying systems approaches relies heavily on how systems are defined, i.e. which relationships are considered important. There are many ways to define systems: from geographic proximity (local, regional, national and international) or in terms of production, market (e.g. a sectoral system including all upstream and downstream producers and the characteristics of the markets which they serve) or technological affinity (technological systems). OECD (2015, 18) has previously defined systems as "the set of stakeholders who have to interact so that the system as a whole fulfils a specific function (or purpose)." However, this definition can be somewhat misleading as it puts the sole attention on the network of stakeholders. However, public policy systems include not only stakeholders, but also regulations, organizational routines, cultural norms etc. As public policy systems are generally outcome oriented, we apply the purposeful systems definition by Ackoff and Emery (1972) where the system is bounded and created to achieve its goal(s), its purpose. Hence, elements of the system are operationalized based on their connection to the goal of the system.

[10] http://www.governing.com/gov-institute/voices/col-systems-thinking-public-policy-programs.html
[11] See in the case of health systems WHO 2009.
[12] OECD 2015; Ackoff. and Emery 1972.

Figure 1: Development of systems thinking: towards methodological pluralism

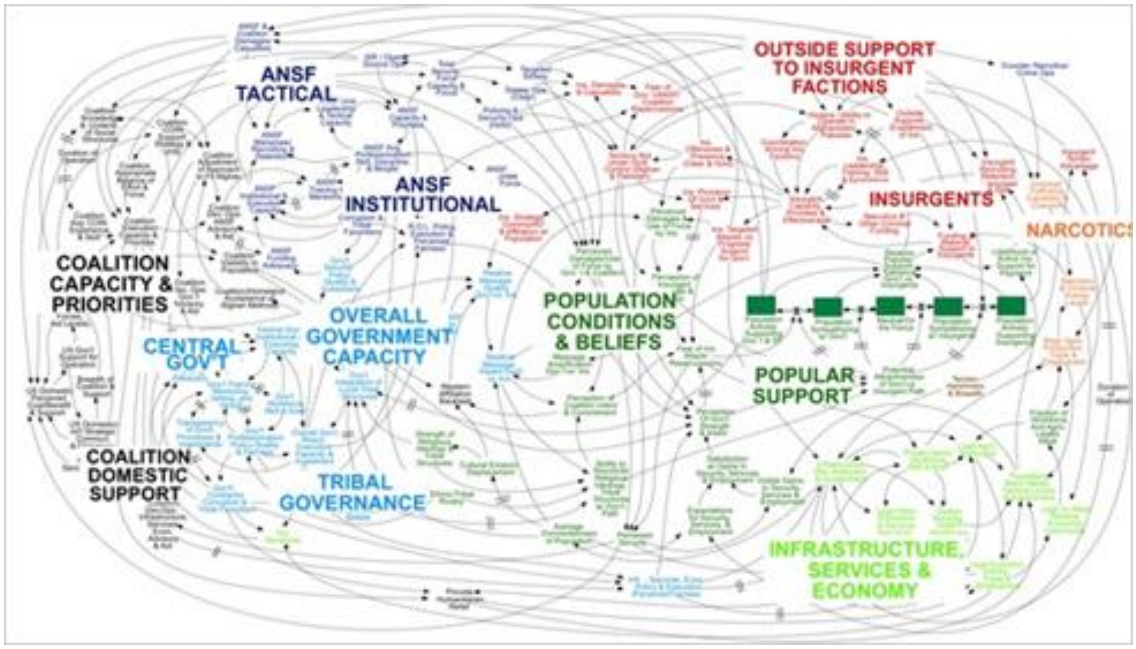


Systems approaches have developed over the last 75 years (see figure 1 above). With increasing computing power there are more tools than ever to trace and visualize causal relationships and simulate complex problems (from causal loop diagrams, stock flows to dynamic simulations, group and mediated modelling). However, modelling always comes with a cost: predefined assumptions simplify complex problems and can lead to the wrong path. Also, more qualitative systems approaches have emerged (soft systems modelling) that concentrate more on identifying the objectives of the system, rather than modelling systems backward from the predefined goal. Both broad approaches have benefits that can be used in different policy situations (either as a sense making tool in a situation where there is an overabundance of data or for gaining insight into decision making and planning process). In practice, most systems approaches use a multitude of methods and we can no longer distinguish the origins of the approaches in detail (a more thorough discussion of the theoretical background and limitations of systems thinking can be found in Annex 2).

Applying a systemic lens to complex problems is useful to map the dynamic of the system underpinning it, how the relationship between system components affect its functioning, and what interventions can lead to better results. System thinking help understand how systems are structured and how they operate. This means understanding what lies between the parts, their relationships, and the gaps between the knowns. It also means reflecting on how to take action from this understanding (i.e. design and design thinking) by creating proposals that are tested before becoming interventions in the systems in question.

The below system diagram (figure 2) of the US military strategy in Afghanistan from 2009 underscores the importance of how visualization of the system alone does not increase the understanding of what needs to be changed in practice[13] and that design thinking can help moving from visualizing systems to actionable knowledge that allows public managers to make decisions.

Figure 2: Complexity of the American strategy in Afghanistan[14]



While it is tempting to assume that front line public services and administrations are distant from or not implicated in large scale complex problems—let alone wicked problems—careful observation suggests otherwise. For example, responding to the challenge of an aging population require interventions at system level to balance social transfer reform and the transformation of service delivery in line with the needs of senior population.

[13] http://www.nytimes.com/2010/04/27/world/27powerpoint.html
[14] Ibid.

Box 3: The case for system approaches: ageing populations

Aging populations is a rich territory for systems approaches. Senior housing, ongoing medical care, nutrition, socialization and wellbeing services, lifelong learning, mobility and independence are all challenges that benefit from systems approaches because they sit at the intersection of multiple professional fields, governmental agencies and human needs.

Aging populations in countries like Finland and Japan present a significant challenge to the provision of public services. The pension systems that have guaranteed benefits for decades were designed at a time of an inverted population pyramid as compared to today. Financial fixes that have fallen under the clear remit of social service administrations have delayed the failure of pensions, but their future is uncertain as dependency ratios continue to increase in both countries.

Tinkering at the system's edges with pension reform, in addition to squeezing additional efficiency out of social services with technology and better management will continue to preserve the system for some time. But to prevent the collapse of public budgets, large scale systems transformation will be required. Societies will need to redesign institutions and other structures to meet the demands of a majority senior population—a significant departure from the current state which favors the young and economically productive.

This transformation cannot happen overnight. Governments will need to set the stage by working at a systems level to introduce interventions aimed at producing a new societal model that is inclusive of seniors. In other words, administrations will be engaged in the transformation of large scale systems by necessity to avoid further governance crises for a problem that is typically managed at the level of public service delivery.

Aging population is not the only domain where system approaches can be applied. There are other public service problems that systems approaches can help solve:

- *Mobility* in general is very appropriate for systems thinking and design, not least because they are complex, interdependent systems manifest in physical matter. But also because the landscape of mobility is shifting away from a need for large scale infrastructure, to smaller individual or medium scale solutions that go the "last mile." These are more complicated problem sets because they are fractal in nature and must correspond very closely with the needs of individual users and their contexts. For example, the City of Warsaw in Poland is developing an urban information system based on micro transmitters in smart phones for the visually impaired. The system allows smartphone owners to receive written or verbal information on the location of the bus stops, number of an arriving trams, the entrance to the museum or taking the queue in the Municipal Office.[15]
- *Education* is also appropriate for systems approaches because of contextual variance. This describes how nearly every transaction in education is unique, and how the objectives of each participant in the transaction are also unique (for instance, school leader to teacher, teacher to student, student to parent). This makes the system especially resistant to scaling solutions, or those that attempt to apply the same logic to every scenario. Education systems also have compounding and contradictory objectives. For instance inculcation of shared identity versus agency and independence for students. Systems approaches help to navigate this space where the optimal is often impossible.

[15] Global Innovation Review call 2016.

- *Machinery of government* (i.e. changing the organization behavior of agencies) is another space where systems approaches can achieve impact. Design is a way of organizing processes, and if bureaucracies are anything, they are repetitive processes. Systems approaches, including design, can function as a neutral arbiter to evaluate process and work to optimize or even better, redesign them toward a transformative capability.
- *Policing, human services, environmental protection, planning, housing, waste and energy* are all domains in which systems approaches have proven or emerging efficacy. The common denominator is that these services directly interface with the needs and lives of citizens whose expectations and realities have changed under the weight of technological, economic and global change. Societal models formed from institutions, civic practices, expectations among a myriad other factors that served these constituents are largely outmoded and must be renewed.

Interconnectivity, wicked problems and empowered citizens are all driving governments to change the way they work. The systemic nature of today's challenges makes this task much more complex than the government reforms of previous generations. Linear, rigid processes will still have a role in public administration, but the number of transactional processes that these manage well will continue to decline. To engage the vastly more complex problem sets of this century, systems approaches will have to supplant traditional capabilities. The alternative is waning relevance and a crisis of governance as citizens look to alternative means to improve their lives.

Challenges to managing complexity in the public sector

This section will look into the core challenges of using systems approaches in the public sector:

- balancing the need for evidence with taking action;
- creating room for open-ended processes and synergistic feedback;
- changing a system that cannot be turned off, redesigned and restarted (e.g., healthcare, education where service provision must be continuous);
- and, working in quickly changing conditions.

Use of information in highly complex environment: evidence versus action

In the past, decision makers benefited from two forms of complexity reduction: first, a lack of interest, necessity or ability to forecast externalities; and second, simplified classification of information into abstractions or well delineated silos. This made diagnosis of problems much easier. With less information, especially information that was contradictory, decision making could proceed unencumbered by uncertainty or complexity.

Today, collecting "enough" data–when full diagnosis of a problem may be too resource intensive or even impossible–is a significant challenge. Sufficiency of information could

forever be out of reach. In this context, how do teams proceed with confidence in a sufficient understanding of a situation? As discussed above, when working on problems related to broader systems or wicked problems, there often is no definitive definition.

Nevertheless, the wave of evidence-based policy making seems to assume that policymakers are able to wait until sufficient amount of data is available before acting.[16] This does not correspond with the everyday policy practice, where reforms and 'decisive' action are undertaken every day. This means that in many cases policy makers concentrate on tangible, specific aspects of the puzzle rather than approaching complex problems with a comprehensive, holistic lens. It is indeed unrealistic to hope that every decision in the public sector should be based on robust evidence, however, the danger of it has to be acknowledged as well: it is difficult to change practices that become commonplace following fast-track decision making.

Conversely, evidence-based methods or rational diagnosis to policy making tend to emphasize positivism and thus, may become overly technocratic overlooking the fact that many competing policy solutions are ideological, value based.[17] Thus, information is not only used to diagnose problems, but also legitimize value-based decisions.

To decrease uncertainty in public sector environments different methods (e.g., scenario planning, horizon scanning etc.) have been used. Nevertheless, uncertainty cannot be reduced in its entirety. Furthermore, governments have become exceedingly dependent on externally produced knowledge and yet, there are avoidable limits to the relevance and usability of knowledge.[18] In cases where there is an overabundance of information, it may be more important to know which knowledge is not needed for decision making rather than having information.[19]

Learning and adjusting the system: the feedback loop dilemma

Feedback is the core principle in cybernetics: correcting system errors is only possible when systems are capable of obtaining information about the effectiveness of their actions. Feedback loop gives information about the functioning of the systems which may later change the policy intervention or its effects. Feedback reinforces what the organization has already learnt and guides future learning processes both on the individual and organizational levels. Thus, feedback is needed to learn and most systems approaches talk about single and double-loop learning.[20] The first describes learning connected directly towards the policy at hand and the other describes a process of reflecting, which allows to change the broader management component behind the policy intervention. There is also a broader 'deutero learning' - learning about learning - which denotes the institutional capacity of organizations to learn.[21]

Feedback loops that lead to meaningful insights - and thus, learning - can only be created with open-ended processes. This means that the system is receptive to alternative ways of

[16] Head 2010, 13.
[17] Stanhope and Dunn 2011.
[18] Mulgan 2005.
[19] Feldman and March 1981, 176.
[20] Agryris and Schön 1978.
[21] Ibid.

doing things, alternative opinions, has tolerance for risks and risk-taking.[22] Both organizational and individual factors influence these processes.

However, these open-ended feedback loops have become more difficult in the public sector due to 'purchaser-provider split' in public service delivery that has emerged with the agentification in the public sector and the prevalence of traditional procurement procedures. Procurement practices in the public sector in general limit open ended processes which makes also the use of iterative, agile methodologies very difficult.[23] There are, however, efforts to counter this: for example, the federal government in the US has developed a marketplace for agile service delivery by making companies prove their skills with working prototypes on open data rather than providing lengthy overviews of their qualifications. This minimizes 'bid and proposal' high quality vendors, but also diminishes the risks of government going into open ended development processes.[24] In many cases these practices cut the feedback loop to the policy maker and substitute the former with increased accountability. Simple input-output metrics are used as success measures. This measurement systems assumes that accountability equals performance.[25] However, linear accountability frameworks only work well in predictable environments.[26]

Static measurement systems that are supposed to supply feedback to dynamic processes in the public sector tend not to work.[27] Most evaluation systems in the public sector do not account for long lead times nor complex feedback loops permeating processes surrounding wicked problems. In these cases, where measurement is difficult feedback starts to depend on stakeholders and their value-based judgments. Consequently, feedback in complex issues needs to also incorporate the dynamic nature of processes - continually "learning by doing" - and also systems knowledge, ability to put value-based information into context. More importantly, this is needed to quickly address ripple effects in the system, unintended consequences - for example, noting that building a road bypass has a serious effect on children's health.[28]

Turning a system off

New systems models can be designed in the abstract, but ultimately they will need to be built within existing systems. This is because large scale systems such as education or healthcare cannot be shut down, redesigned and restarted as a company might shut down an underperforming vehicle plant to replace outdated equipment. This is the in effect the March's dilemma of exploring and exploiting: how to introduce systemic change while at the same time providing services described by laws and regulations.[29]

Most public services must be continuously available. For public sector innovators, this makes for a particularly perplexing class of problem. It is both wicked, and also its basic

[22] See more in an Acker et al. 2015.
[23] Usually public sector organizations use some form of fixed price contracts in which time, cost and scope of activity are fixed in the procurement process. This usually means that the supplier takes the brunt of the risk at the forefront and changing activities based on feedback, 'learning by doing' becomes very difficult later on. This is easily exemplified in software development processes Book et al. 2012.
[24] Global Innovation Review call 2016.
[25] Kelly 2005.
[26] Head 2010, 14.
[27] See in the context of public sector innovation measurement Kattel et al. 2015.
[28] http://www.governing.com/gov-institute/voices/col-systems-thinking-public-policy-programs.html
[29] March 1991; see also discussion in Lember et al. 2016.

function, and therefore shape, must be preserved. As empowering as Buckminster Fuller's instruction to "build a new model that makes the existing model obsolete" is in the face of this kind of problem, many public services cannot be made obsolete. They can and should be continually renewed but their core function must remain constant. This structural dilemma requires a non-standard approach because any intervention aimed at transformation must be at once sympathetic *and* disruptive to the old system; incrementalism must be married to a whole systems framework.

Take education, perhaps the most reform intensive domain in the public sector portfolio. Nearly every corner of most education systems are targeted for reform, yet little systematic improvement is being realized. Why? How can the US for example, spend on average 600B USD per year on public education, and nearly the same sum on reform of that system, and still see student performance stagnant or declining?

There are at least two reasons for education's resistance to large scale change beyond the fundamental issue of it being an enterprise highly determined by its multivalent context (location, parents, teachers, students, curriculum, etc). First, the system cannot be turned off and rebuilt. Every day, students show up in classrooms with real demands for learning, and increasingly, emergent needs for additional social services. Their needs must be met. And most students and parents are unwilling to be a test case for reform. Change must happen in an incremental, step-wise fashion that gives administrators and other stakeholders' confidence that the effort will lead to improvement. In Finland for instance, the national curriculum is renewed on a 10 year cycle, and in the last round (2016) was carefully organized to include the opinions of as many stakeholders as possible. While Finland's curriculum is an exemplary education policy and development process, it is a product of a system that is continuously operative, and resistant to change. A decade-long multi stakeholder process would seem glacial compared to systems change in the tech sector for instance. Second, authority is largely concentrated in central offices and other administrative bodies in most education systems. In most cases, the system is designed around the people that run the system itself, rather than the "clients" (i.e. students). This means that those who are responsible for maintenance and continuity of the system, must also manage its reform and foster innovative new practices, but that their interests tend to turn backward toward their own needs. Debate about education's purpose and shape in the future is unusual if not altogether absent in this administrative format. Without a clear idea about what the future should be and why, it is difficult to organize reform efforts around common goals. In other words, change cannot be systemic. It is always piecemeal and therefore not able to achieve the synergistic effects promised and demonstrated by systems approaches. Attempts are being made at making the "existing model obsolete" such as with the charter school movement in the US. But these remain marginal and have not achieved their promised innovation transfer into traditional education settings.

Designers and systems thinkers, and those responsible for improving public services should ask themselves critical questions about how to keep core services running while reforming the underlying system. They should work to uncover what is working well in a system and should be preserved, and similarly, what provides rigidities and frictions that work against change, but are important to preserving the public interest. And, is it possible to work within the system to reform it or must something be done on the outside as well. Transformative change may require the spark of a crisis in order to significantly redesign an entrenched system.

This, of course, all takes time and is akin to changing the tires while driving a car. In government, time is a scarce resource principally because of instability caused by political life-cycles. This perennial challenge cannot be fully addressed here, but suffice it to say that a widely shared vision for the future of a system born out of a co-creative process–as opposed to a set of administrative priorities–will go a long way to providing a durable platform for systems change.

Speed of change

Established institutions promote their own stability; they are by-and-large path-dependent and can be highly resistant to change. Look at any ministry whose origins dates back a century or more. They likely combine remits that no longer make sense today. For instance, in Finland the Ministry of Transport and Communications (LVM) had a combinatory logic compatible with a time when transportation and communications infrastructure were developed simultaneously. But today, transportation and communications (ICT) have little in common. While the problems the public sector faces today have changed considerably, established public institutions struggle to change. This is one of the core challenges of systems thinking in the public sector. It is critical to understand as prior analyses have shown that changing the architecture of the system can have a more profound impact than discrete policy interventions following ad hoc diagnosis of policy failures.[30]

Systems approaches to public service delivery

In the introduction to this chapter we discussed why applying system lenses to complex challenges faced by the public sector. Here we discuss how systemic approaches have been applied to transformation of public service delivery.

There have been several proponents of system thinking in the public sector[31] also in connection with the development and application of management theories to public service delivery. The shift in interest in system approaches is linked to the understanding of citizens as integral part of service delivery as 'co-producers' or 'co-creators', thus holding important information on the performance of the system.

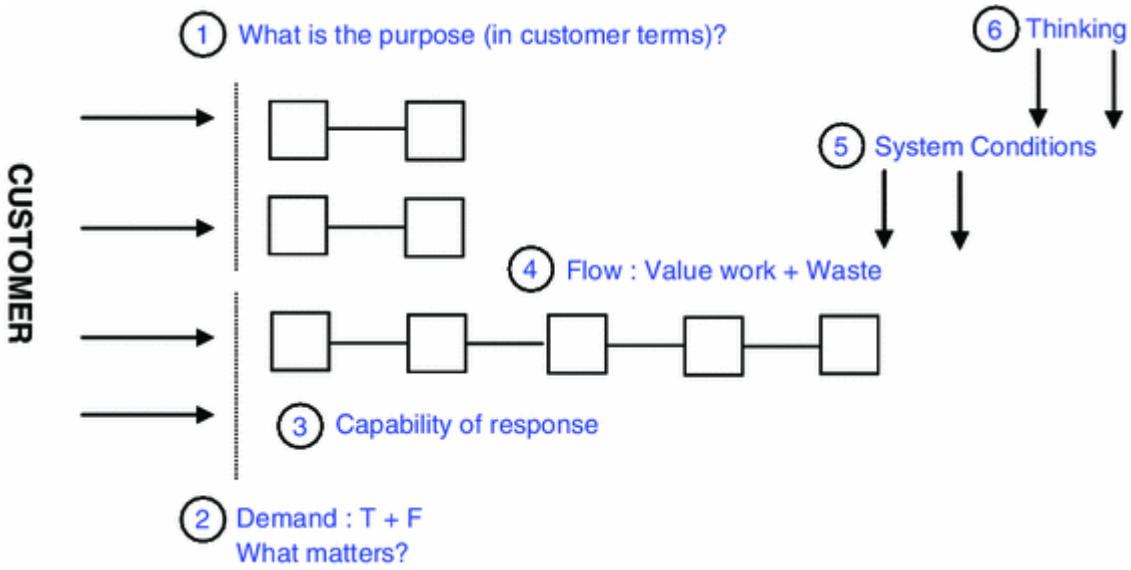
While there is no discrete list of characteristics of what good service delivery in the public sector means, there are some elements that have been outlined in literature. These include knowing the service users (their requirements, expectations, etc.), user-focused mindset, designing services according to the service user's needs and measuring the success from the viewpoint of end-users.[32] However, concentrating on discrete elements of public service delivery systems to reform (in connection to the service-dominant logic) have also received critique, as more profound system level problems are not brought to light.[33] This is especially important in the public sector due to the increasingly fragmented and inter-

[30] See OECD 2015, 43 for references.
[31] These include Jake Chapman at Demos in the UK, and John Seddon with lean systems (under Vanguard Consulting) and the more detailed Vanguard Method. Recently, NESTA and other think tanks/policy labs have discussed the use of systems thinking within the public sector in the context of public sector innovation. Also Donella Meadows' work has been used in the public sector context, but her perspective on systems theory and specifically leverage points was not specifically developed with public service delivery in mind.
[32] Osborne et al. 2013, 139.
[33] See Jung 2010; Powell et al. 2010.

organizational context of public service delivery, where systems have become more complex and problems more difficult to deal with.[34] This means that changing the service delivery system for a single public sector organization or an agency may not deliver the desired effect.

On example of system thinking applied in service delivery is the Vanguard Method (following Seddon's 'Check-Plan-Do' cycle) developed for use in service organizations. This method identifies two different types of demand in service organizations: *value demand* (what the organization is asked to do or provide/which problems to solve) and *failure demand* (demand caused by failure to provide the right service or product to the customer). This model starts by identifying the purpose in user terms and quality demand. It moves to checking capabilities and rebuilt the system in ways to eliminate redundancies and "waste" and focus on the processes that generate value for the user (see figure below).

Figure 3: The Vanguard method for 'Check'[35]



The Vanguard Method has been applied to public sector organizations (an example from the Netherlands can be found in Box 4 below). The case of ChildProtect shows that implementing systematic change in the public sector takes time, but it can also have very positive outcomes. The Vanguard method in particular gives practitioners a chance to go through individual learning processes that are needed in order to change their institutional processes.

[34] Osborne et al. 2013, 135.
[35] Seddon 2003, 112.

Box 4: ChildProtect in Greater Amsterdam[36]

ChildProtect is the public youth protection agency of Amsterdam (Netherlands). On a yearly basis it looks after 10 000 children at risk with the help of 600 staff. In 2008 the agency was put under heightened supervision by the inspection services and the Amsterdam alderman because it was unable to fulfil its core mission: assessing risks posed to vulnerable children and providing timely help. In 2011 a larger re-design of the organization was initiated to keep 'Every child safe'. A core group of ten caseworkers, two team managers, two psychologists and a consultant trained in the Vanguard method and were given authority to redesign internal processes.

In three months, the group went through the "check", "plan" and "do" phases of the Vanguard method and delivered a way of working approach ("doing" what was "planned"). The check showed that ChildProtect was split organizationally across different roles (social workers working with parents on voluntary bases, guardians who had legal responsibility over the children and parole officers working together with convicted juvenile offenders. Hence, there was not a single contact point for the family. Therefore, caseworkers were unsure who was supposed to act on signals of unsafety of children. Caseworkers dealt with established protocols and reporting that was not central to the mission at hand—keeping children safe. In the planning phase, new basic principles of action were discussed: a caseworker should deal with the whole family system, directly communicate with families (the "Functional Family Parole Services"), and phases of engagement were outlined. Previous silos were to be abolished and replaced with teams that were organized around any potential case. New focus was put on early intervention and holistic care of the entire family.

After the initial analysis was completed, three similar teams of volunteers started and were given three weeks to go through the process building on previous findings, while undergoing their own learning process at the same time. This was followed by a 'rolling-in' process where 40 teams were taken through the process so that they could experience their own check, plan, do phases. This took a full year and required additional changes to supporting services such as IT, facilities, etc.

The whole process exceeded its initial expectation: it improved both the quality of the public service and diminished the connected costs. For example, the number of cases where children had to be forcibly removed from families decreased by 50%. The changes reportedly resulted in cost savings of 30 million EUR annually. In 2015 ChildProtect was elected the Best Public Sector Organization in the Netherlands.

While there is case-specific evidence that systems approaches have been applied in the public sector, there are no systematic reviews on how these approaches, including the Vanguard model, have used in the public sector and how successful they have been. Public sector organizations tend not to make public, specificities of reform processes *a priori*. Consequently, there is also no specific research on which specific systems approach fits a specific context. Nevertheless, systems approaches have been applied across various fields in both social research, and also in action research. For example, systems thinking has been applied to address:

- childhood obesity and social policy in Australia[37]
- child protection in England[38]

[36] Wauters and Drinkgreve 2016.
[37] Allender et al. 2015; Canty-Waldron 2014.

- design/management of children's services departments in England and Wales[39]
- health prevention from obesity to tobacco,[40] mental health services in North Wales[41] and more generally public health[42] (WHO has used systems thinking in health systems reform)[43]
- higher education in the UK[44]
- environmental follow-up in Sweden,[45] waste oil management in Finland[46] and sustainable food consumption in Norway[47]
- infrastructure planning in Australia[48]
- and in some cases even in military and political affairs in the US[49]

One of the most well-known systems exercises in the public sector is the Munro Review (see Box below). It utilized a multitude of systems approaches without devising a concrete methodology (in comparison to the Vanguard model) with the aim to show how different reforms interact, what were the effects on the objectives of the system before devising a narrative account of what needed to be changed in the child protection system. While the review was widely covered by the media and received positive reactions from practitioners, it was not straightforward to implement the recommendations in practice. It was time-consuming and complex as many actors were involved in order to change public policy systems. For example, in the process of organizational redesign, authority may be needed to transfer from one organization to another. In the public sector context this often means legislative changes (as was the case with the Munro Review). These issues can become magnified if problems fall between municipal and state mandates. For example, it can be very difficult to plan working transportation systems across municipal boundaries taking into account desired moving patterns.

Prior research has shown that without proper training and clear guidelines, practitioners turn back to previous delivery models even if systems approaches are used to re-evaluate public service conditions.[50] This is in effect, human nature. But, unwillingness to embrace new ways of working continues to be one of the biggest barriers to change in the public sector.[51] Furthermore, there can be active resistance to change and political lobbying against reform from powerful incumbents as is the case in energy sector especially.

[38] Lane et al. 2016.
[39] Gibson and O'Donovan 2014.
[40] See overview of obesity policy in Johnston et al. 2014; Bures et al. 2014.
[41] Evans et al. 2013.
[42] See review of relevant papers in Carey et al. 2015.
[43] WHO 2009.
[44] Dunnion and O'Donovan 2014.
[45] Lundberg 2011.
[46] Kapustina et al. 2014.
[47] Vittersø and Tangeland 2015.
[48] Pepper et al. 2016.
[49] US State Dept. Bureau of Political-Military Affairs
[50] see Carey et al. 2015, 4.
[51] NAO 2006.

Box 5: The Munro Review of Child Protection[52]

One of the most well-known examples of systems thinking in the public sector is the Munro review of child protection in England. The Department of Education commissioned an independent review to reform the child protection system in 2010 from Professor Eileen Munro.

The goal was to understand why policies were not yielding expected results in protecting children from abuse and neglect and to design a new system of child protection based on new insights. The central question in the analysis was: "what helps professionals make the best judgments possible to protect a vulnerable child?" The analysis outlined how the system had become over-bureaucratized and focused on compliance rather than the welfare and safety of children. In other words, the system was working in service of itself rather than its "clients".

The Munro review was published in several steps: first, in 2010 a 'Systems Analysis' of the current child protection system was released. This was purposely analytical, aimed at policy makers showing how reforms interact and the effect these interactions were having on institutional practices. The second report, 'The child's journey' published in 2011 outlined the child's experience in the system from needing to receiving help. This report also outlined the need to work with children and families who have not yet met the threshold for child protection. With extensive consultation the final report outlined how to develop a more child-centered system of child protection together with a flexible assessment system.

The review used causal loop diagrams (CLDs) to communicate how causal relationships in the child protection system worked and visualize how the 'compliance culture' had evolved. Furthermore, several other concepts from systems theory were used in the review: single and double loop learning, ripple effects, requisite variety, socio-technical systems, etc.

Following the Review, the Secretary of State for Education issued eight trials of the recommendations and this unearthed unintended consequences due to exogenous factors: rocketing caseloads and public sector cuts.[53] Further, roll-out of the system was postponed due to government delays in changing statutory guidance.

While we do not have concrete characteristics of what inhibits systems level change in the public sector, broader public sector change and innovation literature is very indicative here. There are several factors that can inhibit systems change in the public sector. These include: unwillingness of managers to take risk,[54] possible political scrutiny from opposing parties,[55] short-term delivery pressures, and organizational culture in the public sector and low levels of management autonomy.[56] Prominent systems thinker, Jake Chapman has outlined some of these characteristics connected to systems failure in policy making:[57]

- aversion to failure
- pressure for uniformity of public services
- perception that command and control is the best way to exercise power

[52] Munro 2010; 2011ab.
[53] Munro and Lushey 2012.
[54] e.g., Osborne and Brown 2011; Torugsa and Arundel 2015.
[55] Potts and Kastelle 2010.
[56] Lægreid et al. 2011; Bysted and Jespersen 2014.
[57] Chapman 2002, 13.

- lack of evaluation of previous policies
- lack of time
- tradition of secrecy
- siloed systems and dominance of turf wars
- complicated procurement systems that limit experimentation
- and loss of professional integrity and autonomy under the knife of efficiency

Some of these factors are not uniform across the public sector. For example, in some countries discretionary learning (staff taking responsibility and exercising agency to solve problems) is higher and this helps to introduce bottom up systems level change.[58] Or if institutions are not that mature or are still developing, they are more receptive to change, thus, making fundamental systems level change more likely in administrative context with less path-dependencies. Usually practitioners and public sector managers have little control over organizational culture after it has segmented or become institutionalized, thus, existing high systems or even policy capacity can be a pre-determining factor for instigating systems level change. Different government functions divided into a 'silo system' can have large path-dependencies which can become a large barrier to change public service delivery systems.[59] Hence, many public sector organizations (as describe above) are ill-equipped to deal with new, complex and wicked problems.

Faced with many contextual problems, is there room for systems approaches in the public sector? How can system change be introduced into the public sector? There are only a handful of surveys exploring these questions: a survey from the US from 2001 showed that 50% of the innovations were initiated by front-line staff and middle managers, 70% were a response to a crisis and specifically 60% resulted due to austerity measures.[60] Indeed, in many cases political opportunities to create momentum for system level change stem from crisis.[61] Thus, crises have been found to drive innovation and change in the public sector.[62] Consequently, crisis—both physical emergence, perceived threat or public uproar—can be a window of opportunity to use systems approaches in the public sector, to reconfigure public service systems and policy on a larger scale. Crises tend to suspend the rules and norms that limit experimentation. Most importantly, a crisis can be an opportunity to step back and ask questions about core purposes of programs or services. By questioning—and reasserting—purpose, an administration opens an opportunity to redesign not only their services, but how those services are resourced, managed and renewed if and when the crisis recedes.

But as outlined above, systems approaches should be a continuous, dialogic process; we should not wait for political crisis to implement change. In static, business-as-usual conditions, there should be opportunities opened for systems approaches in the public sector. Regardless of different types of public sector organizations and context, there is evidence that policy entrepreneurs—committed leaders—can create space for change in any institutional context.[63] Consequently, it has been proven possible to overcome budget

[58] Kaasa 2013; Arundel et al. 2015.
[59] Bason 2010.
[60] Bornis 2001.
[61] McCann 2013.
[62] See Kay and Goldspink 2012.
[63] Leonard 2010.

and temporal uncertainty and restrictions if practitioners have the will to change work toward the transformation of a system.[64] Personal leadership and commitment of key individuals is an important factor in supporting successful change in the public sector,[65] even if it can be piecemeal at times. What matters is that work towards systems change is initiated and sustained as fully as possible. Strategies that open up organizations and support outside collaboration with enterprises, citizens, etc. also enforce organizational learning and help speed and spread the adoption of change.[66] Nevertheless, a broader engagement with systems approaches may require a substantive shift in the culture and operations of public organizations.

[64] Torugsa and Arundel 2015.
[65] Pärna and von Tunzelmann 2007.
[66] Walker 2013.

Toward a Framework for Systems Transformation

New systems-based practices

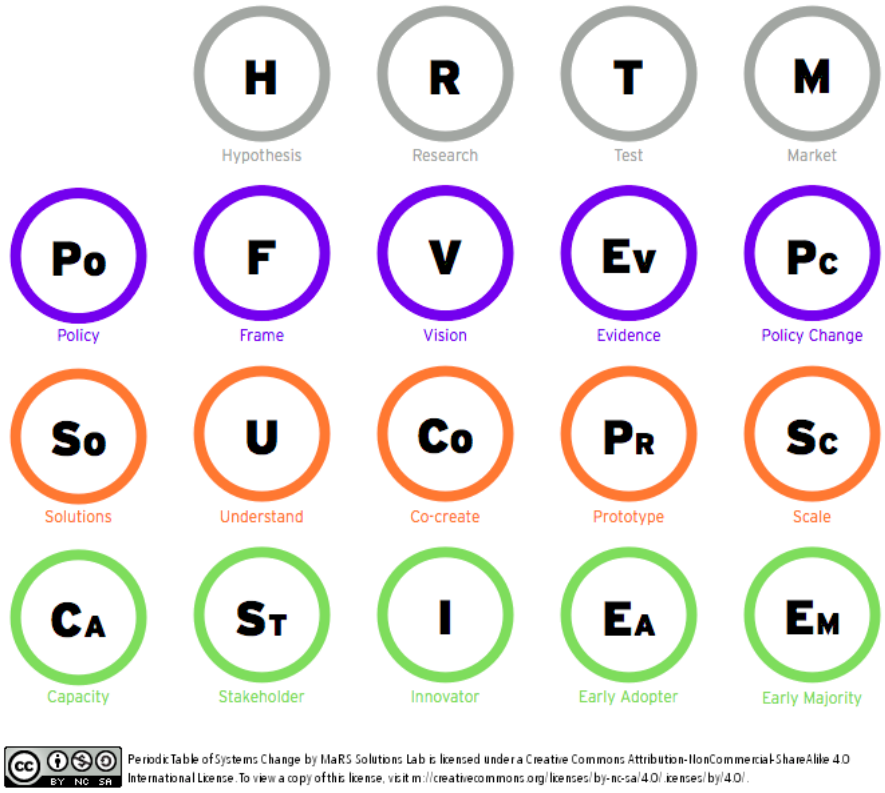
Innovative approaches to problem solving and service delivery are proliferating across governments as they contend with complex problems for which there are few precedent solutions. At the same time, front line public servants face "customers" who have come to expect tailored, responsive products and services that they routinely experience from business, especially the tech industry.

In the vacuum left by command and control systems inability to cope with these demands, new systems based practices are stepping in. Nesta has long worked to build an ecosystem of systems and design-based practices around government with its social innovation programs, i-teams, Creative Councils, among others. Sitra's Helsinki Design Lab, Strategy Unit and partnerships with organizations such as Demos Helsinki have not only deployed systems approaches on issues such as clean tech and urban decarbonization, but also worked to develop the theoretical and practical underpinnings of systems approaches and strategic design.

MaRS Discovery District in Toronto does much of the same, but also brings in organizations and businesses with the potential to be change agents, and helps to build their capacity and expertise. Embedded in MaRS, the MaRS Solutions Lab works at the intersection of design and systems thinking to develop solutions, policy and capacity around complex societal challenges such as health, work and food. Their "Periodic Table for Systems Change" (Figure 4) provides a useful framework for understanding the different kinds of elements required to navigate and alter complex systems. The Solutions Lab focuses intently on capacity building of the people and institutions implicated in systems change in recognition that culture can be just as – if not more important – than any strategy.[67]

[67] "Culture determines and limits strategy" Schein 2010: 377

Figure 4: MaRS Solution Lab's Periodic Table of Systems Change



In the United States, the Office of Personnel Management's (OPM) Lab@OPM works to spread design and systems based practices and tools across government through training programs for government workers and contractors, while providing a platform to bring together other Federal agencies to address complex challenges.

MindLab, Denmark's cross government innovation group foregrounds the importance of citizen involvement, voice and co-creation, which necessitates systems approaches. MindLab's staff includes designers, sociologists, ethnographers and others who work blended teams together with citizens.

The Australian Centre for Social Innovation, TACSI, a not-for-profit funded by government, applies design and social research in co-creative processes to tackle difficult social, economic and environmental problems. They look for ways to crack "open the current system at crisis points"[68] and develop new services that meet unmet or neglected needs. Their well-known "Family by Family" project is a good example of this approach. In working to address the seemingly intractable problem of dysfunctional families, TACSI aimed at reducing growing demands on social services by pairing families that had overcome crisis with families currently in the midst of crisis. Their critical insight was not first ask how do we mitigate chronic stress, but what might a successful family in difficult circumstances look like. Once the target was thriving families, not mitigation, better, more impactful services could be designed.

Many of these efforts remain at the margins—often organized into "labs" that have the space and mandate to innovate government processes. But they have yet to move toward the center of government. And they have yet to be given access to the structures of

[68] Nesta 2014

government or begin to tackle the norms and standards that dictate the behavior of civil servants.

Systems thinking/design thinking

Currently there is a surge of interest in *design thinking* in the public sector especially in connection to co-designing public services together with citizens through participatory processes.[69] One only needs to observe the proliferation of "sticky notes" in government offices to confirm this shift. However, the interlinkages between service design and systems thinking have to made clear especially in the emergence of 'design thinking'[70] and design management.[71] The former denotes the use of design methods to match consumer needs and value with what is viable both technologically but also for business strategy.[72] Design management is more geared towards prototyping, but some approaches also include clear elements from systems thinking (e.g. methods such as understanding user experiences, ideation, rapid prototyping, visualization and also systems).[73]

With the increased popularity of 'design thinking' the policy realm has also proliferated with different toolboxes and guides on how to use design and design thinking in the public sector and sometimes these mention systems thinking together with design tools.[74] In general, these methodologies try to rationalize change processes within the public sector and are therefore reductionist to a degree. By definition, tools and tool kits that are divorced from the underlying principles that were used to create them is a reductionist approach even when labeled "systemic". We see friction between the context specific nature of systems analysis and the latest push for a generic 'toolbox' approach in the public sector. Nevertheless, designers working in the public sector also see themselves as craftsmen, designing against contextual demands and user needs in practice, and not against archetypical situations.

However, there is no clear-cut definition how these approaches—systems thinking and design thinking—fit together. In some publications system thinking is regarded as a part of a larger design skill-set.[75] At the same time, others apply design as a tool in a larger systems thinking approach.[76] The origins of systems thinking and design thinking are clearly different—design thinking originating from product design approaches[77] and design more broadly from architecture and product design—but they are interlinked concepts. Thus, design as a concept was already used by systems thinkers in the 1980s, albeit more as a 'problem solving tool'.[78] What is important to note is that *systems thinking is not only systematic design*. Systems thinking at its core is oriented towards organizational learning,

[69] See e.g., the wealth of material on UK's Design Council also on public services: http://www.designcouncil.org.uk/resources/search/im_field_objective/public-services-486
[70] Rowe 1987.
[71] See e.g., Cooper et al. 2009.
[72] See Brown 2008, Martin 2009.
[73] Mulgan 2014.
[74] See for example materials on: http://social-labs.com/toolkits/
[75] Mulgan 2014.
[76] See e.g. Gharajedaghi 2011.
[77] This is largely attributed to David Kelley and IDEO Design. See further Kelley and VanPatter 2005.
[78] E.g., Argyris and Schön, 1978; Ackoff 1981.

reflection in action. At the same time, the narrow focus on systematic design is often how systems thinking is applied in practice.[79]

Design is a useful bridge to integrate systems thinking into everyday organizational learning.[80] Hence, some see the popularity of design thinking combined with evidence based policy making as a way to rejuvenate interest in systems thinking in the public sector.[81] Still, design thinking tends to deal with events, problems and the application of tools (we have all be subject to the sticky not storms of "creative problem solving"). It concentrates on action, prototyping ('thinking through doing') and usually it is considered to belong to Simon's rational-technical problem solving logic.[82] In many cases, the feedback loop from an implementation phase is weak (which is a clear break from traditional design practices). Furthermore, with rational problem solving, more complex changes in value distribution may be left unaccounted for as policy makers can choose the solution that satisfies current conditions which may not be the best solution.[83] Hence, one can end up with piecemeal solutions on the surface of underlying structural policy problems. Service designers concentrating on second or third order design problems directly connected to user needs may neglect to deal with fourth order design problems[84]—systems integration—linked most often to wicked problems.[85]

For example, design methodologies employed by public sector innovation labs use rapid prototyping often, however, many of these solutions do not fit with the broader public service system.[86] Thus, it is difficult to move beyond experimentation to long-term exploration.[87] This can be exemplified by the Government of Alberta CoLab's systemic design guide (Box 6). While they use many systems thinking tools, they not deal with the implementation process, which in the public policy context can be the most difficult part due to feedback from traditional institutions, established bureaucratic procedures and short political lifecycles.

Box 6: CoLab's Systemic Design Field Guide (Australia)

In 2016, the Government of Alberta CoLab published the guide "Follow the Rabbit: A Field Guide to Systemic Design". It was developed with Government of Alberta Staff in mind, but it can be applied to different public policy areas, sectors and intersections.

The CoLab outlines five key characteristics of systemic designers: they are inquiring, open, integrative, collaborative and centered. It adopts a simple formula: playfulness + discipline = creativity.

The guide goes through a systemic design project, introducing the following phases for

[79] Li 2002, 387.
[80] Ibid. 392.
[81] Wastell 2010.
[82] Dorst and Royakkers 2006.
[83] Ibid.
[84] Defined by Buchanan 2001 the four orders of design are symbols, things, actions, thoughts with the corresponding design areas graphic design, industrial design, interaction design, and environmental design.
[85] Junginger 2014, 148-149.
[86] Tõnurist et al. 2015.
[87] In the context of social innovation see Brown and Wyatt 2010.

systems design projects: planning, workshops and evaluation. The methods used include steps such as “look” (which includes tools such as interviewing for empathy, empathy map, keep asking why, ethnography), “frame” (rich pictures, systems maps, iceberg diagrams, CLDs, concept maps, six thinking hats, speed dating, affinity diagrams, card sorts, world cafes), “generate” (participatory prototyping, dotmocracy) and “adapt” (reflection and action space).

In the planning phase, the nature of the problem should be outlined—if it is not a complex problem, than systemic design approach would be “overkill”. Additional important questions to consider: is the client open to change, does the client have “top cover” (senior level champion) and is the client committed (with resources, willing to implement the project), and most critically, do we even know who the client is? During the workshops sequencing is important (bringing in external perspectives, ideation, testing, integrating findings, evaluating processes, implementing and sharing results, maintaining momentum during workshops). There are some specific roles that should be fulfilled in workshops: facilitator (usually an outside designer), recorder, note taker, narrator. The workshop is followed by an evaluation and after a few months a check back to see if anything has happened since the get together. The approach is design centered, focuses on the workshops and does not go into implementation.

Systems thinking helps to put a managerial problem into context, into systems events, patterns and structures rather than events alone for which design solutions are applied.[88] At the same time, systems thinking can overemphasize the analysis (‘thinking it through’) and gets into trouble by ignoring action. Consequently, both approaches can complement each other in practice. The danger is that both approaches tend to become too rigid in applying their own specific methodologies and thus, limit their use in broader policy making circles.

Design has always been concerned with the interaction between people and things. For much of its history, these things tended to be objects. But increasingly, design is working at the intersection of people, processes and outcomes, making it particularly relevant for managing a transition toward human centered policy and services. Human centered design (HCD), strategic design, design thinking and other variations have gained traction in many administrations moving to reorient around their citizens. Other systems approaches are also well positioned to better incorporate citizens’ interests into public services as principal stakeholders.

Requisite variety and the Ashby Space

In 1956 the cybernetician W. Ross Ashby published *An Introduction to Cybernetics* wherein he described the internal order of a system to be a response to the environmental or external forces it faces. His *Law of Requisite Variety* stated “only variety can destroy variety”[89] which was later recast by Stafford Beer to the more well-known phrase “variety absorbs variety”. Both Ashby and Beer were describing a state of dynamic stability wherein systems can only control input (perturbations) to the extent that it has sufficient internal variety to react. For example, in order to make a choice between two competing

[88] See discussion in Dunne and Martin 2006.
[89] Ashby 1956: 207

alternatives A and B, the decider must be able to accept or become either A or B in order to choose one of the possibilities.[90] In the context of public policy and services, Ashby's law states that any control system must be at least as complex as the system it is controlling, otherwise a complexity gap will arise from the mismatch. For instance, in a tax regime where legislators create increasingly complex regulations, constituents will always be able to develop more means of evading taxes than regulators can address. This dynamic results from the variety and quantity of avoidance schemes available to lawyers, accountants, and tax advisors which are then multiplied by the variety of individual circumstances. The solution to this complexity gap is not to make tax policy more complex, but to reduce the variety available to the public by simplifying the tax regime itself.[91] In essence, reduced variety on the regulatory side will result in a reduced number of responses by the regulated. Ashby's law may be the most important principle to consider when working on—and especially developing interventions for—complex systems.

Complexity scholars Max Boisot and Bill McKelvey have returned to Ashby's law and applied it to the contemporary debate around managing organizations in increasingly complex environments. Their *Law of Requisite Complexity* holds that "to be efficaciously adaptive, the internal complexity of a system must match the external complexity it confronts."[92] With respect to managing complexity, organizations have two principal adaptation strategies. The first strategy is to simplify or reduce the complexity of incoming stimuli so as to keep internal complexity minimized. This *complexity reduction* can be done through abstraction such as creating theoretical models that make information more manageable or actionable. There are risks associated with this strategy that stem from oversimplification such as in the banking sector where securitization of residential mortgages shielded unaccounted risks leading to the global financial crisis. Examples from the public sector abound, but at a systemic level, the organization of domain authority into ministries is a form of simplification or complexity reduction. For instance, we know that housing sector is responsible for a significant portion of energy consumption, and that behaviors drive energy usage, yet governments have formed separately a Department of Housing, a Department of Energy and a Department of Human Services. This artificial segmentation of problem spaces reduces complexity, but also limits the degree to which any single organization can understand and take action on systemic challenges. Here there is a complexity gap between a problem such as climate change, and the government's ability to address it holistically.

The second strategy is *complexity absorption* wherein organizations create internal complexity that is determined to be equal or greater than the external complexity that it faces. Complexity absorption leads to requisite variety which in the best case permits an organization to be adaptive, opening up new kinds of strategic options.[93] But there are risks too: resources can be quickly depleted as the organization grows in size or diversity,[94] and possibly becomes too complex itself to be effectively managed (e.g. multinational financial institutions). In the public sector, complexity absorption results in the proliferation of new internal agencies within departments or ministries. For instance, the US Department of State has as many as 71 internal Offices and Bureaus, each with its own remit, leadership, resourcing, cultural norms and legacies. This leads to the remarkable cultural phenomenon that physical proximity to the Secretary of State's office is indicative

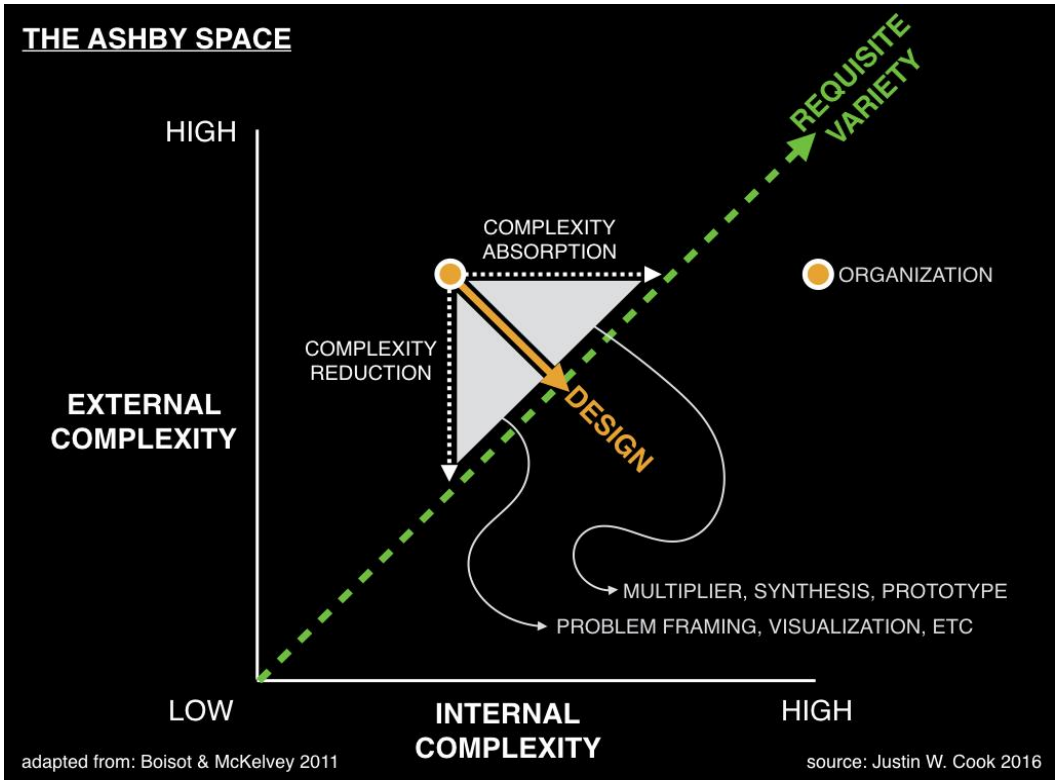
[90] http://pespmc1.vub.ac.be/REQVAR.html
[91] Casti 2012, 56.
[92] McKelvey & Boisot 2009
[93] Hämäläinen 2015
[94] Boisot & McKelvey 2011

of importance, priority or power of a Bureau or Office as opposed to a more fluid resourcing scheme based on global affairs. On a much smaller scale, the push toward data capture and analytics is also a form of complexity absorption as public administrations deploy tools that can potentially help them understand their environment more holistically. But of course the persistent challenge of big data is the ability to understand and take action on vast amounts of new information; complexity begets complexity.

Boisot and McKelvey describe these interrelated strategies of complexity reduction and complexity absorption and the trade-offs inherent between them as the *Ashby Space*.[95] Figure 5 (adapted from Boisot and McKelvey) illustrates this conceptual framework and the potential of design and other systems approaches to manage complexity. The diagonal line represents requisite variety, or an ideal state of dynamic equilibrium where the variety of an organization's responses (internal complexity) matches the incoming stimuli (external complexity). According to Ashby, equilibrium can be achieved through some form of regulation.[96]

It follows then that *regulation* is the key task of organizations operating in complex environments. The objective of regulation is to move toward requisite variety as complexity increases. As Boisot and McKelvey point out, "the variety that the system then has to respond to depends in part on its internal schema development and transmission capacities and in part on the operation of tuneable filters, controlled by the system's cognitive apparatus, and used by the system to separate out regularities from noise…".[97]

Figure 5: The Ashby Space

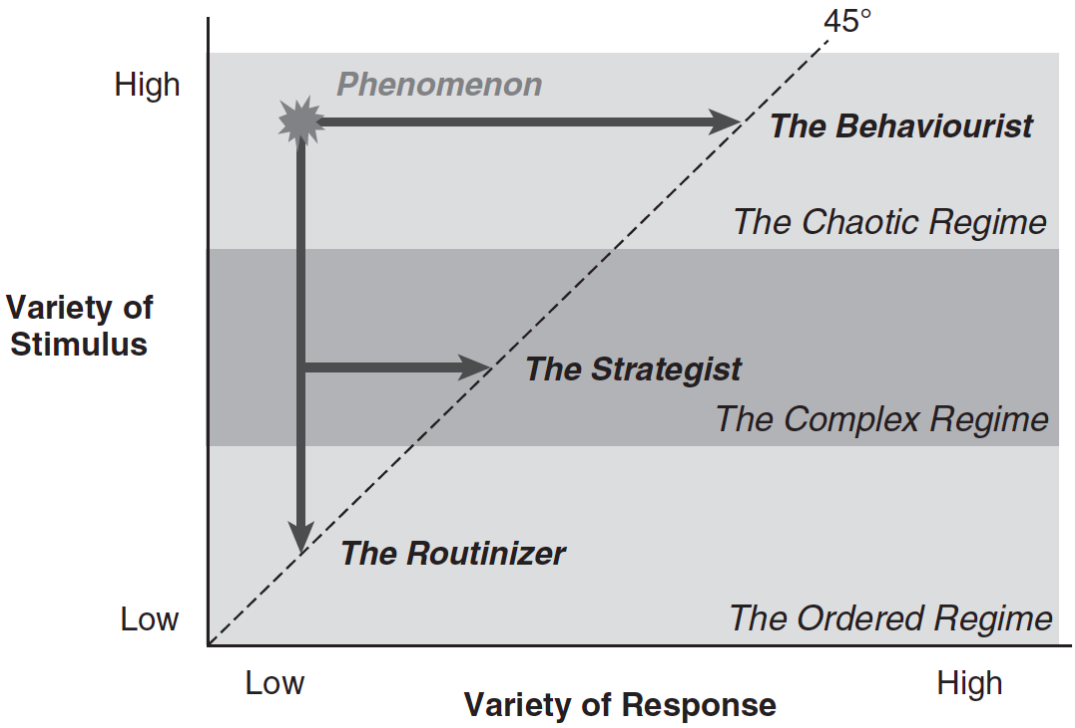


[95] ibid.
[96] Ashby 1956
[97] Boisot & McKelvey 2011: 284

Figure 5 illustrates an organization experiencing high levels of external complexity facing a need for regulation to move it toward requisite variety (stability). As discussed above, there are two strategies to move toward stability within the Ashby Space: become more complex internally or reduce complexity by simplifying variety. An alternate complexity reduction strategy could be to retreat and focus only on core competencies, but this is unusual among most organizations not facing crisis and may be altogether impossible due to the interconnectedness of today's challenges.

However, we propose that a third strategy exists for working toward requisite variety that can achieve a more stable position than either complexity absorption or complexity reduction on their own. Design processes and some systems approaches are very effective tools for managing complexity and generating productive outcomes. We propose that employing design principles and methodologies specifically enables an organization to transit the Ashby space more efficiently toward requisite variety. The field's growing adoption across multiple sectors where normative tools are no longer achieving results suggests as much. While design methodologies still remain largely marginal to more firmly established strategy processes, a shift is underway that is pushing designers deep into organizations, making them part of the system itself. This is enabling designers to move beyond "innovation" teams responsible for novelty to participants engaged in implementation and therefore the evolution of the system itself. This shift provides designers the opportunity to engage self-adaptive systems directly.[98]

Figure 6: Three Complexity Regimes (Boisot and McKelvey 2011)



Design has traditionally worked to make sense of complexity through problem framing, visualization, ethnographic practices, working with relative precision and across disciplinary cultures, etc. These methodologies do not artificially simplify complexity, but

[98] http://jods.mitpress.mit.edu/pub/designandscience

aim to contextualize and order information and then make it actionable. Crucially, design processes that include implementation also create a feedback loop between information, ideas, people and action through prototyping and iteration. Rather than loading more complexity into the structure of an organization (complexity absorption), design allows for variety to be explored and exploited *within the process itself*. By optimizing between reduction and absorption strategies, design and systems approaches transit the Ashby Space more productively toward requisite variety, enabling what Boisot and McKelvey termed the *complex regime* (Figure 6) where complexity can be embraced and successful schema can be developed. The following sections will explore in greater detail systems approaches and design methodologies that have proven effective within the Ashby Space.

Returning to the question of systems change in crisis versus static conditions, what can be learned from the Ashby Space framework? In the face of crisis, organizations tend to adopt a complexity reduction strategy in order to make a situation manageable. This is understandable, and in some cases appropriate. However, experience shows that this carries significant risks associated with decisions that can worsen outcomes. For instance, in the aftermath of Hurricane Katrina that devastated New Orleans in 2005, the Federal Emergency Management Agency (FEMA) supplied thousands of what came to be known as FEMA Trailers, which were mobile units intended to provide temporary housing. While this quick reaction provided housing relief for those that lost their homes, many of the trailers contained dangerous levels of formaldehyde that caused significant health issues. Worse still, as of 2015—a decade after the crisis—people continue to occupy FEMA trailers,[99] suggesting an inherent conflict or error in what was designed to be a short term solution. Alternative examples of progressive, productive reactions to crisis exist as well. As Helsinki Design Lab explored in their 2013 case study *Rebuilding Constitución*, the response to the devastating tsunami that destroyed the city of Constitución, Chile demonstrates that a systemic, inclusive, co-created solution to redesigning and rebuilding an entire city can be done both efficiently and successfully.[100]

In static conditions, both complexity absorption and complexity reduction can occur. Returning to the example of the US State Department, the proliferation of Bureaus and Offices, suggests complexity absorption for an administrative body charged with managing global affairs for the US Government. However, just as departmentalization of large segments of public sector problem spaces is a form of complexity reduction, the same holds true for the internal structure of a single department or ministry. When conditions are fairly static (for instance the absence of a large scale conflict such as WWII or the rise of polarizing adversary such as the USSR), organizations such as the State Department find themselves attempting to both reduce and absorb complexity which we would argue moves them no closer to requisite variety. The key question in a static condition is how does an organization create an opportunity to transit the Ashby space toward requisite variety when there is not an external stimulus that forces action.

[99] http://grist.org/politics/people-are-still-living-in-femas-toxic-katrina-trailers-and-they-likely-have-no-idea/
[100] Boyer, Cook & Steinberg 2013, 25.

Working with relative precision

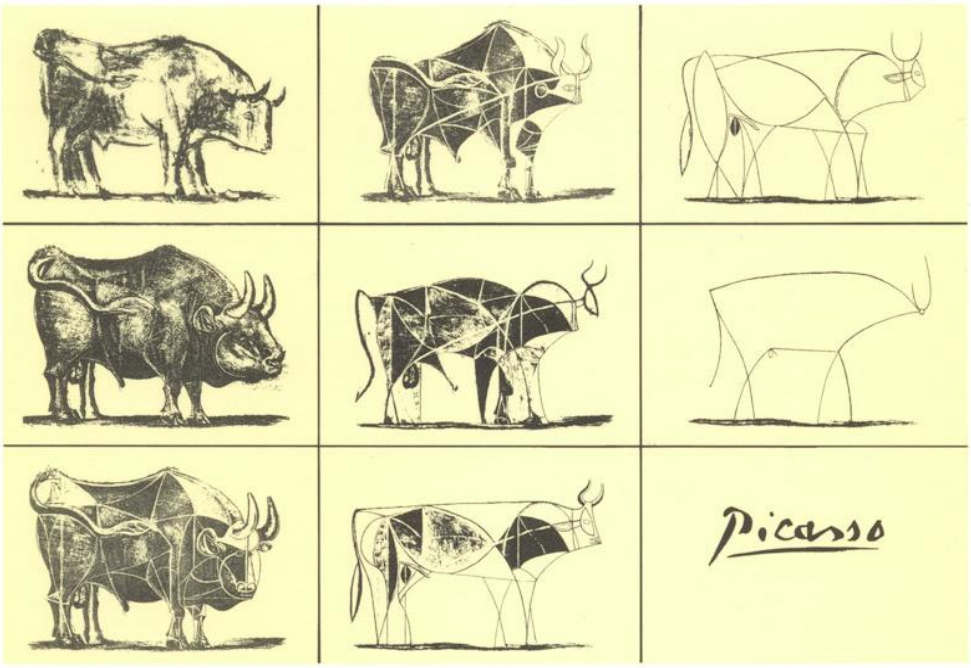
For many in the public sector, the fiduciary responsibilities that come with public office require a conservative approach to risk–with authority comes responsibility. This responsibility can be realized either through strict regulations on policy design and implementation. Or tacitly, through behavioral norms within institutions. In most areas, precision and certainty of evidence are understood to be a fundamental precursor to decision making. This is especially true for domains such as healthcare and education where the public expect positive outcomes, not experimentation and risk of failure. While it is certain that governments use evidence in their decision making, it is not clear if the evidence fully informs policy or if decision makers are able to comprehend evidence because of time, expertise, complexity or other constraints. The capture, analysis and transmission of evidence can also be a very time consuming process. Political cycles and research cycles operate by very different clock speeds. Policy problems, especially certain social or environmental challenges can be resistant to the formulation of comparable data. And in countries such as the United States, the evidence itself can be politicized; accepted by some as science, derided by others as fiction. These factors lead to a conflicted state: on the one hand, evidence is necessary, on the other, evidence may not be useful in a decision making process.[101]

Enter then, wicked problems. As discussed above, wicked problems are emergent meaning that they result from the interaction of smaller subsystems. Typically, it is at the level of the subsystem that science and evidence creation are most effective and precise. For instance, the cognitive development of children can well be explained by neuroscience and psychology, but it is difficult to understand how learning emerges from the confluence of social, cultural, economic, environmental and biological factors. The problem that should concern policy makers the most – in this example, learning – is out of reach of the more narrowly defined domains of scientific inquiry. While some have begun calling for a second order science approach to policy making, much work must be done to develop the field before it can be widely applied.[102]

So what can be done when facing a problem with no "definitive definition"? For designers and systems thinkers, the answer lies in their ability to work with relative precision. In order for barriers stemming from uncertainty to be overcome, knowledge about a wicked problem must be comparatively appraised. In practice this means treating qualitative and quantitative data with equal rigor and by actively searching for, or inventing bridges between, the two. This process usually requires intuition and testing. The former, while perhaps an uncomfortable topic for many disciplines because of its apparent lack of seriousness, intuition is a critical skill that is honed by experience and central to many designers' practice. In the context of strategy, intuition requires full investment of time and thought so as to have a sense about how things fit together.[103] The latter, testing, is also dependent on the former to the extent that it requires experience to know how to test ideas efficiently and productively.

[101] See The Alliance for Useful Evidence.
[102] See Sitra/IFF's report "Second Order Science and Policy" http://www.decisionintegrity.co.uk/SOSP%20Report%20Final%20June%202016.pdf
[103] Boyer, Cook & Steinberg 2011: 37.

Figure 7: Picasso's "Bull" Lithographs, 1945[104]



Visualization is also an effective tool for working with relative precision. In its most common form visualization is the sketch. Sketching allows the rapid transposition of ideas to paper, recording concepts while still allowing for addition, subtraction and interpretation. Precision can be increased or decreased in several ways. For instance, Figure 7 shows a collection of Picasso's famous "Bull" lithographs. On the left, he begins with fully developed drawings based upon a visually accurate portrait of a bull. On the right are rapid sketches that distill the essence of the bull to a few lines. Each lithograph effectively communicates the idea of a bull, but some allow for more interpretation than others. This interpretative space serves a purpose when confronting wicked problems. It allows for differing perspectives to enter a representation of an idea or analysis without relying on narrative which itself can become so complex and circular so as to be disabling. Sketches and other forms of visualization also preserve ideas so that they may be easily returned to over the course of work. Words on the other hand, unless carefully recorded can be fleeting and lost in process. Narrative can be difficult to re-contextualize, as anyone who has thought, "that seemed like such a could idea at the time" can attest.

Working with relative precision also allows designers to propose solutions before all the facts are known. This prefactual process is familiar to the practice of architecture where designs for whole or parts of buildings, landscapes, infrastructures, etc. are proposed well in advance of having fundamental information such as budget, location, occupancy and other constraints. In other disciplines such as engineering, it is critical to have the most complete information possible before developing a solution in order to manage risk of failure. This approach is productive when variables are known, but virtually impossible when working with wicked problems.

A prefactual process enables an *open-ended solution* to be developed yielding at least two principal benefits. First, developing a solution early creates a test case based in part on the

[104] https://www.flickr.com/photos/sorarium/8578925321

unique problem being tackled rather than a generic theory. From this early prototype, greater understanding of the problem itself may be assembled. Second, because a solution was developed early and with the expectation that it will change, it can evolve radically as more information is gathered. Ideally, this results in solutions that are more robust and better tailored to their specific context.

Toward a systems transformation process

This section will outline a systems transformation process that is a summary of the authors' experience and research. Each subsection will outline in general terms key elements of success. Greater specificity will be highly dependent on the context, institutional capacity, problem, timeframe and resources available to public administrations as they embark on systems change. As discussed above, each wicked problem is essentially unique which prohibits many 1:1 comparisons between systems tactics. However, strategy and principles should be transferrable despite contextual variance inherent in large scale systems. Where possible, we provide examples from the public sector to help illustrate how these principles can be applied. As these are necessarily short, please refer to the case studies for further analysis.

People & Place

While the value of having good people working in supportive spaces may seem obvious, it is so often overlooked as an indulgence, especially in the public sector. Yet these two variables – talent and workspace – are among the most important considerations of any highly successful startup or established, innovative company. The same is true when applying systems approaches to complex problems.

"Good people" is a broad and perhaps impolitic phrase. But design is an inherently optimistic act and systems transformation in the public sector is ultimately concerned with improving people's lives. So it is critical to have a core team in place that is invested in both the change *and* betterment of a system.

The selection of individuals into teams should be done carefully. Having lateral thinkers and multiple disciplines present is important, but not as critical as their ability to maintain applied optimism. Systems change can be a slow, grinding process. Possessing optimism for the value and purpose of change helps bridge the countervailing forces certain to emerge. That said, design and systems thinking rarely succeed with standard collaborative processes that can be completed during one-hour meeting slots. This is because wicked problems cannot be solved by any single discipline that creates an optimum solution based on their tools and worldview. Multiple arenas of deep knowledge must be integrated, even when it is contradictory. This synthesis across disciplines is possible when teams are able and willing to work inter-methodologically in an effort to find the best process fit for the topic at hand. And Loose fits are common under uncertain conditions, but they should not be feared or forced into greater conformity.

It is also useful to bring in external expertise that becomes embedded in a team for a fixed period. For instance, the Collaboratory at the US Dept. of State hired a Rhode Island

School of Design trained designer to come in as a contractor and bring a new set of skills to help build out a new platform for collaboration. Or, at the Finnish Innovation Fund (Sitra), members of the Strategy Unit have joined the Prime Minister's Office and Ministry of Economic Affairs and Employment for fixed terms to both bring new ways of working and thinking into government, but also improve Sitra's intelligence about how government operates. These "exchange programs" allow an expansion of ways of working and cultural norms that provides a space for new practices to emerge.

It must be recognized at the outset that for some, a systems transformation might equal loss, including employment, seniority or job satisfaction. Those that stand to lose should not be excluded however as they undoubtedly possess deep insight into the machinery of systems. In practice this can translate into engaging those that stand to lose in a carefully managed process that allows them to redesign their roles within a new system.

Place is also important as it signifies the investment an institution is making into process. Working in an isolated basement versus a public space closely connected to the heart of an organization or even a storefront rented in the city, sends two very different messages to those involved, including external stakeholders. Even when space is at a premium, seeing to the psychological and physical comforts provides teams a baseline sense of wellbeing that will help them overcome obstacles such as the frustration that is a normal byproduct of ambiguity. It can be simple: remarkable effects can be realized when managers provide employees with access to decent coffee and good food. Google, Facebook and others learned this to their benefit long ago.

Working space must also enable dedicated, long-term collaboration. Given the complexity of systems approaches, it is not reasonable to hold all of the critical information in one's mind at all times. Having visualizations, artifacts, reports, images, etc. pinned to the walls of a workspace can spur new, connective thinking as a project unfolds.

Dwelling

Wicked problems often outstrip our ability to effectively define them. This mismatch between problem and definition sometimes arises from old concepts that have not been updated or recast to meet a changed landscape.

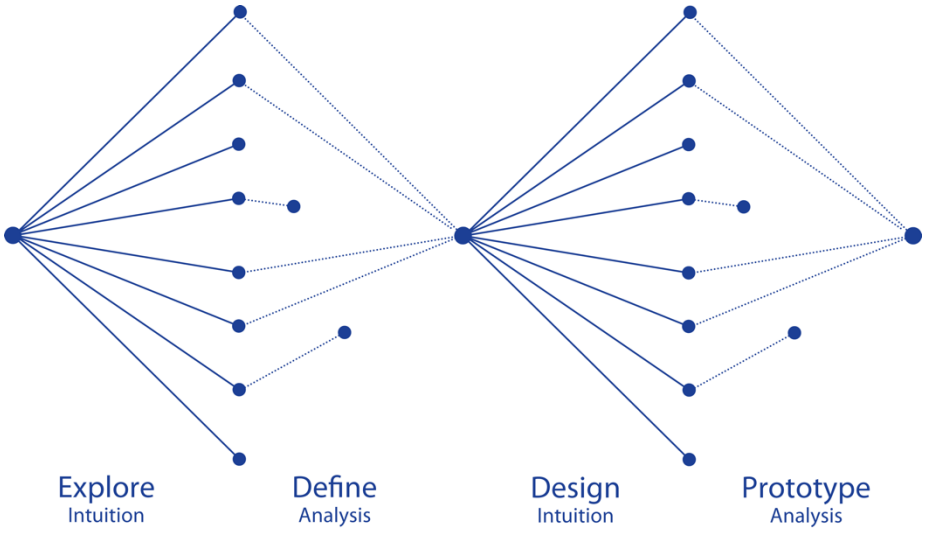
For instance, *civics* is a concept and practice that has been central to the American understanding of duties one has to the state. Today, civics is widely understood to be satisfied by voting. But in the past, the civic lives of Americans were much more rich, connecting individuals to communities and communities to government. Using the Google NGram Viewer which searches for the frequency of terms present in the vast Google Books library, civics was a term actively used through the world wars but began a precipitous decline in the 1960s. Since that time, the word appears at a much lower frequency, even after 9/11. This suggests that the idea of civics which was once a foundational concept, has gone unrenewed for half a century. Meanwhile, technology, identity politics, and structural changes have pushed Americans away from their government and one another. Anyone interested in rebuilding American politics or communities will need to renew the definition of civics in the process.

Dwelling means investing the time to understand and articulate both the problem and the objective. Even in the context of discrete problems, it is easy to include significant biases or rely too much on tacit knowledge. To unpack the tacit dimensions of understanding and minimize bias, it is important to ensure that topics are sufficiently explored and that related issues are given more than a passing glance. This is especially true when working with complexity where some causal factors may not even be directly observable. Accounting for all sources of input, including those that are unspoken, may help reveal a more complete problem architecture.

Systems change and especially design processes often begin with a conversation about purpose. Defining the purpose of something helps one understand why something should exist and how best to achieve it. But for so many central public institutions or constructs, purpose has gone undefined for decades. Take education for instance. When was the last time a country had a society-wide conversation about why and to what end do we educate our children? Or healthcare: is its purpose to extend life or improve wellbeing? We don't know and we won't know until we take the time to debate purpose. Time assigned to dwelling enables this kind of searching and thinking. In a public sector context, using the term "dwelling" may cause consternation. Other phrases adapted from project management such as "phase zero" can be useful here.

In the language and practice of design, dwelling is often described as divergence or exploration. This phase is then followed by subsequent phases of defining what has been learned, or convergence. The UK Design Council's famous *Double Diamond* diagram captures this notion well.

Figure 8: Double Diamond adapted from Helsinki Design Lab (2010) and UK Design Council



Dwelling also suggests that alternate means of coping with information may be required. For instance, storytelling, when combined with harder quantitative data can be an effective tool for understanding complex systems. But to design an effective story, phenomena may have to be observed and analyzed through multiple lenses. Models may have to be built to illuminate relationships and expose gaps. This takes time and resources, and it dedicates them to a phase of work that may not produce timely or obvious results. Here, dwelling is a

form of due diligence for complex systems that will pay dividends in later stages by accelerating the ability to make meaningful propositions.

In a public sector context, dwelling can be enabled through engagement processes where officials interact in context with citizens and other stakeholders to understand their lived experience (discussed in the next section). The key is then spending the time aligning what is learned in the field with what is understood to be the limits and opportunities present in a system, with a given problem set. For instance, if an administration is interested in developing better services for aging populations, it is usually not enough to gather more data from constituents. This data must be instrumentalized and made actionable by developing new principles, frameworks or logics from it that can then be worked from as interventions are designed. Making information actionable requires the ability and resources to be reflective, which we call dwelling.

Connecting

To understand citizens, it is essential to get close to them; to see their lives, their desires, their fears, their successes through their lived experience. This action of *connecting* is itself extremely difficult, especially for governments where institutional structures often thwart the ability to develop a holistic understanding of people and the issues they face. To connect, engagements with citizens must be meaningful, generative and respectful, not arms-length instruments such as surveys. Connecting takes time and resources, and tools such as videography that may not be readily available or familiar. Working with citizens in co-creative processes can be unpredictable and can yield results that are counter to what is deemed acceptable or desirable by an administration. Careful facilitation is also required. In the best case, good facilitation destabilizes authority and expertise so that controversial issues can be explored and captured more completely as citizens feel free to challenge political and business interests.[105]

The kind of knowledge generated by connecting with people is perhaps equally challenging as it doesn't enjoy the same universality as quantitative knowledge. Centuries of parsing economic data has led to extreme facility of its uptake and use in driving decision making. But what about less structured, qualitative data? How can decision makers confront a narrative, have strategic conversations and then reach unbiased decisions about policy and services? These questions sit at the center of every discussion that leads to the traditional approach of mild, distant citizen engagement.

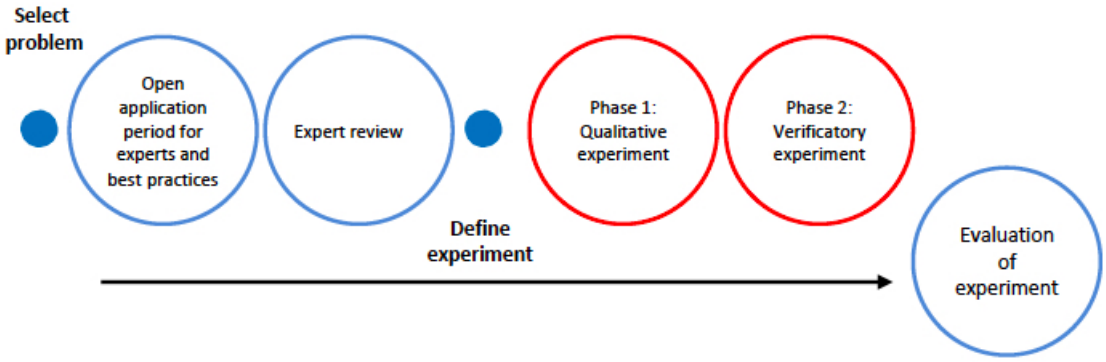
However, the social science ethnography provides critical capabilities that allow qualitative data to be worked with as rigorously as quantitative data. Ethnographic practices have gained traction and indeed have become central within many design and systems methodologies. While it is typically modified (i.e. simplified) from its stricter tenants in the academy, "ethnography light" can still be a rigorous observational and analytic practice. A deeper examination is beyond the scope of this paper.[106] However, when considering an ethnographic approach it is critical to keep in mind that observation is not a passive

[105] See Helsinki Design Lab's writing on Hybrid Forums. http://www.helsinkidesignlab.org/blog/hybrid-forums-for-urban-controversies-the-ten-commandments
[106] Ethnography has many variations including Hybrid Forums (see Michel Callon et al *Acting in an Uncertain World*. See also the vast sphere of co-creative processes aimed at connecting authentically to citizens.

process.[107] As one Brown University ethnographer said, "ethnography means making the strange familiar and the familiar strange"[108] meaning in the act of observing, one must recognize the implications of their presence and the role interpretation and bias will play in reaching conclusions.

In connecting with citizens, it is also critical that a diverse representation of the public be involved. Without diversity, even the best co-creative processes can mirror standard engagement practices which tend to bias proximal or known stakeholders. This can and should include individuals that may not have a direct stake in the process. Their disinterest can provide useful ballast to conclusions that are too easily reached.

Figure 9: The process for experiment (Design for Government: Human-centric governance through experiments Demos Helsinki 2015)



For public service managers, connecting can be done with a variety of tools that exist on a spectrum from low touch to high touch. On the low side, questionnaires mailed or sent electronically can provide basic information from those who opt to be involved. On the high side, heavily facilitated co-creation processes can engage citizens on a deep level, raising the possibility (and risk of not realized) of a deep sense of ownership and commitment to the outcomes. Engaging citizens in experimentation around public policy or programmatic solutions can be a middle ground. For instance, the Prime Minister's Office in Finland has developed an experimentation platform for citizens together with the think tank Demos Helsinki. The objective is to crowdsource strong ideas for how to improve Finland, develop the ideas into experimental proposals and scale the proposals if successful (see Figure 9).[109] This form of connecting engages citizens so that they have a shared responsibility in the work and success of government.

Framing

The problem with complex, systems challenges is that it is difficult to know what the problem actually is. As noted earlier, there are no definitive definitions of wicked problems. So how can the problem be known? More specifically, how can the problem be *framed* so that action may be taken?

[107] https://www.research-live.com/article/opinion/ethnography-caught-between-myths
[108] Sarah Besky, lecture at RISD Institute for Design and Public Policy, 2016.
[109] http://www.demoshelsinki.fi/en/2015/12/08/this-is-why-finland-is-able-to-implement-the-basic-income-experiment/

Framing, or in the context of design, *problem framing* is a key method designers and systems thinkers use to unpick and ultimately work around dilemmas and paradoxes that have prevented change from occurring. A problem frame stakes out the territory in which action will be taken in order to achieve a desired outcome. For instance, consider a physics teacher wanting her students to gain greater proficiency of core scientific principles. One framing option is to design better exercises that cover principles more comprehensively. Another framing option is to turn students into scientists so that they can discover principles directly through inquiry. Each approach is aimed at the same objective, but depending on how the problem is framed, either curriculum or pedagogy will be the focus of the solution.

Problem frames link the desired outcome with a definition of how a solution might be organized (the patterns of relationships between parts). It leaves out the specific elements that will be deployed as those are determined after a problem frame appears promising.[110] Framing is a dynamic process where multiple outcomes and solutions are explored as an understanding of the problem, outcome and context evolve and are refined. However, problem frames should be formulated with some attention paid to feasibility, especially within a highly regulated environment like public administrations. If the desired outcome and possible approaches are not aligned with the capacity of an institution or collaborative body, it can become disruptive.

A related concept has been outlined for the management community by Hamel and Prahalad in Harvard Business Review. Their concept of *Strategic Intent* sets a course of action based on methods available and a desired outcome. As they state, "the goal of Strategic Intent is to fold the future back into the present… while [it] is clear about ends, it is flexible as to means." Within organizations, strategic intent provides a shared platform on which ideas can be explored and built into solutions while maintaining focus on overall objectives.[111] For the design community, strategic intent can be blended with other objectives such as targeting specific populations or developing durable products.

In his book *Frame Innovation*, Kees Dorst offers a useful, although demanding, nine-part "frame creation process model":

- Archeology: analysis the problem in depth as well as earlier attempts to solve it
- Paradox: investigate why the problem is hard to solve
- Context: explore key stakeholders of the problem and their environment, behaviors, etc.
- Field: examine the broader landscape surrounding the problem
- Themes: analyze and articulate deeper factors at play in the field
- Frames: investigate implications of possible actions given themes and outcome
- Futures: "think forward" to see if the frame will lead to viable solutions

[110] Dorst 2015: 53.
[111] Hamel, Prahalad 1999

- Transformation: critical evaluation of different solutions and their feasibility over time
- Integration: ensure frames & solutions can be well integrated into stakeholder organizations

A lighter approach to problem framing is to ask a series How Might We (HMW) questions. HMWs are a common tool used in design thinking methodologies within corporations and consultancies. The trick is that the question avoids using phrases like "how can we do this" where "can" implicates additional questions about risk, capacity or other challenges that can derail a framing process. As Tim Brown, CEO of IDEO explained in Harvard Business Review:

> The 'how' part assumes there are solutions out there — it provides creative confidence, 'Might' says we can put ideas out there that might work or might not — either way, it's OK. And the 'we' part says we're going to do it together and build on each other's ideas.[112]

Balancing ambition and feasibility is important for HMW questions. For example, "how might we deliver more accessible digital services to seniors?" is likely to work better than "how might we improve the lives of seniors?"

Other approaches that share similar traits as framing include systems mapping and modeling, scenario planning, forecasting, design fiction, among others. The limitations of these methods is that they bias what is or what should be rather than how to get there.

Designing

> "Today there is no lack of vision in the world, but vision alone is hard to act on."[113]

It is impossible to give a full accounting of design, design practices and methodologies as well as the diverse world of design cultures within the space a few paragraphs. However, there are a few concepts that are useful in the context of wicked problems and public administrations working toward better public services.

Design has two fundamental concerns: first to order information into concepts, logics and rationales and second, to create processes that produce useful outcomes.[114] Traditionally this has meant working through a set of constraints provided by a client to identify an approach, developing a novel solution and then a fabrication process that will produce the solution; say a chair or tea cup. For a world of wicked problems, design is proving an essential tool for *specifying intentions;* a critically important capacity when it can be hard to understand what problem is actually causing nocuous symptoms, let alone what must be done. Design has also always been operative at the intersection of intention and realization; analysis and execution. It is a discipline constructed around the feedback loop

[112] https://hbr.org/2012/09/the-secret-phrase-top-innovato
[113] Boyer, Cook, & Steinberg 2011
[114] "Useful" is broadly defined here to mean anything from economic value to delight.

between ideas held and actions taken. This makes it particularly well suited to function rigorously in ambiguous environments where precedents have little value.

How to begin a design process? See the sections above. Then ask a few questions. Kees Dorst provides a simple equation[115] that has proven useful when facilitating teams of non-designers working to solve complex problems:

WHAT + HOW = OUTCOME

Where WHAT are the elements such as people and things. HOW is the patterns of relationships or connections between the elements. And OUTCOME is the observed phenomena, the result of a process where the elements interact. In a typical deductive reasoning process where cause and effect are being determined, if the "what" and "how" are known, then the outcome can be predicted.

But design processes change the knowns in the equation:

???? + ???? = OUTCOME

Here, something is known about the outcome (objective) but the elements and relationships are still to be determined. Dorst terms this equation "design abduction" in which "two unknowns lead to a process of creative exploration".[116] This concept is especially useful with complex challenges because it may only be possible to determine the desired outcome; elements and how they fit together will then depend on a variety of other factors.

A discussion about desired outcome is largely the same as defining a vision for an alternate future. In the author's experience, a positive vision for the future is a critical piece of infrastructure from which all other ideas, frameworks and solutions are hung. After framing a outcome/vision, it is important to describe the principles that will govern that alternate future. In most circumstances, the principles answer the "how' variable in Dorst's equation. For instance, when the British colonists created a vision for a future where government was for the people by the people, they also defined the principles that would guide decision making such as a representative democracy and separation of powers. Taken together, vision and principles form the conceptual framework of a design for systems transformation process.

The next step is to determine solutions (the "what" in Dorst's equation) that can intervene in an extant system and inflect it toward the desired future. In the ideal case, a group of solutions (remember that there is no optimum solution to wicked problems) should form a portfolio that is more than the sum of its parts because of the synergistic nature of the solutions working together on a systemic challenge. The portfolio functions as a kind of systems acupuncture.

It should be pointed out that in the context of systems change, the term *solutions* should be used carefully. Solutions have neat boundaries in terms of time and scope and interact with systems in predictable ways. Interventions (the author's prefered term) are different

[115] Dorst 2015: 45
[116] ibid: 49

in that they are designed with the system in mind. They anticipate a reaction by the system and are positioned to constructively incorporate the reaction while still working toward original objectives. Fundamentally, solutions are finite while interventions more open ended and adaptable.

Prototyping

Today prototyping (experimenting) is generally a well understood concept in the product design and technology worlds. Increasingly prototyping approaches are being used in the public sector[117] and innovation labs in higher education[118] and other sectors. Prototyping involves early stage testing of ideas well before a final product is fully conceived. The process seeks to answer questions that cannot be uncovered through further analysis or deduction. Typically only portions of solutions are tested to see how an idea will perform according to certain factors. In design and construction for instance, this often involves building a portion of a building's facade at scale on or near the site to test how it performs according to local environmental factors.

According to Nesta:

> Prototyping can be applied in the same way to public services. Prototyping of public services might be a way of testing early-stage ideas with service users to help choose between alternatives. It can also be used to think through key aspects of how a service would run and test it with people. Prototyping is a flexible methodology, it can be used to develop new services or improve existing services. It can be applied to the development of simple or more complex services and, depending on the level of depth required, it can be low-cost and quick or it can be more complex and take longer.[119]

Public sector examples of prototyping include temporary new bus routes in cities where new services are needed, but true demand cannot be reliably gauged. In person to person service scenarios, prototypes can test new environmental conditions such as service center design, barriers (or lack thereof) between citizens and front line workers. Interactions can also be prototyped through role playing to test length, content, tone, usefulness, etc. of customer engagements. This helps bring the citizen closer to the process and ensure that public services are meaningful to them as opposed to most efficient for the administration.

The value of a prototyping process is typically worth additional costs as it ultimately reduces the final risk of failure. In the context of systems change, prototyping serves another function which is to help uncover greater insight about the nature of the problem itself and to help build trust among stakeholders that impactful solutions are being developed. When engaged in work that is without precedent and where ambiguity reigns, the only way to gather evidence may be to test an idea empirically. Prototyping ultimately leads to better services that have been developed at lower risk and with the buy in of key stakeholders.[120]

---

[117] See Nesta's report *Prototyping Public Services* for an in-depth analysis of the topic.
[118] For instance, the Stanford D School
[119] Nesta 2011, 6.
[120] Ibid, 15-16.

Keep in mind that prototyping can be done without significant resources. It can be both low risk and low cost. In the public sector, experimentation budgets are rare and procurement rules can slow momentum. The best solution may be to just build and test an idea, even if it is execution is imperfect. A "hacker's" ethos can help drive work forward, even when institutions prove too rigid.

On a practical note, it is important to document evidence when prototyping. Not only does this make feedback loops more useful, it also provides evidence to current and future stakeholders about the value of an initiative. Evidence generated from prototypes can be used to gauge risks associated with scaling up or investing in further refinement, such as when deciding whether or not to begin a pilot phase.

Stewarding

Helsinki Design Lab described stewardship—with respect to systems change—as "the art of getting things done amidst a complex and dynamic context. Stewardship is a core ability for agents of change when many minds are involved in conceiving a course of action, and many hands in accomplishing it."[121] Stewardship is what happens after an implementation phase begins. It is not *execution* nor is it *neutral*.[122] It differs from many traditional project management techniques in that it opens up the opportunity to change directions, both tactical and strategic, once work has begun and new information about the system or problem is available. The core premise of stewardship rests on the notion that solutions, in the context of wicked problems, are never optimal. Rather, solutions should be understood to be interventions into a system to which the system will react, requiring adjustment of the intervention in order to achieve impact. The best public service designers work to minimize the negative or unexpected system reaction employing techniques such as human centered design and co-creation to ensure that the system will at least be receptive to the intervention and that to some degree it is a response to demand that is either expressed or latent. But even well designed interventions will require adjustment: stewardship collapses the gap between analysis and execution common in policy spheres.

Stewardship can also be understood as a form of agile leadership in a project phase that is often viewed not to require significant decision making (i.e. "we figure out what do, then, we do it"). It involves continuous calibration between evolving contextual realities and desired outcomes. Strategic intent (discussed earlier) is a similar idea in that *folding the future back into the present* requires a constant, robust connection between objectives, methods and systems dynamics.

This requires several modifications to traditional approaches. First, resources must be distributed differently. Typical public sector procurement approaches are aimed at ensuring that deliverables match specifications formed well before the work begins. In a command and control environment, this makes sense. But in the context of wicked or systemic problems, the outcome, by definition, cannot be predetermined. There is no "theory of change" before the project begins. The theory follows on developing an understanding of the problem and the system(s) in which the problem is situated. Therefore, resourcing will need to be more carefully balanced across all project phases, ideally allowing the project team to take advantage of new opportunities as they emerge, or

[121] Boyer, Cook & Steinberg 2013, 7.
[122] Ibid, 15.

unsuccessful paths are foreclosed upon. When working opportunistically, it is of course important to pay careful attention to scope creep through active vigilance. This need not be a heavy reporting regime, but only a regular check in to ensure work is developing according to expectations. Architecture offices have a tradition of having each project team present their work at the end of each week to the whole office. Not only does this allow the principles an opportunity to show leadership and ensure a project is meeting the office's and client's objectives, it also creates a productive dialogic atmosphere among rank and file employees. Even physicians have a similar process called Morbidity and Mortality meetings (or M&Ms) where they discuss practices, policies, errors and successes to ensure the practice is advanced despite a context defined by mostly unique transactions.

Second, authority must be distributed differently. In a typical command and control or analyze-then-execute process, decision making authority resides in the initial scoping and resourcing decisions. Implementation in this context, by definition, should not require further decision making that exceeds the scope or initial framing. Stewardship requires the authority to continue to make decisions as the project develops. In other words, authority is distributed through all project phases, rather than front-loaded. This is because (as explored above), the problem cannot be fully understood before an intervention begins. In fact, the problem may never succumb to full analysis if it is a wicked problem. This fundamentally challenges an approach where analysis is expected to reveal the full scope of issues to be addressed, leaving only decisions about how to address them and with what resources.

Third, timelines (and therefore processes) are unpredictable and should be as open ended as possible. This is especially challenging in the public sector for a multitude of reasons not least of which is the apparent inefficiency that open-endedness would suggest. It is much easier and acceptable to begin and complete a program on time and on budget, even if the program does not actually improve the situation. But systems change takes time and is unpredictable, and processes must accommodate long time frames and the ability to adjust to meet new demands. Stewardship is the practice of managing this unpredictability.

Finally, stewardship arises naturally out of any truly collaborative process. Why? Because collaboration always carries some kind of cost that is generally a product of the mismatch between different organizational cultures, norms, policies and even professional languages. This cost introduces the possibility of needing to change directions, rethink assumptions or allocate resources differently. The adaptive approaches to resourcing, authority, timeframes and process present in a steward's toolkit make meaningful collaboration possible.

One example of a stewardship in practice (among others) is explored in the book *Legible Practises*[123] in the context of the UK's Government Digital Services (GDS) program. The concept of "public beta" builds on an idea borrowed from the tech sector but applied to public services. Technology companies often release products in *beta* before they are considered complete. For instance, Google's Gmail email platform was famously in beta for more than five years after it had more than 100 million users.[124] In the public sector, the idea is similar: "make services available to the public before they are fully refined and use

[123] http://helsinkidesignlab.org/legiblepractises/. More from Laura Bunt at Nesta can be found here: http://www.nesta.org.uk/blog/designing-beta-public-service-finding-courage-be-imperfect
[124] www.slate.com/articles/news_and_politics/recycled/2009/07/why_did_it_take_google_so_long_to_take_gmail_out_of_beta.html

this beta period as a way of collecting feedback to further refine the project."[125] GOV.UK, was launched by GDS in beta in order to create interest, buy-in and feedback from the public. By attaching the idea and even label "beta" to the product, it signaled to the public that GOV.UK was a work in progress and a process for improvement was built-in. In addition to the aspects of stewardship outlined above, a public beta also requires a different tolerance (and system to receive feedback) for scrutiny by critics, and therefore courage on the part of public managers. As Laura Bunt notes in here Nesta blog on the topic: "beta indicates a culture of continuous improvement. Trial and error, learning and adapting - principles inherent in this stage of usability testing - are important in ensuring that services adapt to our changing needs and expectations."

Evaluating

Experience suggests that evaluating systems transformation efforts can be a fraught exercise. Systems change over long timescale. They change in unpredictable ways. In the course of all of the upheaval, causalities can easily be lost. For example, can the claim be made that Al Gore's loss of Florida in the 2000 US presidential campaign lead to the rise of ISIS in 2014? Perhaps, but imagine setting out in the final days of the election to define the metrics of success or failure for a Gore or Bush presidency. What would the metric measure? What kind of indicators could have been developed to measure stability in the Middle East and the rise of non-state actors as it relates to political events in the United States?

This example is extreme. But in the drive to measure impact in every facet of society, consideration should be given to propriety and value of trying to measure what may not actually be measureable.

This is not to say that developing an evidence base is not important. Evidence is critical to so many aspects of systems change work, not to mention its value in ensuring that the public interest is being served. But evaluation should be carefully designed so as to have minimal impact on the work itself. As Christopher Wren, the architect of St. Paul's Cathedral in London placed on his epitaph in the crypt: "Reader, if you seek his monument–look around you."

In the public sector context, this might mean working with stakeholders throughout a project to co-develop a set of measures or performance metrics that are project-specific and measured during and well after an implementation/stewardship phase. This will require trust and resourcing at the outset of a project that distributes evaluation authority to project teams. It might also mean waiting for months or years after a project has been completed before gathering data. Longitudinal analysis might become the new norm for public administrations working on complex challenges. This will require new means of gathering, storing, analyzing and eventually sensemaking.

Also, given that evidence might be unstructured, originate from non-traditional sources, or is gathered via opportunistic means, analysis tools will need to be made adaptable. They will need to have equal facility with both quantitative and qualitative data for instance, and perhaps find expression through narrative or film as opposed to spreadsheets. But more importantly, decision makers and managers will need to exercise leadership as they work

[125] Boyer, Cook & Steinberg 2013, 128.

with the uncertainty inherent in this kind of ambiguous information landscape. They may face additional scrutiny as the public sector (along with other fields[126]) transition toward better use of second and third order evidence.

Our relationship with evidence may well become more fluid. But perhaps certainty was never as certain as we had believed. One only need to think back to the Global Financial Crisis to see the pitfalls of "evidence" and certainty. As J.L. Austin wrote in Sense and Sensibilia (1962):

> The situation in which I would properly be said to have evidence for the statement that some animal is a pig is that, for example, in which the beast itself is not actually on view, but I can see plenty of pig-like marks on the ground outside its retreat. If I find a few buckets of pig-food, that's a bit more evidence, and the noises and the smell may provide better evidence still. But if the animal then emerges and stands there plainly in view, there is no longer any question of collecting evidence; its coming into view doesn't provide me with more evidence that it's a pig, I can now just see that it is.

Challenges and opportunities in the public sector

We have outlined above many reasons why systems approaches can be an arduous albeit awarding process. More so in the public sector where organizational learning is challenging due to input-output evaluation systems, path dependencies and the need to coordinate action between various governance levels. Traditionally governments were designed for stability, reliability and predictability and it is not surprising that there is a resistance to change. Nevertheless, many systems in the public sector need to transform to respond to 21st Century challenges.

When should public policy makers use systems approaches?

Systems thinking is not panacea for all ills. Neither is design. Systems approaches in general are very time- and resource-intensive, especially when used to transform the functioning of a policy system in practice. Hence, policy makers should think before initiating these processes if they are indeed willing to implement large scale changes within policy systems. Otherwise the exercise would be largely wasted.

However, with many wicked problems characterizing our policy space it is clear that there is a miss-match between organizational structures and problem structures. For example, if it is clear that the care system does not fulfil the needs of the aging population, while we have less people who can provide the service to begin with, then systems approaches can be a good approach. Furthermore, in cases where traditional specialization of tasks or sector in the government apparatus does not respond to the challenges any more, systems approaches can be helpful. As such, possible policy areas that could benefit from a systems approach involving transboundary policy challenges include climate change, internal security, immigration and integration, policing, education, health care system etc.

[126] E.g. systems biology, systems medicine, phenotypes, Bayesian studies (such as clinical trials).

While in some cases policy makers face imminent problems that they need to respond to - e.g. as is the case with the Syrian refugee crisis -; in other cases, the problems are known, but the effects are more far removed, remote - as is the case with climate change. Consequently, public pressure for policy change can be also considerably different. Invariably in crisis situations the window of opportunity is open wider and there is more room to change, start over and dramatically reconfigure public service delivery; however, in most other cases change initiatives have to contend with resistance from established institutions, protocols. In more static conditions some level of backing from high level leadership is needed to legitimize change processes and create the authority to work against both internal and external resistance to change. Consequently, the need to legitimize systems level reform can vary from situation to situation.

There are several questions public policy makers need to analyze before attempting systems transformation:

- How complex problems need to be addressed?
- Is the uncertainty connected to the process high?
- Where does the legitimacy for policy reform come from?
- How much time is there to implement chances?
- Is there high-level backing to implement systems change?
- Does the potential systems level change crosses different governance levels?
- Are the stakeholders open to change and cooperation in the process?

If policy makers are dealing with complex problems, with high levels of uncertainty and they have legitimacy and backing to implement a significant reform, then a systems approach is appropriate.

How much should public managers and civil servants know about systems approaches?

Usually systems approaches in the public sector are expert led: the existing processes are analyzed and a new system is worked out with teams of specialists (systems thinkers, designers etc.), but they usually do not participate in the implementation of systemic change nor in the long-term learning process within organizations. Hence, also public sector managers and administrators have to know about systems connected to their policy areas to continue the learning process. There, however, is a difference in being systems aware and systems specialist. We do not advocate that all public managers and civil servants should become systems thinking specialists; rather it is important for different public policy experts and managers to be aware of these approaches.

In general, *public managers* working with complex problems should have a general understanding of the systems they are working with. For reflexivity in their policy field general knowledge about working with complex systems is beneficial: one needs to be aware about complex processes - for example links within the system and the possibility of unintended consequences - to look for them. Furthermore, this helps to work with relative precision, make decisions under high levels of uncertainty; understand the limits of

intervention and importance of experimentation. Public managers are usually the ones that can start changing organizational processes to build up open ended approaches, thus, some knowledge of the potential and value of systems thinking is needed.

Policy experts within specific fields should have more precise knowledge on how their policy systems work, who are the stakeholders and what are possible the causal relationships within the system. Even if this can never be precise, it is needed to understand the problems practitioners are working with and build up open ended practices to gain useful feedback. In attempting systems change they are the ones working on the details: putting together teams to analyze processes, procuring for help from outside the public sector. That is why, knowledge about the usefulness and limits of different systems approaches can be highly necessary. Do we need help in simulating effects in an overabundance of data or more profound, objective perspective in outlining the interdependencies within a policy system? Systems approaches and tools can considerably differ in these circumstances.

Street level bureaucrats have an important role in systems change. They are closest to the end users, their needs and the effects. Consequently, they are the ones with the firsthand knowledge of how a specific arm of the system is functioning, while they might not have the full picture of the functioning itself. However, they should be included in the open ended processes systems approaches require, because they are usually the first to spot unintended consequences and pass on the feedback to the policy makers. However to do so, they need to be aware of the overall goals of the systems. Hence, they have to be systems aware, especially in terms of the functions systems are fulfilling.

The above does not signify that different groups of practitioners would not be involved in a more profound systems reform. Creating awareness of systems failures and shortcomings is needed in all levels from a public manager to a street level bureaucrat to create a fertile ground for change.

How should public managers use systems approaches in the public sector?

As outlined above there are various systems approaches that have more or less rigid methodologies. We do not promote a single, specific systems approach - the selection of the method and specific tools connected to the aforementioned depends on contextual elements and policy problem in question. This point cannot be emphasized enough: the systems and design tools used will have their greatest effect when they are selected specifically to address the context, the problem, the timeline and the capacity of the organizations involved.

So how will a public manager know that a systems approach might be appropriate? The first indicator will be that their current tools and logics that underpin the design of those tools are no longer able to meet expectations, or are making the problem worse. The exhaustion of traditional problem solving approaches suggests that systems dynamics have changed the underlying architecture of the problem itself. New analytical tools and problem solving methods will be needed. Another indicator might be that the problem in question cannot be solved under the sole authority of the administrative body or even within the whole of government. A second order indicator could be the demand from citizens to have a voice and role in the work of the administration where none had existed (or was treated as tangential) before. Finally, any problem set that cannot be addressed via a large or small scale single initiative either because of cost and time constraints, or

difficulty in building sufficient constituencies, or because of the complexity of the problem itself will benefit from systems and design methodologies.

So you have a systems problem. Now what? There are likely two immediate action items that can be taken. First, think about who can help you understand the systems problem and how. This will likely require external expertise, but you will undoubtedly find allies internally who have been down this path before and can speak to resourcing, procurement, buy-in and other issues with specificity to your context. For external expertise, it is recommended you look to designers and others with some public sector experience as the motives that drive decision making is very different in a public service context than say, product design. A good place to start are think tanks that are working on innovation in virtually any context.

Also, you, as a manager, will probably need to provide some training opportunities for both you and your staff. This does not have to be a large, formal professional development scheme. It can start small, but the objective is to begin to socialize ideas about systems and complexity, and new ways of working with a new type of problems. For instance, you could invite a speaker to come in and share some insight into wicked problems and how they can be approached. Socialization will set a foundation for further exploration through formal training that will help enable everyone to feel some ownership, and most importantly, have a role to play in a changing administration.

Again, greater specificity will be highly dependent on the context, institutional capacity, problem, timeframe and resources available to public administrations as they embark on systems change. However, we highlighted strategic principles in systems approaches that in our perspective are essential to systems transformation success.

ANNEX 1: Definitions

Ashby Space: the relationship between variety of stimuli and variety of response (or in organisational terms, external complexity and internal complexity. When stimuli and response are in balance, this is called *requisite variety*.[127]

Complex adaptive system: a system involving often human activities and dynamics that make it continuously emergent and with only limited predictability.

Complexity gap: mismatch between the increased complexity and uncertainty of the world on the one hand and the established governance arrangements and institutions of the society on the other.

Intervention: small scale discrete or coordinated actions that can transform larger systems.

Linear causation: an understanding of each cause as the effect of a previous cause.

Soft Systems Methodology: a methodology used to support and to structure thinking about, and intervention in, complex organizational problems.[128]

Stewardship: the art of aligning decisions with impact when many minds are involved in making a plan, and many hands in enacting it.[129]

System: elements joined together by dynamics that produce an effect, create a whole or influence other elements and systems. Systems exist on a spectrum of comprehensibility: from easily observed and analysed to highly complex or novel requiring postulation. A system is always more than the sum of its parts.

VUCA: an acronym for Volatility, Uncertainty, Complexity, and Ambiguity that describes the general state of global affairs today. The term was coined by the US Army War College to describe the fallout left by the end of the Cold War.

Window of opportunity: when separate streams of problems, policies, and politics come together at certain critical times, then solutions become joined to problems, and both of them are joined to favorable political forces.[130]

Window of viability: a balance between diversity and efficiency. Too much efficiency can lead to brittleness whereas too much diversity can lead to stagnation.

Wicked Problems: complex challenges where conflicting interests and priorities, and incomplete and contradictory information make establishing shared facts and understanding difficult.

[127] Boisot and McKelvey 2011.
[128] http://www.learnaboutor.co.uk/strategicProblems/m_s_3frs.htm
[129] http://www.helsinkidesignlab.org/legiblepractises/
[130] Kingdon 1995.

ANNEX 2: A brief history of systems approaches

Complex problems are not new and the effort to simplify in order to make these problems 'manageable' has long been on the agenda of both policy makers and academics and especially systems thinkers. While there are general streams of systems thinking (general systems theory, cybernetics, systems dynamics, etc.), there are thousands of different streams of 'systems thought' with hundreds of different methods and techniques. Today, many policy studies have moved to apply methodological pluralism (choosing the method(s) based on the problem at hand)[131] when applying systems approaches. But it is important to understand the background of different approaches before applying or insourcing analyses. No method is perfect and systems thinking and other similar methodologies should be seen as one of the many tools available for governments.

Systems approaches have been around for more than 80 years—since the 1930s.[132] They are rooted in the works of von Bertalanffy and his General Systems Theory[133] and Boulding's contribution on hierarchical complexity.[134] These strands largely originated from biological and ecological studies. During the Second World War, systems research was pushed forward by engineering studies: operations research leading to the emergence of cybernetics and control theory[135] and systems engineering.[136]

Cybernetics is a study that concerns itself with the flow of information through a system and how this information is used by the system to control itself.[137] One of the cornerstones of organizational cybernetics is the Ashby theorem on requisite variety (complexity).[138] The theorem states that simplifying complex problems does not bring us closer to workable solutions—complex problems usually also require complex action. Thus, public managers must have access to a variety of actions similar to the variety of circumstances they wish to control.

As such, cybernetics introduced several new themes to the debate: for example, the relationship between the peripherality (autonomy) versus centrality (control) of actors within organizations, importance of variety and participative management. Cybernetics asks where new ideas can grow within an organization and what kind of autonomy is needed for the former. Consequently, it is most useful as *diagnostic and design tool for development and viability of organizations*.[139]

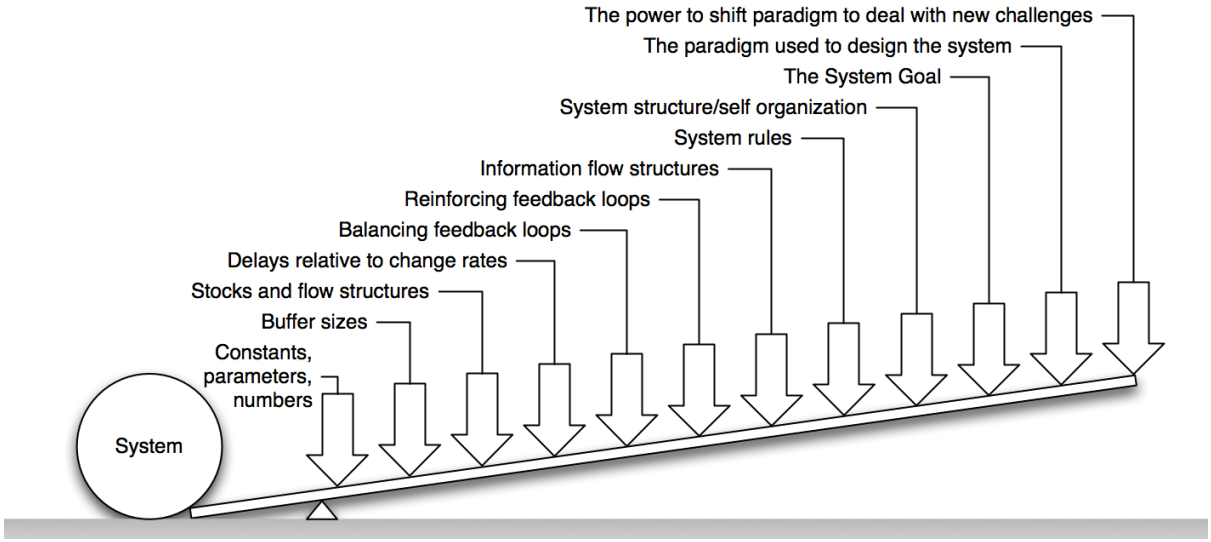
In parallel, the surge after World War II in computing power made it possible to model larger systems with quantitative computer models leading to the formal study of '**system dynamics**'.[140] This created the momentum to mainly utilise quantitative modelling to describe complex interactions and feedback in systems.

---

[131] https://johnpostill.com/2012/10/31/methodological-pluralism/
[132] See e.g., Jackson 2009.
[133] See historical overview in von Bertalanffy 1972.
[134] Boulding 1956.
[135] E.g., Ashby 1956; Wiener 1948; Bateson 1972; also Beer 1979.
[136] Hall 1962.
[137] Mingers and White 2010.
[138] "Only variety can destroy variety" Ashby 1956. This means that actors have to balance their own complexity/variety with the contextual/situational complexity/variety. This can be achieved by simplifying external variety or amplifying actors own variety or both at the same time.
[139] Schwaninger 2004, 414.
[140] Forrester 1961; 1968.

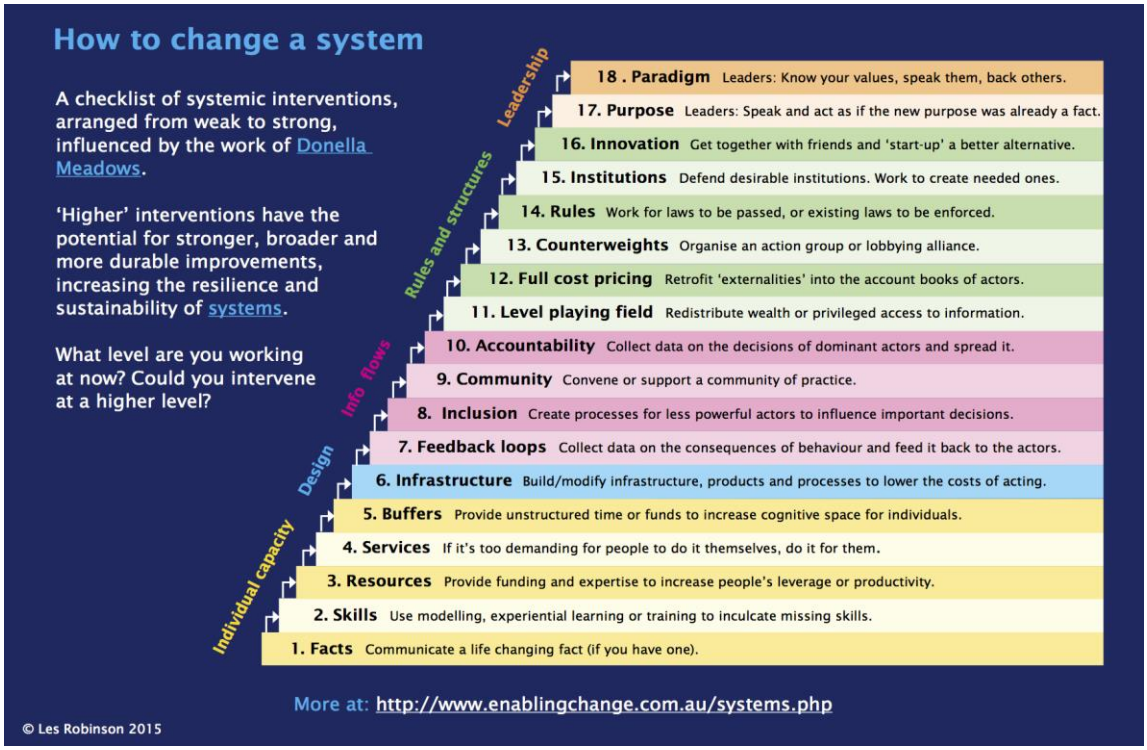
The early system dynamics proponents believed that some generic feedback structures can be described and modelled.[141] This has also carried over into Peter Senge's work on learning organizations—*The Fifth Discipline*[142]—and systems' archetypes that are proposed to explain many organizational problems. This work is also echoed by Donella Meadows and her 'leverage points' and the twelve places to intervene in a system—see Figure 10 below.[143] These approaches simplify the analytical process to a degree, make it easier to use, but also come at a cost: concentrating on theoretical expectations of problems—archetypical situations—true causes of problems may be missed. Nevertheless, this simplification allows systems dynamics to identify various causal loops within the system and test the former in computer models, simulations. When there is a lot of data to make sense of this can be a justifiable approach (see example in Box 7).

Figure 10: Meadow's leverage points



[141] Forrester 1969.
[142] Senge 1990.
[143] Meadows 2008, 3.

Figure 11: Les Robinson's adaptation of Meadows leverage points.



Box 7: Using simulations for obesity, Nat'l Collaborative on Childhood Obesity Research (USA)[144]

Childhood obesity is a very complex problem which includes traditional risk factors (nutrition, physical activity, predisposition), and also environmental factors (interpersonal, community and intersectoral dynamics).

In 2009 the Centers for Disease Control and Prevention, National Institutes of Health (NIH), Robert Wood Johnson Foundation, and US Department of Agriculture formed the National Collaborative on Childhood Obesity Research (NCCOR; www.nccor.org). The goal of the organization was to address the growing childhood obesity epidemic in the US by building research, surveillance capacity and use innovation to stimulate systemic thinking to generate fresh, synergistic ideas to tackle the problem. The collaborative effort is also intended to help accelerate policy change based on systems insights. In 2011, NCCOR launched the Catalogue of Surveillance Systems and the Measures Registry (www.nccor.org/measures) to make freely available resources on system characteristics connected to childhood obesity.

Two NCCOR affiliated networks, the Childhood Obesity Modeling Network and Envision, implemented systems-based approaches focusing primarily on understanding childhood obesity in developed nations. For example, Envision tries to use computational simulation models to create learning laboratories that mimic reality and test virtually different combinations and sequences of childhood obesity interventions.

Quantitatively models of systems interactions in general rely on predefined goals and causal relationships.[145] Thus, it has limited applicability, especially, concerning social

[144] Bures et al. 2014; McKinnon et al. 2012.
[145] Jackson 2009, S26.

systems as it cannot be very well applied to unstructured problems. Consequently, debate over systems dynamics in social sciences has moved from modelling 'external reality' to modelling people's subjective perceptions.[146] Since the late 1970s, *'soft systems'* approaches have emerged[147] next to hard systems/system dynamics approaches as a response to the expansion of systems theory to the social world.[148] Soft systems methodology is more interpretivist, qualitative in nature and considered to be more human-centered.[149] In effect, soft systems approach is understood as a continual process.[150] Thus, the focus is on stakeholders, their views and process as learning. While *hard systems engineering approaches would analyze the system backwards from the desired objective, soft systems methodology would begin by asking what the objective is*. Consequently, it is mostly useful to gain insight into the decision making and planning process in systems. Nevertheless, there is also critique about the relative nature and subjectivity of the methodology.

Box 8: Towards methodological pluralism

Soft systems and system thinking in general has expanded in the social realm since the late 1980s and 1990s when systems thinking was combined with complexity theory, network organization and learning organization theories.[151] The origins of the complexity/chaos theory are in chemistry, chaos and mathematics, which present a challenge to the stability-based orthodoxy because they highlight the importance of instability, discontinuity and nonlinearity. Consequently, soft systems methodology is now used to tackle wicked problems, while it is also understood that complex problems involve various phases and therefore, also different methodologies and approaches may be employed to achieve success.[152] This has led to the parallel development of critical systems theory[153], which sheds light on power relations in systems; usually an ignored dynamic in hard and soft systems theories and multi-methodology or methodological pluralism.

As systems approaches cover various tools and methodologies both from the quantitative to the qualitative (from stock and flow/causal loop diagrams, participatory system mapping, group model building, cognitive mapping, mediated modelling, and even SWOT analyses to strategic choice approaches, etc.) there is a lot to choose from. Nevertheless, hard systems approaches have been more delineated and causal loop diagrams (CLDs)—based in systems dynamics/cybernetics—are still the most frequently utilized to visualize systems.[154] However, this is not problem free. These describe causal relationships between selected variable sets focusing on both negative and positive feedback loops within a given system. Thus, CLDs usually describe existing patterns of systems and fail to describe future behavioral patterns of the system or provide deep insight into how one might intervene in the system.[155]

Recently these methods have been extended to include participatory modelling

[146] See Lane 2000.
[147] Jackson 2009.
[148] Checkland 1999.
[149] Pepper et al. 2016, 135; Mingers and White 2010.
[150] Checkland and Scholes 1990.
[151] E.g., Kaufmann 1995; Senge 1990.
[152] Mingers and White 2010.
[153] Ulrich 1983.
[154] For example, in the field of sustainable consumption Jackson, 2009; Nemecskeri et al., 2008.
[155] Nemecskeri et al. 2008.

approaches—for example, participatory systems mapping, group model building and mediated modelling.[156] Participatory systems methods have been increasingly applied in the field of natural resources.[157] Furthermore, in practice most systems approaches use a multitude of methods and no longer distinguish the origins of the ideas in detail.

While recently there has been a push towards multidisciplinary and methodological pluralism in many fields (described in Box 8), the legacy of formal modelling in systems thinking has led to the assumption that the qualities of a 'systems thinker' or rules of systems thinking can be discretely described.[158] Some authors have concluded that without intensive training in systems methodologies success will be unlikely.[159] Thus, systems approaches have remained rather rigid when it comes to practice and it is not surprising that systems thinking has not come to the fore in many domains, especially the public policy and management communities. However, we specifically align ourselves with the recent developments towards methodological pluralism and problem-based approaches to systems thinking and design. Hence, we call on policy practitioners to avoid the paradigm trap of rigid utilization and encourage them to synthesize different approaches.

[156] Sedlacko et al. 2014.
[157] E.g., van den Belt et al. 2010.
[158] Anderson and Johnson 1997; Meadows 2008; see also a review by Buckle Henning and Chen 2012. For example Buckle Henning and Chen (ibid.) highlight the systems thinking orientation in six different categories: orientation towards (1) causality, (2) logic, (3) particular data sources, (4) explicit and implicit structures, (5) subjectivity, (6) self-reflection.
[159] E.g., Ledington and Donalson 1997

ANNEX 3: Case Study Methodology

Systems approaches are rarely labeled as such. They tend to emerge out of a convergence of dynamics, such as inspired leadership, intractable challenges, access to competent stakeholders/partners and sometimes an unusual funding situation. This methodology will be used to develop four case studies to analyze the use of systems thinking within the public sector. We will utilize the framework of systems transformation outlined in Chapter 2 as a general approach to both case selection (identify cases where these processes are evident) and case analysis (understanding how these principles were applied in practice). Most importantly, we will be looking at how a problem was framed or reframed so that a new solution and possibly methodology could emerge. This reframing may result from inspired leadership, new information, crisis, new partnerships, etc. We will also be looking for tactics or actions that were designed and executed with an eye toward systemic impact. As it is impossible to do everything at once, actions that are developed to work together, synergistically toward systemic impact are often the only way to achieve systems transformation.

The specific case studies will:

1. Identify areas in which systems thinking will be useful within the public sector.
2. Give insight in how systems approaches have been used in different public sector context: differences in methodologies, legitimization, and approaches to uncertainty etc.
3. Outline the contextual differences in applying systems thinking in real life situations.
4. Identify the challenges and possibilities for systems thinking within the public sector.
5. Conclude what works in the public sector and what does not.
6. Generate awareness about the potential of systems thinking in the public sector.

As systems approaches have different kinds of impacts on governments and governance processes, we will seek to produce variety in our case studies. For instance, some systems approaches and resultant innovations result in governments forming long term working relationships with external partners, while others want to pull a set of methodologies, or even project teams into government itself and establish permanent capacity. It will be useful for public sector managers interested in systems approaches to see the variety of responses possible given the variety of the challenges and opportunities they face.

The case studies will be selected based on prior desk research on the topic. Following criteria will be applied to the selection of cases:

- The case has to deal with a public policy problem, although, connected public service delivery can also lie outside the public sector.

- The public policy problem needs to be complex and systematic in nature: have multiple interconnected explanations, no optimum solution, multiple stakeholders, high levels of uncertainty etc.
- There has to be a potential for transformative effects on the systems level, i.e. current solutions are failing or have limited impact.
- Systems approaches have been used to analyze the problem.
- Cases will be selected in different policy areas: e.g., active and healthy aging, resource efficient production and eco-innovation, transportation and public safety.

The case study analysis will utilize desk research and to the extent possible interviews with stakeholders (and if need be questionnaires). Through triangulation of data we will try to identify why and which systems approaches were chosen to solve the policy problem, how systems analysis was carried out (what did the process entail, who were the stakeholders, which resources were used, how much time did it take), if the results of the analysis were implemented in public service delivery, what (endogenous and exogenous) challenges were encountered at different stages of the process, what were the perceive or measured effects of applying the approach. These topics cover our initial areas of interest and will be more targeted based on the initial desk research of the case studies. The interviews will be semi-structured and based on an interview guide utilizing both inductive and deductive questions.

REFERENCES

Ackoff R. 2006. Why few organizations adopt systems thinking. Systems Research and Behavioural Science. John Wiley.

Ackoff, R.L. 1981. *Creating the Corporate Future: Plan or be Planned for*. New York: Wiley & Sons.

Ackoff, R.L. and Emery, F.E., 1972. *On purposeful systems: An interdisciplinary analysis of individual and social behaviour as a system of purposeful events*. Tavistock, London, UK.

Allender, S., Owen, B., Kuhlberg, J., Lowe, J., Nagorcka-Smith, P., Whelan, J. and Bell, C., 2015. A community based systems diagram of obesity causes. *PloS one*, *10*(7), p.e0129683.

Alter, M.J., 2004. *Science of flexibility*. Human Kinetics.

Anderson, V. and Johnson, L., 1997. *Systems thinking basics*. Cambridge, MA: Pegasus Communications.

Argyris, C. and Schon, D.A., 1974. *Theory in practice: Increasing professional effectiveness*. Jossey-Bass.

Argyris, C. and Schön, D.A., 1978. *Organizational learning: A theory of action perspective* (Vol. 173). Reading, MA: Addison-Wesley.

Arundel A, Casali L, Hollanders H., 2015. How European public sector agencies innovate: The use of bottom-up, policy-dependent and knowledge-scanning innovation methods. Research Policy 44:1271-1282.

Arundel, A., Huber, D., 2013. From too little to too much innovation? Issues in monitoring innovation in the public sector. Structural Change and Economic Dynamics 27, 146-149.

Ashby, W.R., 1956. An introduction to cybernetics. *An introduction to cybernetics*.

Bason, C., 2010. *Leading public sector innovation: Co-creating for a better society*. Bristol: Policy Press.

Bateson, G., 1972. The logical categories of learning and communication.*Steps to an Ecology of Mind*, pp.279-308.

Beer, S., 1979. *The heart of enterprise* (Vol. 2). John Wiley & Sons.

Bergen, P. and Reynolds, A., 2005. Blowback Revisited-Today's Insurgents in Iraq Are Tomorrow's Terrorists. Foreign Aff., 84, p.2.

Betts, J., Holden, R. 2003. Organisational learning in a public sector organisation: a case study of muddled thinking. Journal of Workplace Learning 15:280–287.

Bloch, C. and Bugge, M.M., 2013. Public sector innovation—From theory to measurement. *Structural change and economic dynamics*, *27*, pp.133-145.

Boisot, M. and McKelvey, B., 2011. Connectivity, extremes, and adaptation: A power-law perspective of organizational effectiveness. *Journal of Management Inquiry*, p.1056492610385564.

Book, M., Gruhn, V. Striemer, R. 2012. "adVANTAGE: A fair pricing model for agile software development contracting." Agile Processes in Software Engineering and Extreme Programming, Vol 111, 193-200.

Borins, S. 2001. The Challenge of Innovating in Government. February.

Boulding, K.E., 1956. General systems theory-the skeleton of science.Management science, 2(3), pp.197-208.

Brown , T. and Wyatt , J. 2010. Design thinking for social innovation [online]. Stanford Social Innovation Review. Available from: http://www.ssireview.org/articles/entry/design_thinking_for_social_innovation/

Boyer, B., Cook, J. and Steinberg, M., 2013. Legible Practises: Six Stories About the Craft of Stewardship. Sitra.
Brown, T., 2008. Design thinking. *Harvard Business Review*, *86*(6), p.84.
Buchanan, R., 2001. Design research and the new learning. *Design issues*,*17*(4), pp.3-23.
Buckle Henning, P. and Chen, W.C., 2012. Systems thinking: Common ground or untapped territory?. *Systems Research and Behavioral Science*,*29*(5), pp.470-483.
Bures RM, Mabry PL, Orleans CT, et al. 2014. Systems science: a tool for understanding obesity. Am J Public Health;104:1156.
Bysted, R. and Jespersen, K.R., 2014. Exploring managerial mechanisms that influence innovative work behaviour: Comparing private and public employees. *Public Management Review*, *16*(2), pp.217-241.
Callon, M., 2009. *Acting in an uncertain world*. MIT press.
Canty-Waldron, J., 2014. Using Systems Thinking to Create more Impactful Social Policy. *Journal of Futures Studies*, *19*(2), pp.61-86.
Carey, G., Malbon, E., Carey, N., Joyce, A., Crammond, B. and Carey, A., 2015. Systems science and systems thinking for public health: a systematic review of the field. BMJ open, 5(12), p.e009002.
Casti, J., 2012. X-Events: Complexity Overload and the Collapse of Everything. William Morrow.
Chapman, J., 2002. System Failure: Why Governments Must Learn to Think Differently, 2nd edn. London: Demos.
Chapman, J., 2003. Thinking out of the machine. *DEMOS COLLECTION*, pp.50-58.
Checkland, P., 1999. Systems thinking. *Rethinking management information systems*, pp.45-56.
Checkland, P., Scholes, J. 1990. Soft Systems Methodology in Action. Wiley: Chichester.
CoLab 2016. Follow the Rabbit: A Field Guide to Systemic Design. Government of Alberta. Available at: https://drive.google.com/file/d/0B0KwcwVigAntYm00Tzl4WnZTX0k/view
Cooper, R., Junginger, S. and Lockwood, T., 2009. Design thinking and design management: A research and practice perspective. *Design Management Review*, *20*(2), pp.46-55.
Dawidowicz, P., 2012. The person on the street's understanding of systems thinking. Systems Research and Behavioral Science, 29(1), pp.2-13.
Donahue, A. and Tuohy, R., 2006. Lessons we don't learn: A study of the lessons of disasters, why we repeat them, and how we can learn them. *Homeland Security Affairs*, *2*(2).
Dorst, K. 2015. Frame Innovation: Create New Thinking by Design. Cambridge: MIT Press.
Dorst, K. and Royakkers, L., 2006. The design analogy: a model for moral problem solving. *Design Studies*, *27*(6), pp.633-656.
Draulans, V., De Tavernier, W. 2016. Vanaf mijn tiende een sandwichkind. Intergenerationele zorg en samenwonen in de Genkse Turkse gemeenschap. In: Luyten D., Emmery K., Mechels E. (Eds.), bookseries: Gezinnen, Relaties en Opvoeding, vol: 1, Zoals het klokje thuis tikt. Samenhuizen van volwassen kinderen met hun ouders, Chapt. 4. Antwerpen: Garant, 83-99.
Dunne, D. and Martin, R., 2006. Design thinking and how it will change management education: An interview and discussion. Academy of Management Learning & Education, 5(4), pp.512-523.
Dunnion, J. and O'Donovan, B., 2014. Systems thinking and higher education: the Vanguard Method. *Systemic Practice and Action Research*,*27*(1), pp.23-37.
Eden, C. 1995. Strategic options development and analysis (SODA). In: Rational analysis revisited. Operational Research Society, Birmingham.

Evans, S., Huxley, P.J., Maxwell, N. and Huxley, K.L.S., 2013. System-level change in mental health services in North Wales: An observational study using systems thinking. International Journal of Social Psychiatry, p.0020764013489672.
Feldman, M. S., March, J. G. 1981. Information in Organizations as Signal and Symbol. Administrative Science Quarterly, 26, 2, 171–186.
Forrester, J.W. and Forrester, J.W., 1969. *Urban dynamics* (Vol. 114). Cambridge: MIT press.
Forrester, Jay W., 1961. Industrial Dynamics. Portland, OR: Productivity Press.
Forrester, Jay W., 1968. Principles of Systems. (2nd ed.). Portland, OR: Productivity Press.
Gharajedaghi, J., 2011. *Systems thinking: Managing chaos and complexity: A platform for designing business architecture*. Elsevier.
Gibson, J. and O'Donovan, B., 2014. The Vanguard Method as applied to the design and management of English and Welsh Children's Services departments. Systemic Practice and Action Research, 27(1), pp.39-55.
Hall, A. D., 1962. A methodology for systems engineering, Van Nostrand Reinhold: N.Y.
Hamal, G., Prahalad C.K., 1999. Strategic Intent. Harvard Business Review, (May-June), pp. 63-76.
Head, B.W., 2010. How can the public sector resolve complex issues? Strategies for steering, administering and coping. *Asia-Pacific journal of business administration*, *2*(1), pp.8-16.
Head, B.W. and Alford, J., 2015. Wicked Problems Implications for Public Policy and Management. Administration & Society, 47(6), pp.711-739.
Jackson, M.C., 2009. Fifty years of systems thinking for management.Journal of the Operational Research Society, 60(1), pp.S24-S32.
Jackson, M.C., Johnston, N. and Seddon, J., 2008. Evaluating systems thinking in housing. Journal of the Operational Research Society, 59(2), pp.186-197.
Johnston, L.M., Matteson, C.L. and Finegood, D.T., 2014. Systems science and obesity policy: a novel framework for analyzing and rethinking population-level planning. American journal of public health, 104(7), pp.1270-1278.
Junginger, S. 2014. Human-centered design: Integrating systems & services around people by providing a common ground for action. In: Freund, L. and Cellary, W. eds., Advances in the Human Side of Service Engineering. AHFE Conference.
Jung, T. 2010. Citizens, co-producers, customers, clients, captives? A critical review of consumerism and public services. Public Management Review, 12, 439-446.
Kaasa, A. 2013. Culture as a Possible Factor of Innovation: Evidence from the European Union and Neighbouring Countries SEARCH Working Paper, European Commission, Brussels.
Kapustina, V., Havukainen, J., Virkki-Hatakka, T. and Horttanainen, M., 2014. System analysis of waste oil management in Finland. *Waste Management & Research*, *32*(4), pp.297-303.
Kaufmann, S., 1995. At Home in the Universe: the search for the Laws of Complexity, Penguin: London.
Kattel, R.; Cepilovs, A.; Drechsler, W.; Kalvet, T.; Lember, V.; Tõnurist, P. 2014. Can we measure public sector innovation? A literature review. LIPSE Working papers, 2, 1-45.
Kay, R., Goldspink, C., 2012. What public sector leaders mean when they say they want to innovate. Incept Labs, Sydney.
Kelley, D. and G. VanPatter. 2005. Design as Glue: Understanding the Stanford d-school. NextDesign Leadership Institute.
Kelly, G. A. 1955. The Psychology of personal constructs. Volume One: A Theory of Personality New York: W.W. Norton.

Kelly, J. M. 2005. The dilemma of the unsatisfied customer in a market model of public administration. Public Administration Review, 65(1), 76-84.
Kingdon, J.W. 1995. Agendas, alternatives, and public polocoes. HarperCollins College Publishers, New York.
Kotiadis, K. and J. Mingers 2006. "Combining PSMs with hard OR methods: the philosophical and practical challenges." Journal of the Operational Research Society 57(7): 856-867.
Lægreid, P., Roness, P.G. and Verhoest, K., 2011. Explaining the innovative culture and activities of state agencies. *Organization Studies*, *32*(10), pp.1321-1347.
Lane, D., 2000. Should system dynamics be described as a 'hard' or 'deterministic' systems approach? Systems Research and Behavioural Science 17, 3-22.
Lane, D.C., Munro, E. and Husemann, E., 2016. Blending systems thinking approaches for organisational analysis: Reviewing child protection in England. European Journal of Operational Research, 251(2), pp.613-623.
Ledington, P and Donaldson, J. 1997. Soft OR and management practice: A study of the adoption and use of soft systems methodology. Journal of the Operations Research Society, 48(3), 229–240.
Lember, L.; Kattel, R.;Tõnurist, P. 2016. Public Administration, Technology and Administrative Capacity. Working Papers in Technology Governance and Economic Dynamics, 72, 1–30.
Leonard, D. K. 2010. "'Pockets of Effective Agencies in Weak Governance States: Where are They Likely and Why Does it Matter?" Public Administration and Development 30(2): 91–101.
Lewin, K. 1947. Frontiers in group dynamics II. Channels of group life; social planning and action research. Human relations, 1(2), 143-153.
Li, M., 2002. Fostering design culture through cultivating the user-designers' design thinking and systems thinking. *Systemic practice and action research*, *15*(5), pp.385-410.
Lundberg, K., 2011. A systems thinking approach to environmental follow-up in a Swedish central public authority: Hindrances and possibilities for learning from experience. Environmental management, 48(1), pp.123-133.
Martin, R. 2009. The design of business: Why Design Thinking is the next competitive advantage. Harvard Business Press, Boston.
McCann, L. 2013. Reforming public services after the crash: the roles of framing and hoping. Public Administration 91(1): 5–16.
McKelvey, B. and Boisot, M. 2009. Redefining strategic foresight: 'Fast' and 'far' sight via complexity science. In: L.A. Costanzo and R.B. MacKay (eds) Handbook of Research on Strategy and Foresight. Cheltenham, UK: Elgar, pp. 15–47.
McKinnon, R.A., Reedy, J., Berrigan, D. and Krebs-Smith, S.M., 2012. The National Collaborative on Childhood Obesity Research Catalogue of Surveillance Systems and Measures Registry. American journal of preventive medicine, 42(4), pp.433-435.
Meadows, D.H., 2008. Thinking in Systems: A Primer. Chelsea Green Publishing, USA.
Middleton, P. (ed) 2010. Delivering public services that work (vol 1): systems thinking in the public sector— case studies. Triarchy Press, Axminster.
Midgley, G., 2000. Systemic intervention. In *Systemic Intervention* (pp. 113-133). Springer Us.
Mingers, J. and White, L., 2010. A review of the recent contribution of systems thinking to operational research and management science.European Journal of Operational Research, 207(3), pp.1147-1161.
Mulgan, G. and Leadbeater, C., 2013. Systems innovation. *London: Nesta*.

Mulgan, G., 2014. Design in public and social innovation: what works and what could work better. https://www.nesta.org.uk/sites/default/files/design_what_works_what_could_work_better.pdf

Mulgan, G., 2005. Government, knowledge and the business of policy making: the potential and limits of evidence-based policy. *Evidence & Policy: A Journal of Research, Debate and Practice*, *1*(2), pp.215-226.

Munro, E. R. and Lushey, C. 2012. The impact of more flexible assessment practices in response to the Munro Review of Child Protection: Emerging findings from the trials. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/181503/CWRC-00088-2012.pdf

Munro, E. 2010. The Munro review of child protection: part 1 - a systems analysis. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/175407/TheMunroReview-Part_one.pdf

Munro, E. 2011a. The Munro Review of Child Protection: Final Report. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/175391/Munro-Review.pdf

Munro, E. 2011b. Munro Review Of Child Protection: Interim Report - the Child's Journey. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/206993/DFE-00010-2011.pdf

National Accounting Office (NAO) 2006. Achieving Innovation in Central Government Organizations. National Accounting Office, London.

Nemecskeri, R., Bodo, P., M. Herczeg and O. Mont, 2008. System Dynamics to Diagnose and Devise Patterns for Sustainable Consumption and Production: SYSCONS, Lund.

Nesta 2011. “Prototyping Public Services”. Available online: http://www.nesta.org.uk/sites/default/files/prototyping_public_services.pdf

Nesta 2014. “i-teams; The Teams and Funds Making Innovation Happen in Governments Around the World”. Available online: http://theiteams.org/system/files_force/i-teams_June%202014.pdf

OECD 2011. Innovation in public service delivery: Context, solutions and challenges. Paris: OECD.

OECD 2015. Systems innovation: synthesis report. Available online: https://www.innovationpolicyplatform.org/system-innovation-oecd-project

Office of the Deputy Prime Minister (ODPM) 2005. A systematic approach to service improvement evaluating systems thinking in housing. ODPM Publications, London.

Osborne, S.P. and Brown, L., 2011. Innovation, public policy and public services delivery in the UK: The word that would be king? Public Administration 89:1335-1350.

Osborne, S.P., Radnor, Z. and Nasi, G., 2013. A new theory for public service management? Toward a (public) service-dominant approach. The American Review of Public Administration, 43(2), pp.135-158.

Osborne, S.P., Radnor, Z. and Nasi, G., 2013. A new theory for public service management? Toward a (public) service-dominant approach. The American Review of Public Administration, 43(2), pp.135-158.

Pärna O, von Tunzelman N. 2007. Innovation in the public sector: key features influencing the development and implementation of technologically innovative public sector services in the UK, Denmark, Finland and Estonia. Information Polity 12:109-125.

Pepper, M., Sense, A. and Speare, K., 2016. Systems Pluralism in Infrastructure Decision-Making for Socially Connected Greenfield Communities. *Systemic Practice and Action Research*, *29*(2), pp.129-148.
Potts, J. and T. Kastelle 2010. Public sector innovation research: what's next? Innov.: Manage. Policy Pract., 12, 122–137.
Powell, M., Greener, I., Szmigin, I., Doheny, S., & Mills, N. 2010. Broadening the focus of public service consumerism. Public Management Review, 12, 323-340.
Reynolds, M.and Holwell, S. 2010. Introducing systems approaches. In: Reynolds, Martin and Holwell, Sue eds. Systems Approaches to Managing Change: A Practical Guide. London: Springer, pp. 1–23.
Rittel, H.W. and Webber, M.M., 1973. Dilemmas in a general theory of planning. *Policy sciences*, *4*(2), pp.155-169.
Rowe, P.G., 1987. Design Thinking MIT Press. *Cambridge, MA*, *28*.
Roy, J. and Langford, J., 2008. Integrating service delivery across levels of government: Case studies of Canada and other countries. Washington, DC: IBM Center for the Business of Government.
Schein, E.H., 2010. Organizational Culture and Leadership. Jossey-Bass. San Francisco, CA. 377.
Schwaninger, M., 2004. Methodologies in conflict: achieving synergies between system dynamics and organizational cybernetics. Systems Research and Behavioral Science, 21(4), pp.411-431.
Seadon, J.K., 2010. Sustainable waste management systems. *Journal of Cleaner Production*, *18*(16), pp.1639-1651.
Seddon, J. (2003). Freedom from Command and Control. Vanguard Press, Buckingham.
Seddon, J. (2008) Systems thinking in the public sector: The failure of the reform regime... and a manifesto for a better way. Triarchy Press Limited.
Seddon, J. and Brand, C., 2008. Debate: systems thinking and public sector performance.
Sedlacko, M., Martinuzzi, A., Røpke, I., Videira, N. and Antunes, P., 2014. Participatory systems mapping for sustainable consumption: Discussion of a method promoting systemic insights. Ecological Economics, 106, pp.33-43.
Senge, P. 1990. The fifth discipline: the art and practice of the learning organization. Currency Doubleday, New York.
Stanhope, V. and Dunn, K., 2011. The curious case of Housing First: The limits of evidence based policy. *International journal of law and psychiatry*,*34*(4), pp.275-282.
Thenint, H., 2010. Innovation in the Public Sector, Global Review of Innovation Intelligence and Policy Studies, PRO INNO Europe. European Commission, Brussels.
Tõnurist, P., Kattel, R. and Lember, V., 2015. Discovering Innovation Labs in the Public Sector. *The Other Canon and Tallinn University Working Papers in Technology Governance and Economic Dynamics*.
Torugsa N, Arundel A., 2015. The nature and incidence of workgroup innovation in the Australian public sector: Evidence from the 2011 State of the Service survey, Australian Journal of Public Administration, 75:202-221.
Ulrich, W. 1983. Critical Heuristics of Social Planning: A New Approach to Practical Philosophy. Bern: Haupt; paperback reprint edition, Chichester: Wiley.
van Acker, W., Bouckaert, G., Frees, W., Nemec, J., Lawson, C. and Matei, A., 2015. *Mapping and Analysing the Recommendations of Ombudsmen, Audit Offices and Emerging Accountability Mechanisms*. Technical report, 59.
van den Belt, M., Kenyan, J.R., Krueger, E., Maynard, A., Roy, M.G. and Raphael, I., 2010. Public sector administration of ecological economics systems using mediated modeling. *Annals of the New York Academy of Sciences*, *1185*(1), pp.196-210.

Vargo, S.L. and Lusch, R.F., 2004. Evolving to a new dominant logic for marketing. *Journal of marketing*, *68*(1), pp.1-17.
Vargo, S.L. and Lusch, R.F., 2008. Service-dominant logic: continuing the evolution. Journal of the Academy of marketing Science, 36(1), pp.1-10.
Vickers, G. 1970. Freedom in a Rocking Boat, Penguin Books, London.
Vittersø, G. and Tangeland, T., 2015. The role of consumers in transitions towards sustainable food consumption. The case of organic food in Norway.*Journal of Cleaner Production*, *92*, pp.91-99.
Von Bertalanffy, L., 1972. The history and status of general systems theory.Academy of Management Journal, 15(4), pp.407-426.
Von Foerster, H., 2003. Ethics and second-order cybernetics. In *Understanding understanding* (pp. 287-304). Springer New York.
Von Hippel, E., 1994. "Sticky information" and the locus of problem solving: implications for innovation. *Management science*, *40*(4), pp.429-439.
Walker, R.M., 2013. Internal and external antecedents of process innovation: A review and extension. Public Management Review 16:21-44.
Wastell, D., 2010. Managing as designing:'opportunity knocks' for the IS field?. *European Journal of Information Systems*, *19*(4), pp.422-431.
Wauters, B. and Drinkgreve, M. 2016. Improving the quality if public service and reducing costs: lessons from the youth protection agency of Amsterdam (Netherlands). Case study.
Weber, M. 1947. The Theory of Social and Economic Organization. Translated and edited by A.M. Henderson and T. Parsons. New York: Oxford University Press.
WHO 2009. Systems thinking for health systems strengthening. WHO Press: Geneva, Switzerland.
Wiener, N., 1948. *Cybernetics* (p. 112). Paris: Hermann.
Zokaei, Z., Elias, S., O'Donovan, B., Samuel, D., Evans, B. and Goodfellow, J., 2010. Lean and systems thinking in the public sector in Wales. *Lean Enterprise Research Centre report for the Wales Audit Office, Cardiff University*.