Complexity and uncertainty in late-stage technocracy: the case of urban sustainability

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Abstract

As sites of economic, political, and social convergence, cities absorb the earliest effects of global crises. These dynamics are observable also in environmental crises and resilience – longer-running challenges to legacy models of urban governance. Shifting epistemic and practical contexts invite scholarship to more thoroughly examine the dynamics of urban policy with regard to the 'localization' of the Sustainable Development Goals (SDGs) and the contribution of city governments to global environmental policy. This chapter examines urban sustainability as an ontologically complex or 'wicked' policy problem, a framing concept with a history in the urban planning and policy literatures but deserving fresh revisitation. The argument is that a 'complexity science' approach that avoids narrative capture is needed to better understand global environmental crisis and its manifestation in cities. This approach seeks to challenge the predominance of linear, atomistic, and reductionist perspectives that remain embedded in policy thinking.

Keywords: sustainability; SDGs; urban policy; complexity science; technocracy; crisis management

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1. Introduction

Urban policymaking is characterized by the increasing convergence of complex problems. These include not only local challenges like housing affordability and traffic management but also the localized impacts of global crises like pandemics, climate change, investment and capital flow dynamics, and others. This chapter explores how urban problems and the localization of global problems can be understood and addressed through the perspective of complexity science. This conceptual orientation is one way to unseat the predominance of linear, atomistic, and reductionist approaches to managing urban crises that engage only what is measured, focus on optimization of decontextualized metrics, and fail to recognize systemic interconnectedness.

This chapter outlines policymaking approaches regarding complex problems in an urban context, explores the application of complexity science to crisis response, and applies the complexity science approach to urban policy through soft systems methodology. The analysis illustrates how a crisis can be explored thoroughly for its complexity and used to draw practical insights. The chapter begins with a review of the mechanics of urban management in the current era, focusing on two salient issues: technology (e.g., 'civic technology' and Fourth Industrial Revolution technologies) and external engagement by government parties (e.g., bilateral and multilateral global urban networks). These issues are selected because they play the greatest role, according to the current urban sustainability discourse, in helping cities fortify themselves against climate threats and meet certain SDG targets (e.g., through adoption of SDGs in urban plans – or, 'SDG localization'). The chapter then examines the theoretical dimensions and applicability of a 'complexity mindset' as a crisis response frame for urban sustainability and crisis management. Examples of complexity mindset applications are outlined, including leadership, collaborative policymaking, and systems-thinking tools. The conclusion brings these ideas together under the broader political theme of public trust in expertise and technocracy, populist 'pushback' against science and technology, and the implications for new ways of thinking about urban resilience, smart cities, and the 'wickedness' of the global sustainability crisis.

2. Mechanics of urban governance in the modern era

2.1 Technology

The evolving role of technology in daily life, urban planning, and policy practice has substantial implications for SDG localization efforts. Technology's contribution to urban policy (particularly monitoring and forecasting) and to sustainability efforts more generally is evident in the near ubiquitous use of data and its integration into decisionmaking processes. At the same time, the potential for technology to advance SDG localization goes beyond data. AI is already transforming how information is gathered and processed. In the realm of industry – where much of the sustainability crisis originated – the advent of the so-called 'fourth industrial revolution' (hereafter, '4IR') presents some opportunities for technology to reduce the impact of production on the environment (e.g., through better monitoring and analysis and efficiency

gains; for further discussion, see Herweijer et al., 2018). It is clear that the narrative concerning the role of technology in urban sustainability is largely sanguine. For example, at a UN Industrial Development Organization (UNIDO) conference in 2019,[3] the director of Adapt, a South Africa-based organization focused on sustainable development, stated that "this digital revolution, like the industrial revolutions before it, promises jobs, increased livings standards, and better health for more people." A 2017 PwC report[4] describes ten types of emerging 4IR technologies (p. 2) and recommends several policy interventions including robust governance structures and safeguards, policy development support to individual countries, and additional research.

The potential of 4IR to transform industrial platforms and the future of work enjoys an already copious body of research (Ślusarczyk, 2018; Hattingh, 2018), and most discussion focuses on application in industry and the private sector. However, there is growing anticipation that 4IR and other emerging technologies can play a role in urban policy and SDG localization, including in environmental projects (e.g., smart urban grids for transport and electricity, and risk-sensitive infrastructure management) and social projects (time-sensitive communication between individual health monitoring systems and nearby care providers). Indeed, the panoply of emerging technologies is vast: artificial intelligence (AI), robotics, and machine learning; blockchain, distributed ledgers, and fintech; Internet of things (IoT); cloud computing; and autonomous systems for transport and energy. Given that 4IR is conceptually built on the autonomous interconnection among technological systems and between those systems and non-technological ones, the applied potential is anticipated for gains not only in data collection and monitoring (see Chicago's Array of Things (AoT) project as an example[5]) but also in efficiency of public service delivery, policy responsiveness, and iterative alignment of urban management systems with evolving environmental, economic, and social conditions.

Another applied example of the role of technology in urban management and sustainability is civic technology (hereafter, 'civic tech'), which likewise has high potential for attracting interest in supporting SDG localization. According to Hartley (2019), civic tech is "the technology-enabled engagement of civil society in urban governance...encompassing systems across governance tasks (policy design, implementation, and evaluation, etc.) and operational areas (transport, safety, waste management, land use, economic development, etc.)" (p. 3). One example of the application of civic tech is government-sponsored virtual platforms on which social entrepreneurs host smartphone applications (e.g., for transportation, safety, political engagement, and health). Such platforms function like a commons, as in a virtual public park, in which the government has little or no jurisdiction over functionality and content (beyond regulating legality) but supplies the infrastructure as a service to enable the emergence of third-party innovators for whom hosting platforms can be prohibitively expensive. As such, civic tech addresses the public welfare while potentially enabling initiatives that relate to

[3] https://www.unido.org/news/boosting-dialogue-fourth-industrial-revolution-11th-africa-energy-indaba
[4] https://www.pwc.co.uk/sustainability-climate-change/assets/enabling-a-sustainable-fourth-industrial-revolution.pdf
[5] https://arrayofthings.github.io/

sustainability. It also provides a portal for the participation of civil society in local social and collective action on the SDGs.

2.2 Local and global engagement

While infrastructure and technology are recognized as means by which cities can make progress on SDG localization, softer aspects of social engagement and institutional design are also crucial. Such initiatives can be understood through the perspective of collaborative governance and reflect on-the-ground conditions that impact the political legitimacy of SDG policies. This subsection discusses three such avenues: collaborations with community groups, community development organizations (CDOs), and non-government organizations (NGOs); engagement of educational institutions; and contributions from the private sector and industry associations.

First, community groups and NGOs, as 'knowledge agents,' represent a crucial link between the perceptions of policymakers and the experiences of residents. As such, these groups have been seen as instrumental not only for understanding and monitoring conditions but also for seeking qualitative input, building support for program implementation, and establishing knowledge feedback loops as programs progress and mature. NGOs and CDOs are especially crucial for strengthening empowerment in traditionally marginalized communities that struggle against SDG-related issues such as poverty, education, public health, and environmental degradation. This approach not only generates urban and local engagement across most SDGs but also directly addresses #16 (peace, justice and strong institutions). Moreover, engaging such organizations in policymaking requires political will at high levels and must be promoted institutionally through participatory processes. These are often lacking in cities around the world. According to a working paper[6] published by the Instituto de Desarrollo Sostenible y Relaciones Internacionales, "emerging forms of collaboration between NGOs are a way to operationalize the integrated and universal nature of the SDGs. However, these collaborations will remain fragile if governments and the UN do not follow the example to overcome silos, and if some types of NGOs are not sufficiently included in national and international processes" (p. 1).

Second, cities typically have a wealth of capacity in educational institutions. Engagement of primary and secondary school students has been pursued through integration of SDG principles across curricular realms (Zguir et al., 2021). There is strong potential for such engagement as children are often climate-aware and may be able to relate such issues to their daily experiences, including growing food, conserving water, and walking or cycling to school. The SDGs have also been used to provide a unifying narrative for class discussions. An example is the institutional effort in South Africa's primary and secondary schools to address social and environmental justice, democracy, and inclusivity (McKay, 2018). Students are also availed of the opportunity to participate in extra-curricular activities related to SDG implementation, including through educational visits and programs organized by community organizations (e.g., environmental clean-ups, management of urban gardens, and other activities integrating

[6] https://www.iddri.org/sites/default/files/import/publications/working-paper-sdgs-and-ngos_eh-dd.pdf

education, participation, and feedback). Interest among young people should not be underestimated; the rise in global visibility of student climate activist Greta Thunberg and the school strike for climate[7] are recent examples. Regarding tertiary institutions, the value of universities is evident in their research capacity and global engagement. Additionally, the student bodies of universities are a source for participants in ideation and outreach activities, as authors and researchers for monitoring reports, and as ambassadors for student-based delegations at international network events. For example, Los Angeles has integrated the work and feedback of university students in the development of that city's SDG Voluntary Local Review (VLR).

For local governments, open and institutionalized channels of communication have been instrumental in facilitating collaboration among public servants, the private sector, and the general public. One supporting strategy is to distil complex sustainability concepts into digestible and compelling imagery that can be used to educate shareholders and the public. Indeed, structures for collaboration and communication already exist but city leaders must consider how they can be used to advance SDG implementation; examples are SDG-related working groups and co-sponsorship of monitoring and reporting about progress within both public and private organizations. In summarizing the value of engaging all stakeholders in SDG localization, Anthony Pipa[8] argues that "The SDGs offer a platform for new models of city governance, to enable coordination, partnerships, and new ways of working among multiple community stakeholders, including local businesses, civil society, and universities. This requires a shift in mindset and a collaborative spirit and can prove useful in overcoming the inherent fragmentation among different sectors within the city" (p. 4).

Cities are taking an increasingly globalized and collaborative approach to SDG localization, presenting an opportunity to strengthen existing global networks and forge new ones (for a useful overview of global urban networks, see Acuto and Rayner (2016) and Acuto (2013); for the same in the context of sustainability, see Gordon and Johnson (2018) and Keiner and Kim (2007)). According to a Brookings report,[9] "Integrating the SDGs into the city-to-city networks in which they participate will, by sharing best practices and innovations, help to leverage needed capabilities. It will also provide a platform for elevating their voice in debates about the SDGs." Evidence indicates, however, that the topical focus (as aligned with individual SDGs) of urban networks varies. For example, a study by Tjandradewi and Marcotullio (2009) found that among Asian cities participating in such networks, leaders felt issues pertaining to environment, health, education, and infrastructure were more applicable to urban policy than were issues pertaining to gender empowerment, poverty, housing, finance, and economic development.

Urban networks have coalesced around specific issues. An example is the portfolio of targets related to the Intergovernmental Panel on Climate Change's (IPCC) report "Global Warming

[7] https://www.nytimes.com/2019/03/14/world/europe/climate-action-strikes-youth.html
[8] https://www.brookings.edu/wp-content/uploads/2019/06/City-leadership-on-the-SDGs.pdf
[9] https://www.brookings.edu/blog/future-development/2019/06/18/cities-the-labs-for-sustainable-development-goal-innovation/

of 1.5ºC," for which "city-networks are operating at the interstices of urban and global governance, building bridges across national borders between city governments and a variety of other actors, and aiming to engender coordinated actions that produce meaningful collective effects" (Gordon and Johnson, 2018; p. 39). Likewise, motives behind the creation of urban networks vary by city type. For example, Mocca (2017) finds in a European study that cities with relatively advanced economies (e.g., those that transitioned away from hard industry and towards knowledge and innovation-based economies) and those with relatively high administrative autonomy are more likely to participate in sustainability-based urban networks, using those networks to build their own regional economic and political profiles. According to the study, cities with center-left governments are more likely to join networks focused on sustainability, raising the prospect of political alignment as a determinant for network-based action. The challenge for policy at the global level is to ensure that urban networks for SDG localization do not resemble a club for the privileged few.

3. Crisis policymaking and complexity

The policy tools and institutional structures that enable urban action on the SDGs, while varying by context, provide a useful lens for examining urban resilience. At the same time, this perspective looks at the 'supply side' of urban environmental policy; that is, how policies evolve and are implemented. Of equal importance is the 'demand side;' that is, the nature of urban policy problems themselves, the study of which can help illuminate whether and how policy interventions match the characteristics of the problems they seek to solve. As such, a consideration of the nature of urban policy problems is essential when examining how cities respond to the sustainability imperative. Much literature has examined how policy problems are measured, highlighting the relevance of technology and associated monitoring systems. At the same time, a deeper perspective focuses more 'up-stream' – eschewing the assumption that problems exist in the way that they are currently understood in mainstream policymaking and instead reconsidering how problems are conceptualized. This analytical approach reveals pathways for alternative epistemological understandings to influence how urban policy problems are theorized and managed in practical settings. This section describes one such epistemological approach, complexity science, and how urban environmental policymaking can be structured or improved based on complexity science.

3.1 Understanding complexity science

Efforts to understand environmental crises as a localized phenomenon (something to be addressed by individual local governments) have, over time, ceded to the growing realization that such crises have global dimensions and should be addressed as such. At the same time, global governance efforts in the wake of crises (e.g., the Covid-19 pandemic) often expose weaknesses, inconsistencies, and rifts in global coordination mechanisms. In this way, such crises also illuminate opportunities for practical improvement and theoretical advancement. Amidst and in the wake of crisis, policy learning in its manifold forms is undertaken to avoid a repeat of whatever mistakes were made. Problem-diagnostic and analytical tools are tweaked

and re-deployed to understand how the crisis materialized. For many crises, the imperative to learn is increasingly urgent given rapidly unfolding technological, social, and environmental change. Rationalist and instrumentalist policy epistemics of the 20th century are now often regarded to be outmatched by highly complex and interconnected problems (Hartley et al., 2019). The sustainability crisis, as experienced at local levels, illustrates the need for a more robust complexity mindset, including a transboundary and collaborative perspective in crisis preparation and a more holistic view of problem definition.

Literature about complexity theory in the context of public policy is growing and increasingly contextually diverse (Eppel and Rhodes, 2018; Guntzburger and Pauchant, 2014; Morçöl, 2013; Cairney, 2012; Geyer and Rihani, 2010; Manson, 2001). Nevertheless, complexity science is variously defined and suffers conceptually and methodologically from its treatment as a pseudo-science (Phelan, 2001). According to Coveney and Highfield (1995), "complexity is a watchword for a new way of thinking about the collective behaviour of many basic but interacting units" (p. 7). Complexity science thus represents a revolution in the way policy problems are conceptualized. Homer-Dixon (2011) describes complexity as constitutive of multiple interconnected components, characterized by non-linearity (small changes having large effects, and large changes small effects), and reflective of the concept of emergence (novel properties that defy existing understandings). Because complex systems can be found in many areas of human society, complexity science is applicable to a number of fields across the social sciences; this interdisciplinary nature also makes it a useful theoretical orientation for the field of public policy. Concepts like self-adaptation and emergence reflect the environment in which public policy operates – including crises and systemic disruption.

Complexity science focuses not only on the parts that contribute to the whole but also on how each part interacts with others in the emergence of new realities. As complexity science is seen to adopt a more comprehensive understanding of systems with multiple and often unpredictable components, Turner and Baker (2019) argue that causal research is difficult. According to Turner and Baker, novel theoretical models that reflect 'real-life complexity' are needed, including the use of complex adaptive systems (CAS) as an analytical framework. The remainder of this section justifies the complexity-based and CAS approaches to understanding policy dynamics in crisis situations.

Crises and other wicked policy problems are often aberrations; their complexities are illegible to existing epistemic vocabularies, methods, and general understandings. A mindset based on complexity science is one alternative for making enough sense of unstructured and unpredictable situations to establish a coherent reactive policy posture. As such, there is a need to adopt a complexity mindset in policymaking and analysis. One way for policy interventions to follow suit is to move away from linear, atomistic, and discrete interventions and towards more holistic and evolving programs of work. Corollary perspectives recognize that complexity characterizes not only the environment in which problems are defined and solutions designed but also the varied settings in which policies are developed and take effect; for example, Butler and Allen (2008) view implementation as an adaptive, interpreted, and self-organizing process that precludes reduction to 'best practices' approaches. Policymakers must understand how complexity defines not only the crisis but also the response to the crisis.

From a practical perspective, complex and adaptive-systems approaches have implications for both qualitative and quantitative analytical methods. Examples of how this epistemological approach is translated into methodological innovations useful to practice include stock and flow and causal loop diagrams, participatory system mapping, and group model building. These and other tools have been used by governments to improve the complexity and nuance of understandings about policy problems. For example, the Singapore government introduced a mix of policy approaches to support its 'whole of government approach' (Low, 2016) for addressing wicked problems, including a matrix approach to help departments better share information, work horizontally, and utilize computer-assisted modeling and scenario-building tools to address the mitigation of systemic risks (Stockdale-Otárola, 2017).

3.2 Crisis policymaking in response to sustainability challenges

Crises are crucial moments in which all the capacities of the state are tested in concurrent and often unpredictable ways. Quality of leadership is defined in large measure by crisis response (Farazmand, 2007). For example, American President George W. Bush was credited for responding quickly to the September 11 events, with a public speech generating a 'rally' effect in the time immediately following the attacks (Schubert et al., 2002). Nevertheless, Bush's legacy was significantly tarnished by the two wars that followed and by what many critics considered to be an insufficient crisis response to the Hurricane Katrina disaster in 2005 (Boin et al., 2010; Malhotra and Kuo, 2008; Sylves, 2006). American President Donald Trump's tenure saw two major opportunities for crisis leadership largely mishandled. The first was the administration's lagging response to the Covid-19 crisis (Lipton et al., 2020). The second, occurring in the shadow of the first, was the administration's response to protests against the murder of a Black man by a police officer (Edmondson, 2020). Trump and his staff, in one widely panned episode, withdrew into a bunker below the White House before having protesters forcibly cleared to enable a photo opportunity in front of a church (Shear and Rogers, 2020).

Whether local, national, or global in scale, crisis policymaking differs substantially from policymaking in normal situations, since there are often no shelf-ready or proven solutions (Hartley et al., 2019; Wenzelburger et al., 2019). During such times, three principal challenges face policymakers. The first is information management. Amidst or immediately following a crisis, policymakers and analysts can experience information overload, where data that is meant to produce evidence-based decisions increases ambiguity about causes and possible solutions (Zahariadis, 2007; Grossman, 2019). Leaders often respond in this situation by using hasty instinct and heuristics, depending on leadership style. These are moments when ideology and political survival can take precedence over rational deliberation.

The translation of information into policies is dependent in part on the cognitive characteristics and processes of policymakers and political leaders. This translation occurs now in environments of increasing epistemic uncertainty, political tension, and problem wickedness, adding further stress on cognitive functioning (Head, 2019; Rittel and Webber, 1973). Consequently, policymakers may be confronted not only by uncertainty about information and knowledge but also by diverging interpretations of the policy problem itself – potentially impacting political will to act on certain dimensions of crisis (Hermann and Dayton, 2009).

High degrees of uncertainty confound problem definition, projections of outcomes, and normative orientations (Wenzelburger et al., 2019). Furthermore, the rapid materialization of negative impacts can engender panic and press policymakers to embrace quick solutions. Policymakers may also face credibility traps that undermine the legitimacy of policy interventions in the eyes of the media and public; an example is the emergence of 'post-truth' and 'anti-science' movements (Fischer, 2021; 2020) and a general skepticism of expertise and intellectualism (Peters and Pierre, 2019; Hermann and Dayton, 2009).

The second key challenge is stakeholder management. According to scholars, crises can involve 'contraction of authority' that concentrates decision making power in the hands of leaders and close advisers, with the consequence that decisions do not reflect bureaucratic compromise or societal preferences (Boin et al., 2016; Hermann, 2001; 1963; 't Hart, 1997; Hermann and Dayton, 2009). Further, transboundary issues like global sustainability and pandemics can cause sudden growth in the number and diversity of affected stakeholders with potentially divergent interests, differing understandings about the nature or cause of problems, and lower levels of inter-group political and social capital. According to Ansell et al. (2010), this increase in stakeholder diversity can impact collective efforts to manage the crisis.

The multi-stakeholder scenario reflects the long-running tension between the policy influence of expertise and that of lay wisdom. That is, if particular challenges call for expert knowledge, the optioning and decision-making stages of policy development may appear less democratic. One policy arena in which this dynamic is particularly evident is smart cities, for which technical knowledge shapes the logic by which problems are defined and solutions are proposed. Under such circumstances, the credibility of technical knowledge and influence of commercial interests can shape the policy agenda (Kuecker and Hartley, 2020a; Raco and Savini, 2019). A similar dynamic is revealed during the Covid-19 pandemic. Throughout the early months of the United States' struggle to contain the virus, political tensions were stoked by populist commentators about whether a chief health advisor, Dr. Anthony Fauci, was ideologically compromised in his contradictions of President Donald Trump's off-handed and unscientific medical claims (Amir Singh, 2020; Kahn, 2020). In a politically charged environment, stakeholder engagement can be used as a strategy to signal political responsiveness. Politicians are sensitive to their constituencies, while experts are beholden to professional expectations about impartiality and scientific rigour. Decisions about scientifically and technically complex policy issues often reflect a compromise between the two.

The third key challenge facing policymakers is time management. Amidst quickly evolving crises, information uncertainty and the element of surprise combine to increase the urgency for expedient intervention (Boin et al., 2005; Hermann and Dayton, 2009). In such cases, rapid policy response must proceed without a full understanding about the nature of the problem. Policymakers rely on lessons from experience with similar situations (Chung et al., 2011), but this approach becomes more difficult for unprecedented crises. For example, Hong Kong relied on some knowledge learned from the 2003 SARS crisis to manage the Covid-19 crisis (Law et al., 2020). However, for a crisis like climate change, there are no experiences with an analogous event. When policymakers are stressed for response time, efforts to temper instinctual policy decisions with sober scientific expertise – when political pressure for immediate and conclusive

action is high (Schneider, 1995) – can be a fraught endeavor. One criticism of the Donald Trump administration's response to the Covid-19 crisis is that the government acted too slowly (Lipton et al., 2020). It is evident, in retrospect, that the administration's slow action was unlikely the result of a cautious approach in waiting for additional scientific evidence to be gathered; rather, the delay is largely thought to be the result of an attempt to downplay the severity of the outbreak in order to maintain economic stability (Leonhardt, 2020). Regarding the speed of response, a widely circulated independent projection showed that mandatory distancing imposed even two weeks sooner would have saved 83 percent of lives lost (Pei et al., 2020). Clearly, time management is crucial in crisis response, with determining factors including understandings about the severity of the crisis, the need to collect more information, and consideration for tangential impacts on society, politics, and economy.

In the context of urban policy for sustainability, timeframes are not uniform across all related problems. The long-unfolding phenomenon of climate change is unlikely to be experienced in any single event, in which the future observers look back to a specific date when 'pre' became 'post.' At the same time, climate change is observable in a multitude of individual events that indeed present themselves as immediate and acute crises; examples are wildfires (e.g., in Australia in 2019-2020 and Canada in 2023) and erratic weather events (e.g., more intense heat waves, floods and droughts, and typhoons and hurricanes). Policymakers must fortify society against immediate crises in the short-run while also waging a policy battle for stability in the face of long-term climate change. Management of information, time, and stakeholder engagement are key focus areas that can help governments maintain crisis-response capacity for multi-faceted policy crises that have both short-run and long-run manifestations. Furthermore, a more receptive epistemic orientation in problem definition can help policymakers and analysts recognize complexity and advocate for a resilient policy posture.

4. Leadership and complexity in the sustainability crisis

In the clutches of crisis, policymakers must consider a mix of factors that define available options and determine the effects of chosen interventions; these include policy interactions and spillover effects (how one policy affects another), unintended consequences, durability of interventions, and policy buffers and safeguards, among others (Hynes, 2017). According to Ramos (2017), policies are designed often within the narrow epistemological confines of a particular issue. That is, the prevailing or mainstream (collective) understanding of a policy issue tends to be the one that defines it, whether in a technocratically or politically oriented setting. When crises emerge, circumstantial imperatives force policymakers to mobilize on multiple fronts; each policy may have been designed effectively for a particular issue but could fail to cohere with other policies in the context of systemic crisis-based mobilization. The harmonization of multiple policies in parallel domains requires both leadership and policy design with a broad view of crisis complexity. This approach reflects a type of systems-thinking that eschews silo-based approaches to problem conceptualization and policy development and implementation (Sucha, 2017). Policymakers in such cases must strive for integrated solutions and consider policy problems from a macro and holistic perspective. Based on a complexity mindset, the following recommendations for managing the emerging urban sustainability crisis

are elaborated in the remainder of this section: adopting complexity leadership, collaborative policymaking, and use of systems-thinking tools.

4.1 Complexity leadership

The notion of complexity leadership draws on the idea that multiple elements of policy mixes must be brought together and applied in a complementary way. Uhl-Bien et al. (2007) argue that the leadership needed for this action prioritizes learning, innovation, and adaptability. According to Baltaci and Balcı (2017), complexity leadership has three types: traditional leadership shaped by Weberian-style administrative hierarchy, adaptive and creative leadership responsive to evolving conditions, and acutely reactive leadership that mobilizes quickly in urgent situations. First, it is appropriate to consider that governance systems and leadership styles are often embedded and thus slow to change. The endurance of organizational systems and cultures acts to preserve legacy policies and institutional elements that existed as organizations first developed. In many cases, organizations and their cultures emerged at a time in history when hierarchical and top-down management models were common. These traditional or 'sticky' organizational elements remain to this day a contextual reality that must be mediated and managed amidst emergent ideas and unprecedented policy challenges. This tension underscores the need for effective, open-minded, and credible leadership.

The second dimension of complexity leadership pertains to systems-based thinking (e.g., the spirit of learning, innovation, and adaptability). This leadership perspective accords with the concepts of emergence and systemic disruption that characterize many modern understandings of crisis and complexity. It also treats complexity not as an affront to order and rationality but as a reality that cannot be ignored or conveniently wished away. Systems-based complexity leadership recognizes that policy crises must be thoroughly understood (learning within and beyond traditional epistemic boundaries), leading to novel insights (innovations) that aid in the ability of society to endure unanticipated disruptions (adaptability).

The final dimension of Baltaci and Balcı's (2017) complexity leadership is acutely reactive leadership. This leadership property can be seen as a form of policy triage that immediately assesses crisis situations on the basis of limited information and mobilizes resources for response on the basis of this incomplete understanding. This leadership process is not characterized by deliberation or the types of decisionmaking processes that necessarily constitute democratic or participatory policymaking; rather, it is an instinctive or broadly heuristic response to mitigate the early severity of an emerging crisis. Given that crises are often unpredictable and have uniquely complicated characteristics, there are few opportunities to apply lessons learned from institutional memory. Policy responses often must be based on the judicious and creative adaptation of knowledge developed through broadly but not perfectly similar experiences, while aiming not to exacerbate the situation, compound the causes, or obstruct additional policy efforts that materialize around new understandings of the problem.

4.2 Collaborative policymaking

Crises are typically multifaceted in that they impact multiple policy arenas. As such, interventions must consider the input of numerous constituencies (Boyd and Martin, 2020). Collaborative and democratic mechanisms are common ways to facilitate such feedback and

have been applied in both immediate response situations and in efforts to establish longer-term resilience (e.g., for urban sustainability). The public administration literature has developed a thorough and detailed body of knowledge pertaining to collaborative governance (Weber and Khademian, 2008; Huxham and Vangen, 2005; Vigoda, 2002) and has also examined collaborative governance and networks specifically in crisis situations (Kapucu et al., 2010; Moynihan, 2009; Waugh and Streib, 2006).

Crucial elements driving collaborative policymaking for crisis response and preparation include information-sourcing and expert analysis, participation and democratic legitimacy, and shared understandings about the nature and dimensions of policy problems. Hannah and Baekkeskov (2020) argue that the method by which ideas are framed and engaged can promote collaboration and coalition-building. In their ambiguity, according to the authors, 'polysemic' ideas (e.g., broad concepts like sustainability and social inclusion) can bring opposing groups together under high-level framings even amidst disagreement over interests and idea specificities. For an issue as broad as urban sustainability – relating not only to environmental health but also to the function of social, economic, and political systems – polysemic ideas offer one pathway to bridge problem complexity and political sensitivity.

At a higher theoretical level, emphasis on collaboration is one vehicle for dissolving epistemic hegemony. The framing of public policy problems has a history deeply rooted in the logic of positivism and instrumental rationalism; these epistemics shape and are shaped by technocratic administrative processes that regard only what their logic can process while marginalizing the rest. This legacy approach comes at substantial peril for efforts to develop policies that are effective, flexible, durable, and politically legitimate. Crisis response governance risks perpetuating epistemic lock-in and existing narratives by strategically refashioning them for modern problems (Kuecker and Hartley, 2020b); in this process, ways of understanding problems are merely repackaged for emerging crises without being fundamentally altered to break the epistemic path-dependence that may have contributed to crises. In matters pertaining to resilience, so-called folk, local, and indigenous wisdoms are examples of 'other knowledges' that can be crucial in filling gaps ignored by technocratic ways of framing problems and solutions. Collaborative processes can precipitate a transformation in epistemic framing by diversifying input sources and enlarging the visionary scope of policymaking.

4.3 Systems-thinking tools

The interpretation of threats to urban sustainability and other crises as complex policy problems invites a systems-based perspective that has implications for how policy ideas are gathered, synthesized, and actualized. Leischow et al. (2008) argue that systems-thinking brings a valuable perspective to policymaking and that related research should be 'transdisciplinary' and 'translational.' The implication is that governments play an important role in facilitating the connection between knowledge and practice, particularly for a policy field that comprises a "complex, adaptive federation of systems" (Leischow et al., 2008; p. S201). Given that a systems approach is useful in simplifying a universe that is "confusing, complex, and sometimes opaque to our queries of it" (Waltner-Toews et al., 2008; p. ix), the applied setting of urban sustainability and other types of multifaceted crises seems well suited for such a perspective.

From a practical perspective, systems-thinking can go hand-in-hand with 'soft systems methodology,' which Carey et al. (2015) argue has applicability for multi-faceted issues like public health. Soft systems methodology is an approach for modeling almost any human activity (Platt and Warwick, 1995) and can be applied to "tackling problematical, messy situations of all kinds" (Checkland and Poulter, 2010; p. 191). According to Checkland (1989), soft systems methodology uses "models of purposeful activity systems to set up a debate about change"; these changes "would be both (systematically) desirable and (culturally) feasible" (p. 273). Soft systems methodology is based on seven stages that broadly involve the delineation of a problem, identification of its root causes, and a reversion of the conclusions back to real-world terms that precipitate the desired outcome. The methodology is a fundamentally social and collaborative exercise that focuses on insights and learning; as such, it is relevant to the study of crisis situations with high degrees of complexity, definitional ambiguity, and interpretive latitude.

5. Conclusion

Efforts by local governments to integrate the SDGs into urban planning and management – and more broadly to address the sustainability crisis – are dependent not only on technology but also the diverse wisdom that comes from multi-stakeholder engagement. Further, such efforts may also benefit from a broader epistemic scope, recognizing that the way policy problems are often named and framed is a vestige of legacy governance styles that originated in eras having different problems and different types of problems. Alternative understandings about policy crisis have more opportunity to emerge in settings that embrace the idea of complexity, emergence, adaptation, and empirical ambiguity. This approach is not necessarily idealistic; contestation about the definition of policy problems (including which ones deserve intervention) is a political reality facing many governments in the current era of populist turbulence.

Facilitating a productive policy conversation across the current era's yawning political gap, does, however, necessitate a common understanding about the terms of debate. This understanding includes agreement about the validity of information, whether from scientists, technical experts, or the community. Validity, however, need not imply preeminence; many valid points of view may exist but there is no space to privilege all at once. At the same time, the notion of 'politicizing' the policy process has moved up-stream. Experts and policymakers once outlined a set of options around which the political debate could then proceed; the facts and assumptions had largely consensus legitimacy. However, the notion of 'upstream' suggests that political debate is inserting itself into the fact- and information-collection stage. Debates about the nature of data inputs are increasingly salient given the growing level of distrust of not only policy institutions but also knowledge institutions. Examples of this dynamic are observable in right-wing distrust of universities and transnational governance organizations like the United Nations and World Bank.

At a practical level, the development and implementation of urban policies addressing sustainability are increasingly shaped by the global policy narrative. Numerous conduits for the sharing of knowledge and 'best practices,' including global urban networks and the influence of global development and finance institutions, have enabled the sustainability

narrative to spread around the world, in a process that policy scholars often label policy transfer, policy learning, or policy diffusion. At the same time, differing fiscal and policy capacities across countries and cities impact which SDGs receive attention – particularly in settings where limited resources prevent action on all SDGs at once. In a study comparing progress on SDGs at the national level, Allen et al. (2018) find the greatest types of implementation gaps (low percentage of countries reporting progress) to be policy evaluation and assessment of interlinkages among SDG targets (both below 10%). By contrast, the most widespread progress was made on establishing coordination mechanisms, stakeholder consultation processes, and mapping and aligning the SDGs against national strategies and plans (all above 90% of countries). In time, scholars and analysts will be able to take a more longitudinal perspective on implementation progress, allowing them to isolate the effects of particular governance variables and compare their effects across cities and developmental contexts.

In acting upon these practical imperatives, a complexity thinking approach can help to account for interrelated challenges and policy domains and to prepare governance systems for future crises. According to Peters (2017), "the nature of wicked, and/or complex, problems is that there is no magic bullet to solve problems, but a better understanding can help facilitate what may be only limited answers" (p. 395). As public policy and administration practice and scholarship advocated for 'modernization' of governance systems throughout the 20th century, the notion that a problem is too complex to fully measure and an ideal solution too elusive to ponder is somewhat epistemically disruptive. This chapter has used SDG localization and the urban sustainability agenda to discuss the complex, interrelated, and multijurisdictional dimensions of crises and consider how theoretical understandings and practical policy strategies can be improved through the adoption of a complexity mindset.

In closing, it is fruitful to reflect more broadly on the epistemic dimensions of emerging crises. Two of the 21st century's most pressing global crises so far – climate change and pandemics – concern issues that have substantial scientific dimensions. The role of science in developing informed understandings is crucial for the function and effectiveness of policy responses. The Covid-19 pandemic is a useful comparison to the sustainability crisis; both are scientific and technical in nature, and both have generated political contestation. Throughout the pandemic in the United States, some scientists and experts appeared in the public eye through daily briefings. The pronouncements of Dr. Anthony Fauci and other medical staff, however, came into contradiction with a political narrative promoted by the presidential administration. The former cautioned against taking the crisis too lightly or failing to fully understand it, while the latter sought to downplay its severity in the interest of maintaining economic activity. The politicization of science was on display when right-wing political commentators reflected openly about whether the scientists were part of a more organized effort to discredit the presidential administration politically (Alba and Frenkel, 2020). This division exemplifies the type of complexities characterizing acute and complex crises. Not only are they inherently multifaceted, but efforts to understand and address them are also shaped by social systems that are not always prepared to deal collectively with disruption to existing understandings or epistemics.

Whether populist pushback against science is blunt political rhetoric or a shrewd and tactically designed revolution against the positivist claims of scientific rationality, there appears to be a growing crisis of epistemic legitimacy that casts science as elitist and populist pushback as heroism. The current era may indeed be characterized by 'late-stage technocracy,' in which the credibility of experts is compromised and claiming possession of the only legitimate policy information is a profitable political strategy. According to Hartley et al. (2020), "in countries with democratic systems and even in some autocracies, disaffection and distrust…is leading to populist agitation, challenging the legitimacy and logic of legacy governance models now relied on to address complex issues" (p. 270). This political-epistemic dynamic was evident during the pandemic and showed signs of eventual emergence even at times over decades of discussions about climate change. It is tempting to view pushback against received or mainstream policy narratives as an effort to dismantle epistemic hegemony and thus borne of social constructivism. Accordingly, Fischer (2020) argues that no amount of fact, however copious or well verified, can overcome fact-denialism or the political forces driving it. Epistemic instability is a political reality in the 21st century, coming at a time when evidence and science are more at the center of the policy debate than ever before. This turbulent era is an opportunity to revisit and strengthen scholarly understandings about complexity for urban sustainability research and practice.

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