

Chapter 2

Appreciating the Wicked Problem: A Systems Approach to Sustainable Cities

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Abstract Sustainable city place-making is a complex process and can deliver systemic unintended or undesirable development paths such as poverty, health inequality, or environmental degradation over generations. The application of socio-technical and socio-ecological systems thinking is applied to this critical challenge of how to create sustainable cities. Creating sustainable cities demands a different process of inquiry by decision-makers, policy-makers, and practitioners to support sustainable holistic thinking and transformational outcomes (Lonsdale et al. 2015. Transformative adaptation: What is it, why it matters and what is needed. UK Climate Impacts Programme, University of Oxford, Oxford, UK). The application of complex systems theory (Santa Fe Institute Bulletin, summer fall 2(1):8–10, 1987; Daedalus 121(1):17–30, 1992; Journal of Systems Science and Complexity 19(1):1–8, 2006), and socio-technical systems thinking, such as “appreciative systems” theories (The art of judgement, London, 1965; American Behavioral Scientist 38(1):75–91, 1994) and “systemic learning cycles” from soft systems methodologies (HRDI 3(3):377–383, 2000, pp. 380–381) are explored as mechanisms to support this new dynamic of skills, behaviour and mindset to foster transformational leadership of place. A new conceptual model and alternative reference frames are proposed as a way to understand and influence transformative action necessary to realise sustainable cities.

2.1 Introduction

The prevalence of persistent ‘wicked problems’ (Anderson et al. 2014, pp. 147–149; Wimsatt 1976) such as poverty, health inequality or environmental degradation in urban societies highlights a critical challenge for creating sustainable cities. Place-making is a complex process and can deliver systemic unintended, inequitable or undesirable development paths over generations (Lee et al. 2014; UN-Habitat 2016, p. 169). This replication of might be viewed as unsustainable development

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paths is a feature of cities globally and is evident in the cyclical nature of economies, in the evolution of businesses and in shocks to political or social systems. Cities and societies are continuously evolving and reshaping with non-linear patterns of development and self-organisation of complex city systems resulting in multiple development paths, some unpredictable, which emerge from the multiple interactions at work.

The expansion of urban development and cities on a global scale has created arenas for economic growth, populations and communities which are vital for quality of life and wellbeing but in contrast deliver unsustainable outcomes or trajectories contrary to these essential human requirements for long-term sustainability. This evidences a tension in our desire for and in our understanding of the complexity of cities. As identified by UN-Habitat (2016): “*cities have become sites of structural transformation*” (UN-Habitat 2016, p. 161) and there is “*an urgent need to reframe the global debate and national agenda for policy and action*”. (UN-Habitat 2016, p. 163).

This chapter offers a contribution to this reframing of the debate, policy and action, through a systems approach to our understanding of sustainable cities. Cities are complex evolutionary and ecological systems which are continually shaped and formed through historical and social construction and multiple interdependencies over time (Martin and Sunley 2014). Drawing on soft systems methodologies, complex systems theories, system dynamic factors and learning processes, an analysis of the sustainable development of cities is undertaken identifying factors that could be addressed for more inclusive and sustainable development pathways.

2.2 Unlocking Socio-Technical Thinking: Research Study and Methodology

The fundamental role of people and their actions (Norström et al. 2014) in the process of city place-making needs to be examined if the critical and urgent challenges of city sustainability are to be addressed. It is argued that there is a breakdown in or a fragility of the process of place-making and in societal understanding of the complexity of cities and how sustainable urban transformation might be realised.

Cities, communities and organisations are biological settlements, involving multiple actors (Emirbayer and Mishe 1998, p. 1003, cited in Davies and Msengana-Ndlela 2014, p. 6; Healey 2006; Martin and Sunley 2014) and actants (Law 1992) and rely on people to design, plan, engage in and shape city development processes. This is a complex picture of connectivity, interdependencies and interaction, with direct cause and effect outcomes not able to be fully scoped. Actors and agents within society or decision-makers within organisations and institutions, fulfil a critical role in determining the outcomes of places explicitly and implicitly through this social construction (Berger and Luckmann 1991) and historical construction of every day decision-making.

This chapter explores the way in which sustainable cities are understood, conceptualised and informed by complex systems theory and systems thinking. It is proposed that creating sustainable cities demands a different process of inquiry by decision-makers, policy-makers, and practitioners to support sustainable holistic thinking and transformational outcomes (Lonsdale et al. 2015). How city ecosystems evolve and how development paths emerge is considered through analysis of complex adaptive systems theory (Holland 1987, 1992, 2006; Martin and Sunley 2006; Martin and Sunley 2014) and the important role of people and their actions in shaping the sustainable development of cities. The prevailing reference frames and “world views” held by people, actors, and agents and are identified as critical differentiators in terms of understanding the complexity and required solutions for city sustainability complexity and judgements which inform action.

The application of soft systems methodology (Checkland 2011) and critical systems heuristics (Ulrich 1983) highlights the importance of engaging with multiple world views to inform understanding of complex systems to support a richer understanding of the problem and potential solutions. Consideration is given to how this systems-led approach could inform a different process of inquiry or policy development. Understanding the way action is shaped and influenced by reference frames (Silverman 1970; Ulrich 2005) or appreciative systems (Vickers 1965) is discussed. The potential for enhancing city sustainability and the effectiveness of judgements and actions through a richer understanding of multiple perspectives at different dimensions of stages of the place-making process and the development of pro-sustainability reference frames is explored. It is posited that the approach to sustainable cities needs reframing to address this complexity and that there is a need for pro-sustainability reference frames if progress is to be made in the future.

A social constructivism perspective informs this analysis (Berger and Luckmann 1991 p1/1991), reflecting multiple realities and perspectives, the social and relational factors involved in city-regional development (Paasi 2001; Brenner 1998, pp. 463; 467) and the systemic interactions, and multiple interdependencies in operation. This embraces realities of pragmatism, including social action theory (Joass 1996) and factors of power which exert influence in human systems (Healey 2006).

2.3 The Research Study Method

This conceptual, theoretical study utilises a qualitative desk-based approach to the analysis of selected literature relating to systems theories and sustainable cities. The study is informed by aspects of a constructivist grounded theory approach (Charmaz 2006, pp. 130–131) to enhance qualitative analysis (Charmaz 2006, p. 9). A constructed theory and contribution is developed (Charmaz 2006, p. 10) relating to “*the main concern*” (Glaser 2001, cited in Charmaz 2006, p. 133; 149): how to address the challenge of fostering sustainable cities and why the challenges appear to be replicated over time in different contexts. Through this a theoretical and conceptual contribution is offered with “*grab and fit*” (Bryant 2009, p. 78) for the reframing of

the debate, policy, and action for sustainable cities (UN-Habitat 2016, p. 163). The research is grounded via iterative analysis, theoretical sampling, and abduction (Charmaz, 2006, p. 188; Bryant 2009, pp. 88–100) using relevant secondary data and extant literature considered useful (Bryant 2009, p. 106) and valid as data when using Grounded Theory (Bryant 2009, p. 64) and Glaser’s “*All is data*” principle (Glaser 2002, p. 1). Whilst primary empirical data is not utilised within this study, interviews with elites undertaken in the context of separate research on the role and contribution of anchor institutions and decision-makers in the sustainable development of city-regions in England informs prior knowledge of the researcher which will have an influence on the iterative analysis.

The focus in this chapter is first on the development of the conceptual framework and the way in which the dimensions of the process of city place-making is shaped and needs to be analysed from the perspective of cities as ecosystems informed by complex adaptive systems and systems thinking. An abstract situational map advocated by Clarke (2003, pp. 558–565; 2005 cited in Charmaz 2006, pp. 118–119) is used to enhance data analysis and the construction of theory adopting a flexible, reflexive approach and “open mind” (Bryant 2009, p. 63). Theories of “Appreciative Systems” (Vickers 1965), “Action Reference Frames”, (Silverman 1970) and the “Reference System” (Ulrich 2005) are applied to the challenge of the shaping of sustainable cities and how these can be used to view the city differently. The proposition is that engagement with reference frames is necessary to fully understand complex urban challenges and to realise more sustainable cities. Different ways of understanding or alternative “world views” are required to unblock hidden pathways and widen the choices available for creating different and more sustainable critical development paths for cities. The implications of this for policy and practice to transform our understanding and process of sustainable city place-making are explored through a synthesis and construction of concepts and theory.

2.3.1 A Conceptual Framework for Analysis of Sustainable Cities

Cities as complex adaptive systems (Holland 1987, 2006) are in a constant and continuous process of reshaping (Martin and Sunley 2014) with implications for the way in which policy and action can effect transformation towards sustainable city outcomes that are always in motion (Holland 1992, p. 18). The abstract situational map (Table 2.1) as advocated by Clarke (2003, pp. 558–565; 2005 cited in Charmaz 2006, pp. 118–119) developed from a messy working relationship map illustrates the complex and complicated dimensions that contribute to the process of evolution and adaptation of sustainable cities. This highlights five dimensions, people, location, temporal, resource and interaction, and interdependence that influence and shape sustainable cities. These dimensions are considered interconnected and interdependent. The reality is more complex involving the richness of diverse societies

Table 2.1 Abstract situational map of sustainable city dimensions: ordered working version

A. People dimensions	B. Location dimensions	C. Temporal dimensions	D. Resource dimensions	E. Interaction and interdependence dimensions
<p>Diverse actors Individual; group; communities; societies; organisations; institutions and government; governance; independent actors; firms; representational; agents; people characteristics: gender, ethnicity, beliefs, religious, faith, political; diversity and inclusivity; tolerance</p> <p>Action and organisation Act and action; leadership; decision; judgement; belief; values, morals, and ethics; mindset or appreciative/reference system; custom, norm, or habit; discourses; institutions (soft and hard); idea; influence; plan, policy, strategy; process; practice; governance; organisation and structures; negotiation or discourse; situation and context; education, skills; resources</p> <p>Belief Mindset or appreciative system; belief; faith; custom, norm, or habit; idea; influence; political; values, morals, and ethics; emotional or affective; understanding and concept of sustainable city</p> <p>Power dimension Role or position; authority; agency; responsibility; influence; size and scale; symbolism; governance</p>	<p>Geography Type, e.g. urban, rural; mixed; resources; bounded or fuzzy boundaries; connected or isolated; 2D or 3D</p> <p>Context or situation dependent All dimensions A-E relevant</p> <p>Scale Micro-macro; local, sub-regional, regional, national, international, multiple, and overlapping</p>	<p>Connectivity and interdependence Historical, present, future; intergenerational; non-linear; systemic; life cycles</p> <p>Context or situation Seasonal; intermittent; conditional, e.g. crisis, economic condition or state, firm or city growth state; resource availability</p> <p>Context or situation dependency Social and historical construction; path dependency; life cycles</p> <p>Change and transitions Evolution and emergence; flows, e.g. increase; decrease; expansion; contraction; stage, e.g. early, mature, scale; changed states; pipeline; outcomes at points in space or place-time</p>	<p>Physical—non-human Built environment infrastructure; natural environment; digital and infrastructure; actants; protection, investment, and renewal; technological development</p> <p>Biological and ecological People dimensions; education and skills; innovation; non-human ecologies and biological entities; economies; cultural and social amenities; organisations; protection, investment, and renewal</p> <p>Natural environment Flora and fauna; natural landscape and resources, e.g. water; air; protection, investment, and renewal</p>	<p>Interaction and interdependence Influences; connectivity; overlapping scales; path dependencies; relationships; actants and actors; networks; all dimensions A-E relevant; holistic and integrated</p> <p>Evolution Continuous change; emergence; adaptation; self-organisation; systemic; multiple paths and possibilities depending on situation; process; transitions</p> <p>Scale Complexity; complicatedness; situational and interconnected to multiple scales; locational; 3D</p> <p>Temporal Past, present, future, intergenerational</p>

and communities with diverse cultures, economic organisation, businesses, communities, institutions, political ideologies, and power influences, resulting in multiple overlapping ecologies, types of environment, and settlement. Dynamic co-evolution of the entity (organism or people) and the environment shape each other and lead to self-organisation of cities, economies, and societal systems. Development paths, path dependency (Martin and Sunley 2006; Martin 2010), and non-linear adaptation emerge through this complex process of interdependencies between multiple actors, organisations and institutions, and environment (Simmie and Martin 2010, Martin 2010). This can lead to institutional or city-regional form with agglomeration forces (Brenner 1998) influenced by people's actions which may or may not lead to sustainable cities over time. In this way:

Cities, clusters, and regional economies arise out of the myriad individual actions and interactions of economic agents (firms, workers, households, institutions) that generate outcomes (behaviours, investment and employment decisions, knowledges...) that serve to reproduce ...spatial systems.

(Martin and Sunley 2014, p. 11)

It is through this complex evolutionary and interactive process involving historical and social construction (Eder 1996) that cities and regions and their sustainability are continuously shaped, re-created, and transformed. Increasing globalisation of society with rapid digital and physical connectivity between people and places enhances and can strengthen local, national, and global interaction and the influences or impacts (positive and negative) that this can bring to a place. Urban challenges are outcomes of this process of place-making or place-shaping which emerge or evolve from a complex web of uniquely configured interactions and interdependencies between people, actions, and the environment at multiple and overlapping scales in time (see Fig. 1.1).

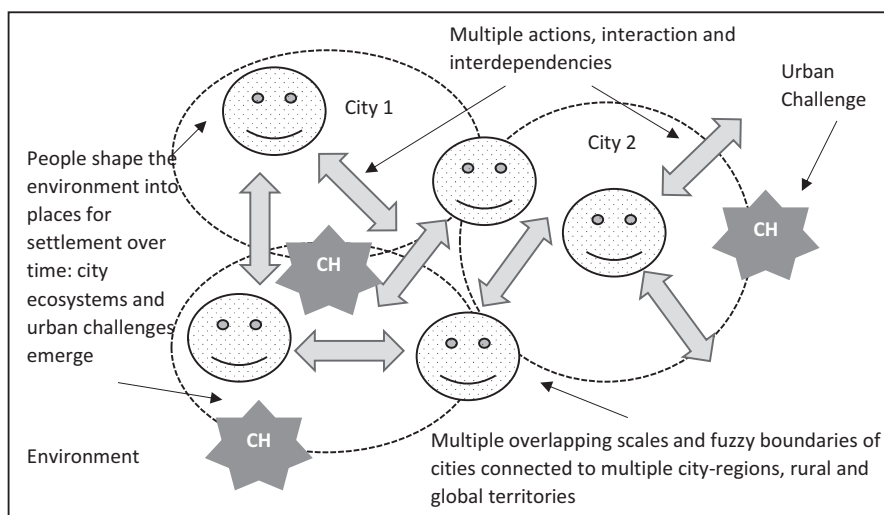


Fig. 1.1 The city ecosystem

The persistence of socio-economic and environmental challenges, inequality, or poverty is an intergenerational feature of cities globally and highlights an underlying societal problem and a potential systemic failure in the process of place-making. This can be viewed as a form of “extended inheritance” or replication of unsustainable practices with urban challenges being represented or reconstructed at each generation via institutional culture or decision-making or from continued practice or beliefs (Martin and Sunley 2014, p. 8). Cities and sustainable cities are created and shaped by people, agency, and actions (Stone 1989; Mossberger and Stoker 2001; Davies and Msengana-Ndlela 2014) within complex organisational and societal structures. This role of people and their actions is under developed in our understanding of sustainable cities (Martin and Sunley 2010, p. 16) and yet is fundamental to addressing the root causes and solutions for sustainable city transformation. Systems theories are applied to this problem to provide a different view of how this can enhance sustainable cities.

2.4 The Results

2.4.1 *Systems Thinking Applied to Sustainable City Transformation*

Complex systems theories as set out in the conceptual framework can explain how cities evolve, the dimensions involved, and how development paths emerge at a macro- or meso-level but do not fully explain why people’s actions and agency continue to produce urban challenges and unsustainable practices. Navigating development paths through this system and influencing their trajectory is a human endeavour. How people interpret the situational context, the options, future possibilities, and resultant actions in their everyday practice and process of shaping sustainable cities is critical (World Bank Group 2015). Actions can build resilience to shocks and support the maintenance of the development path (Perrings 1998); or action, such as innovation or entrepreneurship, can support transformation to a new or different path. Replication of unsustainable development paths such as urban poverty, environmental degradation, or social inequality over generations is a factor of people’s actions, interdependence, and evolutionary systemic forces.

Actions are shaped and influenced by people’s beliefs developed by culture, values, institutions, experiences, professional practices, social norms, and habits which are historically and socially constructed. Practices can impact negatively on a society, economy, or a place when actions, decisions, or habitual practices are informed by reference frames that are perceived as unethical or against the perceived societal standards or regulation. The way in which collective cultures and habitual practices in the financial crisis in 2008–2010 contributed to fraudulent behaviour and rule breaking is illustrative (Bachmann 2011, p. 209). Such perceived malpractice or insufficiently regulated practice, as standards in journalism, the financial sector and

sports have highlighted, show how habits, norms, or standards of practice are vital for maintaining stability of a system or to deliver the right transformation for improvement. Values and a mindset for the creation of shared more inclusive value are important elements in the application of systems thinking.

Mindset, social norms, and culture play a significant role in determining the way in which decisions and actions are framed (World Bank Group 2015, pp. 62–75). Cities and their conceptualisation have multiple meanings influenced by history, culture, and society (Hall 1984, pp. 346–348; Batty and Marshall 2009, p. 551) and are interpreted, conceptualised, or perceived in diverse ways in a similar way to sustainable development (Gibson 1991; Pezzoli 1997, p. 550; Haughton and Counsell 2004). This different way of seeing and understanding, what Vickers terms an “appreciative system” (Vickers 1965) influences and can constrain appreciation of the problem and will frame solutions and actions. Institutional practices and professional norms and habits contribute to the development of individual reference frames through this continuous interaction and reshaping informed by relevant legislation, professional, or organisational rules. Appreciative systems, termed “mental models” by the World Development Report (World Bank Group 2015, p. 11) are becoming identified as important in shaping and influencing actions but some may also “*contribute to the intergenerational transmission of poverty*” (World Bank Group 2015, p. 11). As Herepath (2014) citing Joseph (2000) highlights

the interplay of structure and agency is sensitized to the emergence of the contested hegemonic control that fosters advocacy for, and resistance to, strategic change, so providing the requisite insight into strategic direction and ensuing outcome.

(Joseph 2000 cited by Herepath 2014, p. 874)

Empirical studies such as that of Bristow and Healy (2015) focused on the study of agency in Wales highlights the systemic nature of agency within complex economic systems and how in this case during the recession, agency appeared to create a dominant think mindset of

‘getting by’—rather than a more reflexive interrogation of ...the need for and means of pursuing longer term, more transformative change. (Bristow and Healy 2015, p. 13)

Reference frames and path dependencies in complex city systems that are influenced by unsustainable or negative “collective patterns of behaviour”, habits, and norms can sometimes act as a constraint or hidden barrier to taking the necessary course action for transformation resulting in sub-optimal outcomes (World Development Report, 2015, p. 55). Internationally, global business executives conceptualised cities primarily as places to do business and for access to customers, markets, and investors (McKinsey Global Survey 2015 in Global Cities Business Alliance 2015, p. 2). Factors such as improving cities as places to live scored low (5–6%) along with the importance for their firm of having a city-level strategy (27%) (McKinsey Global Survey 2015 in Global Cities Business Alliance 2015, pp. 14; 17–18). This has implications for the way in which sustainable cities are understood and conceptualised and for framing actions. Research undertaken by Ibrahim, El-zaart, and Adams (2015) in the Arab region highlighted a gap in knowledge relating to effecting transformation towards smart sustainable cities and a need

to address challenges at city and national levels (Ibrahim, El-zaart and Adams 2015, p. 573). This illustrates a need to address the development of pro-sustainable reference frames and to reframe understanding, policy, practice, and outcomes dimensions for realising Sustainable Cities.

It is evident that “Appreciative Systems” (Vickers 1965), “Action Reference Frames” (Silverman 1970), or “World Views” (Checkland, and Scholes 1990, p. 40) influence understanding, judgements, and decision-making of a particular situation, concept, objective, problem, or decision. As Silverman (1970) identified

The overall set of expectations and meanings through which the members of organisations are able to act and to interpret the actions of others is a social construct...participants continually shape and re-shape the pattern of expectation by means of their actions. For, as they act, they validate, deny or create prevailing definitions of the situation. In doing so, they are influenced by the changing stock of knowledge in the wider social world, by their own particular interpretations of the situation, and by the form of their attachment to the existing system.

(Silverman 1970, p. 196)

Soft Systems Methodology (Checkland and Scholes 1990), Critical Systems Heuristics (Ulrich 1983), Appreciative Systems (Vickers 1965), or Silverman’s Action Reference Frames (1970) offers a relevant approach to understanding decision-making and judgements made regarding action for transformation sustainable city discourse. These approaches go some way to enabling diverse world views to be integrated into the judgement or decision-making processes and in the interpretation or understanding of the complex nature of cities. Soft Systems Methodology (Checkland and Scholes 1990) and Critical Systems Heuristics (Ulrich 1983) integrate different perspectives or “world views” into the process of understanding the complex object under analysis, for example, a wicked problem, a societal challenge, or a city system. Checkland (in Checkland, and Winter 2000) sees these perceived problems as being multiple world views of people as observers and the process of problem solving as a “*learning process*” in trying to understand this complexity and address it through purposeful “*action to improve it*” which necessitates a holistic view informed by multiple perspectives (Checkland and Winter 2000, pp. 379–383). For Ulrich (1983) informed by similar systems thinking, this process of understanding is set in a world reality that involves “*social planning*” which requires an emphasis on “*the art of promoting improvement*” (Ulrich 1996 and 2014, pp. 7–9) involving understanding multiple perspectives not merely “*purposeful-rational action*” (Ulrich 1983, pp. 6–7).

In this regard, Ulrich engages with “*critical holism*” (Ulrich 1993, pp. 5–7), a way of addressing the integral challenge of “holistic thinking” necessary for sustainable development through a practical methodology (Ulrich 1993, pp. 3–5). This critical inquiry process or “*systemic triangulation*” (Ulrich 2005, p. 6) of discourse involving views on Values, Facts, and the System that inform boundary judgements (Ulrich 1993, p. 14; 1996 and 2014, pp. 15–16) requires engagement with potentially different or conflicting views on values, purpose, power, knowledge, and legitimacy to inform purposeful action (Ulrich and Reynolds 2010). This enables a dialogue on “*what is ideal*” and “*what ought to be*” (Ulrich 1996 and 2014, pp. 20;

23–42) supporting a reframing of the reference frames that inform the different views or stances. For whom is left to negotiation via discourse but for a Sustainable City Reference Frame or Lens, it is proposed that this ought to be inclusive of all people which the city supports. Soft systems methodology adopts a similar integration of different world views and perspectives to shape the conceptual model with Simonsen (1994) proposing a “*united perspective*” rather than using a single perspective which can reflect power or vested interests (Simonsen 1994, p. 17).

2.4.2 A “Sustainable City Lens”: Implications for Transformation of the Sustainable City Debate, Policy, and Action

Applying a systems approach to the process of development of sustainable cities offers a different view of conceptualising and framing city place-making processes through a “Sustainable City Reference Frame” termed a “Sustainable City Lens” for practical application (see Table 2.2). A systems perspective offers a different, more integrated and holistic view of Sustainable Cities and has implications for the transformation of conceptual models, policy development, sustainable city planning and practice, and the way in which this action and emergent outcomes might be enhanced. Ellingsen and Leknes’ three dimensions (2012, pp. 227–229) for understanding city-regional development, Concept, Object, and Practice are considered helpful as a foundation for developing a practical and useful explanation of the stages of Sustainable City place-making. This recognises that cities and regions are relational and institutional spaces, as well as socially and historically constructed territories (Ellingsen and Leknes 2012, pp. 227–229). This on its own is considered insufficient for addressing outcomes and the earlier five conceptual dimensions which are not fully covered by Concept, Object, and Practice dimensions of place-making.

A fourth dimension, “Outcome Emergence”, is introduced to reflect the continuous evolution of cities and the associated conceptual dimensions discussed earlier in this chapter. The “Outcome Emergence” dimension reflects the nature of outcomes and indicators as progress made in the shaping of a sustainable city as at transitory moments at a point in time, over a particular geography on the time continuum. This provides a lens or transitory snapshot of sustainable city outcomes at different and overlapping scales which can be observed in “place-time” and opens up options for path dependencies to be explored and improved through a learning system and reflexive approach informed by the interaction and interdependence conceptual dimension. The term “place-time” is utilised from the work of Einstein, frequently referred to as “space-time” (Minkowski 1908). The literal translation “place-time” of Lorentz’s “*Ortszeit*” is used (Lehmkuhl 2010, p. xli) to reflect the geography of cities and supports an explanation and understanding of cities in development as evolutionary processes.

Table 2.2 Reframing city development policy and action: towards a sustainable city lens

Reference frame and definition	Present approach (UK focus)	Systems approach	Sustainable city lens
Principles and value systems	<ul style="list-style-type: none"> • Market and economic growth orientation • Secondary attention to social welfare and protecting environment • Increasing consideration of social deprivation and access to education • Shift towards individual responsibility and reductions in state welfare with austerity • London centric and skewed investment • Northern powerhouse and devolved administrations • Policies transferring some powers and responsibilities to some city-regions with elected mayor model • Increasing role of private sector through local enterprise partnerships, health, education, and other privatisation models • Weakening of sustainable development commitment through re-interpretation and restatement of previous labour government policy. Criticism of progress made in Sustainable Development Goals (SDGs) • Short—medium-term timescales for return • City as a business, market, designed and planned for business, markets, retail—viewed as a bounded place • A built environment emphasis; infrastructure investment lags in some cities; • Individualistic, institutional, and organisational interests predominate within society 	<ul style="list-style-type: none"> • Action for improvement and inclusive benefit with action informed by multiple world views • Long-term timescales • Whole system sustainability • Holistic and Integration of all factors and elements • A continuous process of historical and social construction • Shaped by interaction, evolution, and interdependences • Society interests to support all individuals • Values informed • Economic, social, environmental, and governance dimensions addressed together with conceptual dimensions relating to people, location, temporal, resource, and interaction and interdependence 	<ul style="list-style-type: none"> • Sustainable city over time with inclusive continuous improvement • Long-term timescales • Whole system sustainability • Holistic and integration of all factors and elements • People and society centric—shared vision and value • Whole system focus • Values informed • Continuous development of sustainable practices and investment in renewal, up skilling, infrastructure, and people • SDGs enacted and prioritised • Long-term timescales for return and short-term outcomes enhanced • Economic, social, environmental, governance, cultural and education dimensions addressed together with conceptual dimensions relating to people, location, temporal, resource, and interaction and interdependence • Community and collaborative approach with responsibility

(continued)

Table 2.2 (continued)

Reference frame and definition	Present approach (UK focus)	Systems approach	Sustainable city lens
Concept How a sustainable city is defined and understood	<ul style="list-style-type: none"> • Different and diverse prevailing views, e.g. design, plan, and build; the green city; the smart city; the business city; the cultural city • Sustainability seen as tick box not embedded into habitual practices and norms • Sustainability considered as environmental rather than integrated • City as bounded within administrative boundaries for policy and investment 	<ul style="list-style-type: none"> • Complex adaptive system with evolution and emergence • Historically and socially constructed with path dependency via multiple interactions and interdependencies • Appreciative systems and reference frames shape action • Fuzzy boundaries and overlapping multiple scales and territories 	<ul style="list-style-type: none"> • Sustainable city shared vision—inclusive, integrated, and holistic • Complex adaptive system with evolution and emergence • Focus on continuous improvement for city sustainability • Historically and socially constructed with path dependency—learning from history and projective action for future • Multiple interactions and interdependencies with pro-sustainable cities appreciative systems and reference frames shape action
Object How a sustainable city is designed, planned, and interpreted into intent as objectives, goals, and action	<ul style="list-style-type: none"> • Individual or stakeholder interest led • Design, plan, build, review • Pro-development institutional planning framework • Object is diverse—individual, organisational, economy, place, people not unified vision • Some collaboration but generally not joined up nor shared and agreed approach 	<ul style="list-style-type: none"> • Shared or community/societal objective enables inclusive stakeholder interests • Whole system approach balancing economic, social, environmental, governance and cultural aspects for quality of life and sustainable society 	<ul style="list-style-type: none"> • Unified vision of sustainable city and priorities and processes to support continuous improvement • Process of development understood as a continuous and as a complex system • Social learning processes support action for improvement and reflexive practice • Collaborative structures and engagement mechanisms to enable multiple views to inform policy and action—boundary judgements debated • Agreed progress stages, long-term vision and outcomes to evaluate progress across all dimensions

<p>Practice The continual process of forming sustainable cities in practice, through action and use</p>	<ul style="list-style-type: none"> • Unsustainable practices prevalent • Lack of integration leads to tensions • Foresight and long-term planning not habitually used • Piece meal and disjointed approach • Strategy and plan led often on specific single dimensions 	<ul style="list-style-type: none"> • Inclusive, integrated, diversity embraced • Collaborative and reflective practice • Multi-stakeholder and systems leadership • Long-term focus and techniques used for forecasting and big data for monitoring trends and patterns • Sustainability approaches more habitual and expected 	<ul style="list-style-type: none"> • Reflexive practice and learning system approach • Continuous improvement focus • Inclusive, integrated, diversity, and values embraced • Collaborative and reflective practice • Multi-stakeholder governance, decision-making, and systems leadership • Long-term focus and techniques used for forecasting and big data for monitoring trends and patterns • Transition management focus and transformational adaption for system change and continuous improvement • Institutional and societal norms and values foster pro-sustainability practices across all dimensions
<p>Outcome Emergence The actual representation and evidence of a sustainable city in place-time</p>	<ul style="list-style-type: none"> • Success led—primarily economic • Economic Growth, Productivity, and GDP indicators used for comparisons at different scales • Social welfare, environmental priorities, sustainable development lag • Indicators and metrics and goals measured and inform action • Reducing influence of European institutions over time 	<ul style="list-style-type: none"> • System led—sustainable system over time • Integrated and balanced system, e.g. economic, social, and environmental all prioritised to achieve sustainability • Holistic focus • Outcomes continuously reviewed and inform reflexive practice and continuous improvement 	<ul style="list-style-type: none"> • Society and people led • Shared vision of sustainable city and of ideal outcomes and priorities • Continuous monitoring of progress, flows, pipelines, transitions, and path dependencies to achieve equilibrium for sustainable cities • Careful management of transitions • Outcomes inform future action for improvement

2.4.2.1 The Conceptual Dimension

Systems techniques and approaches have the potential to inform conceptual understanding, development of inclusive shared visions of sustainable cities, and better connected policy and practices. The development of a systems informed “sustainable city reference” frame is explored to enhance understanding and practical usefulness (Table 2.2). Systems methodologies and complex adaptive systems understanding foster and enable a more inclusive people-centred approach to concepts of sustainable cities and the system changes needed to secure and maintain them. Transformation necessitates systems change which is likely to involve multiple stakeholders and a wider perspective than that which is within the purview and responsibility of any single decision-maker or organisation. This engagement with the concerns of others and the way in which more inclusive, collaborative, and shared understandings of the real issue or solutions capable of addressing the root cause of the problem has the potential to enable transformation of the system beyond line management or organisational responsibilities or roles. This moves the judgement boundaries towards the whole system, societal learning, and engagement collaboratively with others who are capable of taking action or implementing the solution across professional or policy concepts and fields.

2.4.2.2 Process Dimension

Processes for inclusive and more collaborative models of decision-making and governance will require changes to mindset and practices. This will necessitate a focus on shared community interests and value (i.e. the Sustainable City Frame) as distinct from individual or partisan interests and organisational short-term benefit. As identified by the OECD (2012, p. 10), case studies of under-performing (against national GDP) and successful regions highlights that policy-making, governance, and policy coordination/integration can act as inhibitors or contributors to success. This is relevant for a sustainable city reference frame with the complexity of decision-making necessitating discourse on diverse and potentially conflicting views of priorities and policies. Using techniques, structural and organisational models that are effective in enabling critical inquiry and reflective practice are needed as well as use of monitoring and forecasting over the long term of flows and data indicators to maintain equilibrium and inform adaptive action to reflect changes in conditions or outcomes. Understanding life cycles and life cycle costing or investment appraisals may offer useful techniques to support investment decisions and priorities for continuous cycles of renewal. The ability to learn from experience and history is important to maximise future actions for improvement. The way in which transitions are managed will impact on the ability to maintain sustainable development paths and continuous improvement. Multiple potential transitions points exist over time and space (e.g. people, territories and administrative boundaries, populations and firms, leadership and decision-making models or actors, organisational, institutional, or

governance structures, policies or processes, economies, resources, and technology). Transitions need careful management and focused people development and action to mitigate shocks to the system or misaligned changes in reference systems including conceptual understanding social or cultural norms or habits.

2.4.2.3 Practice Dimension

Pragmatically, the continuous evolution of complex city systems highlights a similar challenge of practicality in the application of systems thinking as with Ulrich's view of holistic thinking for sustainable development (Ulrich 1993, pp. 3–5). Implementing these approaches will necessitate a transformation in systemic, habitual, and professional practice. This change requires a shift in mindset and understanding of the problem and a willingness to engage on the part of many in sharing solutions, neither of which is simple to achieve in complex city systems. This necessitates individual learning skills and abilities to be reflective and reflexive (Schon 1983) as well as individual, institutional, and organisational capacity to engage in different multiple collaborations and decision-making over time, across organisational boundaries and territorial scales. This has implications for education and skills policy and our approach as a society to the development of values and beliefs. Concepts of systems leadership (Van Dyke 2013, pp. 4–6) and systems transformation are highlighted more recently in the literature in contexts where transformational, as distinct from incremental adaption for maintaining development paths, is desired (Lonsdale et al. 2015). For example, this has been considered to enable entrepreneurship (Auerswald 2015), address resource constraints, and enhance services in the NHS and in city devolution contexts (Grant Thornton 2016, pp. 15–19). This could be viewed as innovation at a city systems level to support new or different more sustainable development paths or to overcome major shocks to the system.

2.4.3 Emergent Outcomes Dimension

A shared vision of what constitutes a sustainable city at a point in place-time, informed by diverse worldviews or perspectives is the basis for the analysis of improvement through a learning system approach (Checkland 2011, p. 504). In order to foster action for improvement, there is a need to reflect on judgements, action, process, experience, and outcomes to inform, adapt, and enable continuous improvement. This draws parallels with reflective practice (Schon 1983) with the need to debate and consider reference frames or appreciative systems (Vickers 1965), relevant data and views of the system, and the extent to which sufficient account has been taken of the different and often competing perspectives and interests to inform the necessary priorities and agreed action for transformation and improvement. This emphasis on sustainable city emergent outcomes embraces the

integration of the five conceptual dimensions: people, locational, temporal, resource, and interaction and interdependence. Typical sustainable development dimensions such as economic, social, and environmental are reflected in this analysis with an extended construction to include Governance (United Nations General Assembly 2015), Culture (due to the importance of values and mindset), and Education (as a result of the importance of establishing values, mindsets, capacity, and skills for collaborative, inclusive, and reflective practice, and transformational adaption and innovation). This also recognises the need for continuous cycles of investment to at least maintain and with the aim of continuous enhancement of education, skills, infrastructure, or other resources over time. Energy and flows of stocks and resources, ideas and policies, and institutional and societal norms have a parallel in this regard, which need to be understood and taken into account to inform projective action and adaption for resilience and for continuous and inclusive improvement.

2.5 Conclusions

This chapter has offered a contribution to the way in which we might better understand the complexity of sustainable cities and the way in which people and reference frames influence action towards their realisation. The replication globally of urban challenges in the development of sustainable cities over time suggests the need for a different approach to addressing sustainable cities. A pro-sustainability approach, informed by Sustainable City Reference Frame, termed a “Sustainable City Lens” has been explored through the application of systems thinking and methodologies. Such an approach has the potential to change conceptual understanding of sustainable cities and lead to very different solutions to everyday policy and practice. The development of and engagement with reference frames as part of this process provides a richer understanding of the competing priorities and possible options that might support sustainability led action. This analysis has contributed to an explanation of why persistent urban challenges are replicated over time through unsustainable practices and policies being inherited through generations or an inability or lack of capacity to engage in transformational adaptation. Complex systems theories and related systems thinking has enabled a richer understanding of the processes and interdependences at play and provided a reframing, different tools and approaches to policy-making to enhance pro-sustainability decision-making and action.

This chapter has provided a first step in revisiting systems thinking to provide an alternative perspective on the challenges in enabling sustainable cities. This different process of inquiry by decision-makers, policy-makers, and practitioners is proposed as a way to enhance sustainable holistic thinking and increase the potential for transformation of cities globally. Further work will be to extend and refine this “Sustainable City Lens” and the conceptual approach to reference frames through empirical data analysis.

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