Studien zur Resilienzforschung

Sonja Deppisch *Ed.*

Urban Regions Now & Tomorrow

Between vulnerability, resilience and transformation

Springer

Studien zur Resilienzforschung

Diese Reihe vertieft aktuelle internationale Diskurse aus der Resilienzforschung und diskutiert deren Implikationen in verschiedenen Praxisfeldern. Dabei folgt sie einer interdisziplinären Ausrichtung und stellt Beiträge aus unterschiedlichen Disziplinen in einen Kontext zueinander. Sie richtet sich sowohl an Forschende als auch an Praktiker, für die neuere Entwicklungen im thematischen Umfeld der Reihe von Bedeutung sind. Veröffentlicht werden Forschungsberichte mit theoretischem und empirischem Bezug, sowie praxisnahe Beiträge zur konkreten Förderung von Resilienz. Die Reihe verfolgt maßgeblich zwei Stränge. So können sich die Beiträge einerseits mit dem Konzept der Resilienz an sich auseinandersetzen, in seinen unterschiedlichen Verständnissen und Ausformungen mit Bezug auf Individuen, Gruppen und größeren sozialen Gemeinschaften. Zum anderen geht es darum, Resilienz im Spannungsfeld zu anderen Konzepten, Theorien und Praxiszugängen zu erörtern. Die Reihe publiziert schwerpunktmäßig Beiträge in deutscher Sprache, wobei auch englischsprachige Fassungen erscheinen.

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Editor

Urban Regions Now & Tomorrow

Between Vulnerability, Resilience and Transformation

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Vorwort/Preface

Da dieses Buch in einer überwiegend deutschsprachigen Reihe erscheint, sei ihm auch ein Vorwort in der Hauptsprache der Reihe vorangestellt. „Urban regions now & tomorrow: between vulnerability, resilience and transformation“ umfasst Beiträge von Autorinnen und Autoren unterschiedlicher disziplinärer Prägung, die sich alle damit auseinandersetzen, welche Herausforderungen Wandelprozesse und ihre Folgen an Städte und Stadtregionen stellen und wie mit diesen Herausforderungen umgegangen werden kann. Dabei findet ein Bezug zu den dominanten Konzepten im Umgang mit Wandel sowie mit katastrophalen Ereignissen statt. Vulnerabilität, Resilienz sowie Transition und auch Transformation werden in den Kapiteln jeweils in unterschiedlich starker Ausprägung hervorgehoben. Ein Schwerpunkt liegt auf dem Konzept der Resilienz und ihren Bezügen zu den anderen Konzepten, und hier besonders zu Transition und Transformation. Mit verschiedenen disziplinären, aber auch konzeptionellen Perspektiven werden Fallbeispiele vorwiegend europäischer, aber auch nordamerikanischer und australischer Städte und Stadtregionen analysiert. Einige der Beiträge wurden bereits auf der Internationalen Konferenz „URC 2014—Urban Regions under Change: Towards Social-Ecological Resilience“ im Jahr 2014 an der HafenCity Universität in Hamburg präsentiert. Überdies befinden sich nun auch Beiträge des Wissenschaftlichen Beirates zu dieser Konferenz im Buch sowie Kapitel weiterer Autorinnen und Autoren aus dem Forschungsfeld.

Danken möchte ich an dieser Stelle insbesondere den Autorinnen und Autoren für ihre Beiträge, den eingeladenen Gutachterinnen und Gutachtern für ihre kritische Durchsicht der einzelnen Beiträge, Markus Nagel für die effiziente Endbearbeitung sowie den Kollegen im Herausgebendenkreis der Reihe „Studien zur Resilienzforschung“, als deren zweiter Band dieses Buch erscheint.

Möge dieses Buch seinen Lesendenkreis unter Praxisakteuren, Forschenden, Lehrenden und Studierenden aus unterschiedlichen stadt- und regionsbezogenen

Disziplinen sowie aus weiteren einzel- sowie multi- und interdisziplinären Zusammenhängen finden, die sich mit Wandelbedingungen und –prozessen sowie den Konzepten der Vulnerabilität, Resilienz und Transition sowie Transformation auseinandersetzen.

As this book is published within an also German speaking book series on resilience studies, the main part of the foreword owes that language. All other parts are written in English and the introduction in Chap. 1 says everything and more what is written above. Nonetheless, I would like to express here my gratitude to all contributors to this book, especially to the chapter authors, to the reviewers as well as to Markus Nagel for his efficient finalizing works.

Hamburg, Germany Sonja Deppisch

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Cities and Urban Regions Under Change—Between Vulnerability, Resilience, Transition and Transformation

1

Sonja Deppisch

Abstract

Different conceptual approaches as well as terms are applied if one looks at how or if cities and their surrounding region are dealing with past, current and future known as well as unknown change processes, their potential impacts and the consequential challenges they evoke. Dominant concepts in this recent discussion seem to be vulnerability, resilience and transition or for the latter also transformation. All of these three are more or less contested concepts with many different understandings. This chapter gives a brief introduction and overview of the discussion as well as of the interlinkages between the conceptualizations used in this book.

1.1 Urban Regions and Change—Now and Tomorrow

Cities and urban regions are attracting a growing attention and population due to global urbanization processes and they represent important hubs of human life. And also, social-ecological interdependencies manifest themselves in complex urban regions across very different scales. Urban regions are confronted with a multitude of past, current and future change processes such as climate or demographic change and consequential challenges to urban and regional development

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on how to deal with their known, uncertain or even unknown impacts. Global as well as other change processes manifest themselves in specific impacts, interacting with the local and regional conditions, resulting from specific complex local human-nature relationships and interdependencies. Also the impacts are depending on the vulnerability of the urban context at hand.

Recent years have shown an increase in the number of disciplinary as well as inter- and transdisciplinary research projects, especially on the topic of dealing with climate change impacts on cities and urban regions. Other change related issues, such as demographic change and globalisation, show similarities in the way these issues can be dealt with in the context of urban and regional development. This makes it attractive to approach such questions in an integrative manner. Additionally, not only long-term change processes are relevant to urban and regional development, but also surprising developments such as on a very short-term scale appearing natural hazards. Many publications focus either on a specific type of change, such as demographic change, see e.g. publications on shrinking or on fast growing cities (e.g. Hollander et al. 2009; Pallagst 2010), or on climate change and specific mainly disadvantageous impacts (see for instance Watson and Adams 2011; Baker 2012). Many books, which are dealing with different change processes in urban regions are either focusing on one specific conceptual approach towards how to deal with the impacts of these changes (for resilience for example: Müller 2011; Coyle 2011; Kegler 2014) and/or they are limiting their focused practical realm to specific disciplines such as urban design (Washburn 2015) or urban planning (Eraydin and Tasan-Kok 2013).

This book here brings together new international research results from different disciplines as well as from interdisciplinary driven research. They are dealing with past, current and future change processes in European, Northern American as well as Australian cities and urban regions, the challenges these change processes pose to a resilient urban and regional development. In addition, contributions deal with potential transformations of urban and regional development and related planning and governance approaches. In contrast to other books, it tackles change in general and does not emphasize a special type of change, as change related issues show similarities in (abstract) challenges they pose to urban and regional development and in the way it can be dealt with them. Also, it follows the aim to cover the very different aspects which are relevant if we look at urban regions undergoing change. Hereby the collected chapters are not only referring to one conceptual approach how it can be dealt with long-term or surprising and also sudden disastrous change, but they refer to three dominant concepts. However, there is an overweight on resilience, owing to the fact that the majority of the chapters was already presented as papers for the Conference “URC 2014: Urban regions under change” (May

2014, Hamburg, Germany) or is written by members of its advisory committee. Some additional chapter authors were invited to contribute as their research focus is suiting the topic and aims of the book very well.

It brings together a collection of empirically based research as well as more theoretical—conceptual chapters that refer all to cities and urban regions. The view is not only and strictly on cities and the urban territory as such. But it also involves also the wider urban region to take into account the complex urban-rural relationships as well as social-ecological interdependencies while tackling the question on how to deal with change impacts.

Addressed are scientists and practitioners from different disciplines working in urban and regional development and focusing especially on change processes in urban contexts and how to deal with their challenges. Also, further stakeholder interested and engaged in the future of their cities and urban regions are addressed. Additionally, this books aims at providing a contribution for those interested or involved in the ongoing debates on resilience and transformation, here with the prevailing reference to the future development of urban regions.

1.2 Different Concepts—Difficult Relationships? Between Vulnerability, Resilience, Transition and Transformation

In recent research literature, different conceptual approaches as well as terms are applied if one looks at how or if cities and their surrounding suburban as well as wider peri-urban region are dealing with past, current and future change processes, their potential impacts and the consequential challenges they evoke. Dominant concepts in this recent discussion seem to be vulnerability, resilience and transition or for the latter also transformation. All of these three are more or less contested concepts with many different understandings.

The second chapter of this book (by Athanasiadou and Tratsela) demonstrates how a suburban space and more specifically, land-uses therein, are changing substantially and dynamically across time. Pelling (2003, p. 163) highlights that *vulnerability* is spatially bounded and in consequence, place-specific. This is especially of relevance as we are looking here at cities and urban regions and how they deal with change and its impacts. And urban spaces are providing a density of human beings as well as many assets in one spot being exposed to internally as well as externally triggered change processes and disasters and their specific and potential harmful impacts at a certain place and time. Additionally, cities are often situated in hazard-prone areas (see Chap. 3 by Galderisi and Limongi). Here in this

book, vulnerability does play a role in some respects. In many chapters the authors are referring to vulnerability or vulnerable groups or infrastructures, but a critical discussion of the conceptual-theoretical vulnerability concept is not intended, as the main focus lies on resilience. However, in literature vulnerability is sometimes conceptualized as the opposite of resilience, in the sense that if vulnerability is reduced, resilience is increased, especially relating to environmental change, risks and disasters (Folke et al. 2002), but also to urban development (see for instance Pelling 2003; or Chap. 3 here). As Kilper and Thurmann (2011, p. 115, relying on a quote of Bürkner) put it, with a vulnerability focus we look at the "susceptibility or violability" of individuals, groups or structures against harms and risks while with a resilience lens we are focusing more on the ability also of persons as well as groups and structures up to a whole system to prevent or re-organize after damage has occurred. This represents a quite limited view of resilience as will be shown further in the next paragraph, but illustrates well one different aspect how the two concepts are used. Different uses of the vulnerability lens in comparison to the resilience lens can also lie in focusing more on actors than on the entire system (city, urban region) or on adopting a more short-term and through the orientation on harms and risks a more normative perspective. But there are also conceptualizations which have aspects in common, especially if we look at social resilience (Pelling 2003; Chap. 5 by Widborg in this book). Within the collection of chapters here, the main focus lies on resilience, which is also the main reason why this book is published within a book series on resilience studies, and it lies also on the interrelations with transition as well as with transformation-oriented conceptual approaches.

Resilience is increasingly used and seems to become another new container term. Using the term or the concept of resilience, there are many different references made to the resilience "of what" or "of whom"; be it in academia in very different disciplines such as psychology, ecology, economics, disaster studies, geography and many more as well as multi- und interdisciplinary studies (for a collection see e.g. Wink 2016) or in the practical context of very different professions. Especially with reference to cities, it is more and more used, either in science or in practice, as show many conferences, publications or even city competitions. And even if the answer to this first question of "resilience of what or of whom" seems to be answered easily at the first glimpse within a specific academic discipline or practical profession, still, a second and deeper glance discovers many differences. Also within the reference to resilient cities and urban regions, one can find many different understandings as well as approaches, not only in other literature but also within this book. One reason behind is certainly that cities and urban regions are analyzed and tackled within that different

disciplines purposing very different research foci. Resilience in this context can be used in relation to the urban and regional technical infrastructure, to spatial structures (Birkmann and Fleischhauer 2009), to the urban society (social resilience, see also Widborg in this book), or to a systemic view of the whole city (e.g. Kumagai et al. 2010), even together with its surrounding urban region, sometimes also understood as a social-ecological system per se.

And then, one can also differentiate what is actually meant by resilience by asking "to what" resilience refers to. To put it in a black and white perspective, while acknowledging that there are many grays in between (see also the differentiation made here in Chap. 6 by Di Giovanni and Chelleri): the (disaster) resilience of cities is either used with reference to concrete or known changes (threats) such as terrorism or natural hazards (see e.g. Naumann et al. 2011; or for disaster resilience Chap. 6 here) or it deals with more general and uncertain, surprising and maybe also unknown complex change processes (for the latter see Chap. 7 by Hutter or Chap. 8 by Deppisch in this book). The grays in between can also be found within this book, as in Chap. 6 Di Giovanni and Chelleri are widening the notion of disaster resilience from the usual bouncing back mode up to a wider resilience notion with transformative characteristics.

Within pure scientific uses of the resilience term or concept, resilience is also differently used, also with different meanings, for early overviews see for example Bahadur et al. (2010) or Brand and Jax (2007). So it might be understood and used as a more analytical tool for measuring the resilience of a city or urban region and then also set in contrast to the specific vulnerability. Or it is used as a more normatively understood concept which provides guiding principles for urban and regional development as well as planning (see Chap. 8). As the study of cities as well as urban regions is a multi- as well as interdisciplinary field, there are also reports to be found which use resilience as a bridging concept between disciplines (see e.g. Beichler et al. 2014). An integrative approach focusing on living with complexity, change and uncertainty and highlighting social-ecological interdependencies is the conceptualisation of social-ecological resilience. Some authors (e.g. Walker and Salt 2012) stress the ability of a social-ecological system to adapt and transform as an important feature of social-ecological resilience, especially to deal with slow changing environmental variables. With regard to urban contexts, the concept of urban (socio-ecological) resilience finds more attention (Ernstson et al. 2010; Eraydin and Tasan-Kok 2013). But as it stands, the concept of urban resilience is not elaborated in detail yet, as the roots in urban ecology have to be overcome to conceptualize a real interdisciplinary conceptual understanding and theoretical ground, which fits the complexity of a city as a human dominated social–ecological system. Critics, however, point out to the underlying normative

undertones of this concept and that it is static in the sense of meaning to returning to the original state which is difficult to apply per se to human-dominated systems, especially if the original state is not a desirable one, like for instance a dictatorship (e.g. Davoudi 2012; Swanstrom 2008). Important to overcome diverse barriers and limited worldviews and perspectives on the system and its resilience is to adopt a cross-sectoral approach in science as well as in practice (see Chap. 3 by Galderisi and Limongi). Increasingly, there are concepts of evolutionary resilience (Davoudi et al. 2013), collaborative resilience (Goldstein 2009) or transformation oriented resilience notions (Deppisch et al. 2015; also Chap. 6 in this book) that have emerged, which try to overcome especially the critics on the static understanding of resilience. This is in order to adapt the notion of resilience to human dominated (and deliberately influenced) contexts such as cities and urban as well as spatial planning.

The latter lead us already to the third concept, or to be more precise, to a package of two interrelated concepts, to which it is referred here in this book. Olazabal states in her contribution (Chap. 4), that the notion of *transformation* does often play a role in research on urban resilience and that the *transition* as well as transformation research approaches have much in common with resilience-related approaches. This manifests itself also here, as in Chap. 10 (Scheele and Schäfer) the authors are referring to both concepts in their empirical study, or as in Chap. 9 Van Veelen distinguishes among resilience actions, transitional and transformational adaptation.

Transformation and transition are sometimes difficult to distinguish as they are often used in relation to a sustainable development in the sense of a normative reference point (Smith and Stirling 2010), especially if applied to an urban context. Transition as a conceptual approach is already around for longer (Geels and Kemp 2007) and has gained more and more attraction during almost the last two decades (Markard et al. 2012). While it referred initially to socio-technical systems, which is still a main point of reference, meanwhile, the view has broadened (Smith and Raven 2012). The transition concept shares with resilience or at least the social-ecological notion of resilience, the basis in complexity theory and the orientation on long-term developments (see also Chap. 4 in this book, where Olazabal refers to both in her conceptualization of urban transition). Some authors explicitly link in their conceptualizations of urban transformations towards long-term sustainability the transitions of socio-technical systems with concepts of urban political ecology (Romero-Lankao and Gnatz 2013). However, as far as the application of this concept stands, it provides a slightly more procedural connotation than many resilience understandings do. Being already the main point of reference of urban and urban development studies (see Chap. 11 of Klindworth

et al. in this book), concepts such as transition management (Rotmans et al. 2001) or strategic niche management point out to this governance-oriented notion and focus (for an overview see Markard et al. 2012). However, it shares, explicitly with social-ecological notions of resilience, the approach to orient on stakeholders and partly also to involve them in analysis or even to foster their engagement in sustainable community development and to leave paths taken so far.

Still, also within the context of urban and regional development studies, the concept is often used with reference to urban socio-technical systems such as energy supply or general infrastructure systems (see Chaps. 10 and 11 here). This does not come as a major surprise, as different infrastructure sectors and networks such as the transportation system, energy or water supply are decisive elements of the urban fabric and also important for the wider suburban as well as peri-urban region.

Additionally, the fundamental change of the society or of parts of the society is highlighted within this concept. This way, often reference to management as well as governance approaches is made; also in analysis of transition processes (see Klindworth et al. in this book). And that is also the bridge for leaving the realm of scientific analysis and getting over to the "real" life, predominantly in the industrialized Western world, where the cases studies within this book are located as well. There, grass root community-led transition town initiatives aiming at self-sufficiency are getting more and more attraction and awareness.

With reference to spatial planning, Roggema, Vermeend and van den Dobbelsteen (2012) understand transformation as a fundamental change of the future of a spatial system in comparison to the present and differ it herewith from transition, which they perceive as a more ongoing and fluent change towards an improved future. However, also in this paper of Roggema et al. (2012), the demarcation line between transition and transformation is very thin if we relate this to the socio-technical transition literature as the authors then describe the last transition step as transformation if it really transforms the landscape (Roggema et al. 2012, p. 2531). Schneidewind and Scheck (2012, p. 48), in contrast, perceive under transition drastic structural changes in social systems. This shows how both terms are interrelated, while it seems that the single use of the concept of transformation has emerged more recently. So far there have been general studies focusing on conceptualizing within research on how to deal with climate change (O'Brien 2011) and identifying community-led transformations empirically (Seyfang and Haxeltine 2012).

1.3 Overview on the Chapters

Within this book, a variety of resilience as well as transition and transformation related concepts are used or it is referred to all three, two chapters explicitly refer to vulnerability assessments. All book chapters relate their work to resilience; however, their notion of resilience can differ. The majority is focusing on resilience, while as mainly the chapters at the end of this book are focusing more on transformation and transition.

The book brings together international experts and researchers with different disciplinary perspectives. Also, inter- and transdisciplinary research results, which share an urban as well as urban regional focus, are presented. It focuses mainly on European urban regions and contains empirically based contributions from European, Northern American as well as Australian urban regions. Also, some chapters concentrate more on theoretical discussions on the different conceptual approaches and terms and their application to urban and regional topics.

Generally speaking, the contributions deal with two overarching challenges. One the one hand, the manuscripts demonstrate a number of different impacts that cities and urban regions are facing when confronted with change. They discuss how change manifests itself in an urban context, how it can be dealt with challenges, which arise from past, ongoing and future change processes in urban and regional development as well as planning and what transformations are necessary in order to deal with these challenges or how a transition towards more sustainable cities and regions could take place. Based on several case studies, there are also current practices in decision-making processes about dealing with change presented and what experiences can be derived from these on-going practices.

In the subsequent chapter *Eleni A. Athanasiadou* and *Maria Tratsela* show how change manifests itself in a suburban context and how it can be understood and interpreted. They refer to urban resilience and focus on the suburban landscape, which they consider as the "critical meeting place" of the "dipole man and nature", characterized by high spatial heterogeneity as well as tensions. Starting from the premise that change is reflected in form, the authors claim the importance of being able to read the spatial forms of urban as well as suburban landscapes. They analyze how the monitoring of spatial patterns can help to read these patterns and to understand how a landscape at hand has eventually transformed as a response to social, environmental and economic change processes within a specified period. As empirical case, the suburban landscape east of Thessaloniki (Greece) is monitored and analyzed with the support of Geographical Information Systems. Within an observation period of more than sixty years, the landscape highly transformed due

to heavy urbanization processes from former agricultural land into urban fabric. Through not dichotomizing between natural and man-made elements, but instead through providing units which provide both within the presented land cover categorization, outcomes of such studies can also provide further insights for planners and decision-makers of urban regions on how to deal with change as well as to open up new possibilities on strengthening resilient developments.

Adriana Galderisi and *Giada Limongi* refer to the, also interdependent, challenges and vulnerabilities cities are faced with. They state that it is important to acquire, present as well as analyze knowledge in a comprehensive as well as holistic manner in order to build and manage resilient urban systems. They doubt that this can be achieved in following-up with the so far usual mode of generating and analyzing knowledge by fragmented sectors and their respective diverse and limited approaches, which are also neglecting the interdependencies of cities with their environment. These fragmented approaches are hindering a deeper analysis of the current situation as well as a comprehensive assessment of social and ecological interdependencies. The authors consider the latter as essential to prevent risks and manage the challenges many cities face. At the same time, they claim that it will be necessary to build resilient urban systems due to increased and deepened uncertainty caused by ongoing change processes such as climate change, growing urban population or natural depletion, which are impacting the already complex cities. They propose as a starting point for challenging the current modes of knowledge management through building an integrative knowledge base, by integrating information through GIS-software. That way a first step would be taken to understand the challenges cities are faced with currently. The chapter focusses on the of metropolitan area of Naples (Italy) as a case study and shows along references to different change processes which problems can occur through integrating fragmented and sector-oriented knowledge and highlights advantages which can arise through using GIS to build an integrative as well as dynamic knowledge base. With that integrated knowledge at hand, urban decision-makers are in a better position in order to understand social-ecological dynamics more comprehensively as well as to support cross-sectoral strategies for resilient urban developments.

Marta Olazabal states that an "operative approach to urban resilience" is lacking in the current state of art, while as further related concepts and notions such as transformation and sustainability are in play, too. In this book chapter the author starts with a complexity perspective on urban shaped areas and characterizes these urban areas as social-ecological, complex and adaptive systems (CAS), which are difficult to define. Olazbal identifies the connections between the three central concepts resilience, sustainability and transformation within the context of urban

areas. She develops a new and so-called "umbrella concept" of "Sustainable Urban Transformation" and within this, the specific understanding of "Urban Resilient Sustainability Transition". This is done in order to fill the gap of the before stated lacking conceptual framework, especially with reference to the transformability of cities towards sustainable development. This can be used as a new approach to further operationalizing urban social ecological resilience as well as transition pathways of urban areas. The chapter brings these results also to the practice of urban decision-making and identifies three main challenges these management and planning practices are confronted with while managing the transition process towards urban sustainability.

Anna Widborg explicitly refers to social urban resilience. Her chapter illustrates that the notion of urban resilience in practical urban planning and urban policy is still focusing on environmental change aspects. Meanwhile, aspects of social change are addressed to a lesser extent in planning for urban resilience. She demonstrates her findings along the analysis of five urban case studies in different geographical and planning contexts as well as thematic settings. The five cases are cities from the US, Australia, the United Kingdom and Sweden. Widborg develops an analytical matrix which allows comparing the single case study results alongside many different aspects relevant to urban resilience. What can be found is a great variety of approaches and measures within the cities as well as some common features. The author demonstrates that the in every case used notion of resilience—be it more with reference to environmental change or with reference to social change—is depending on which change processes and their impacts are dominantly perceived in specific locations. Also, this chapter shows the benefits of already further developed and more concise urban resilience notions which are related to environmental (or climate) change. In practical urban planning and policy of the cases under investigation, social issues are more discussed in context with the "social sustainability" discourse and less with reference to "social urban resilience", as the author shows. This gap between discourses can be bridged by specific measures and tools, as it is already applied in one of the cases.

Gracia Di Giovanni and *Lorenzo Chelleri* refer to disaster resilience. In their chapter they analyze reconstruction plans which were elaborated after the earthquake in the Abruzzo region (Italy), which took place in 2009. These plans were generated to reconstruct the main city of the region, L'Aquila, and further minor centers. The time reference for their analysis is six years after the disaster took place. In their analysis the authors refer mainly to one of the key challenges of disaster resilience, namely to what extends future socio-economic development trajectories can be pursued in a unified manner together with the reconstruction of the built environment whilst undergoing demographic change. The post-disaster

recovery planning and related governance as well as social processes are described in detail and related to the socio-economic situation before the destructive earthquake happened. The authors show that even if it was wished and intended by inhabitants and planners of the region, the aim of disaster resilience to merge short-term rebuilding aims with longer-term and mainly socio-economic recovery strategies to reach local and regional sustainability was not really reached. Instead and especially thanks to the national funds allocation as well as to legislative frameworks as well as further socio-institutional context conditions, restructuring (mainly private) buildings was the main focus. Also, transformative and more long-term notions or aims of the local plans were also weakened by this focus and the framework conditions, so that finally the challenge of merging reconstruction and socio-economic development was not solved within the cases, but further exists.

Gerárd Hutter is stating in his chapter, that even if it is dealt with future developments in urban as well as regional development and planning, planning research does not tackle explicitly surprise. According to the author, the so far given resilience research on urban development and planning is only implicitly dealing with surprise. Therefore, he suggests a planning research agenda which includes preparation for surprises, not only in conceptual approaches, but also in empirical studies as wells as in endeavors to synthesize both. And for the time being, his chapter already provides a contribution to two of these new tasks for planning research on the future developments of cities undergoing change. It entails a conceptual approach to surprise by defining it further and by providing conceptual ideas on how to prepare for surprise in urban development. And it also includes two empirical examples within the City of Dresden (Germany), one is within the context of natural hazards (floods) and the other example shows how urban planners of Dresden are not dealing with surprise in the context of uncertain demographic developments.

Sonja Deppisch tackles in her chapter mainly the question if a resilience notion can be used as a leitmotif for spatial planning dealing with land-use development. More specifically, she relates resilience thinking to urban and regional planning within the context of strategies to deal with climate change impacts in coastal urban regions and the consequent challenges posed to planning. In her chapter the notion of resilience thinking is based on an emphasis on complexity and learning to live with change, adopting a perspective of social and ecological interdependencies and questioning paths already taken and taking into account potential transformations. The author considers this understanding as useful for tackling the challenges future climate change impacts pose on current decisions on urban land use. Potential gains as well as trade-offs that could occur by applying this resilience perspective

as a leitmotif within spatial planning are discussed and related to the challenges climate change places on to planning. The conceptual reflections are illustrated with empirical examples of the San Francisco Bay Area (United States), of Stockholm (Sweden) and Rostock (Germany).

Peter C. van Veelen presents two cases of potential adaptation to climate change impacts in order to develop resilient urban waterfronts in Rotterdam (The Netherlands) and New York (United States), which are flood-prone. He concentrates on the question how urban change and development dynamics can be used to facilitate resilient urban waterfront developments and how these urban change, renewal and transition processes can be used effectively to reach transformations. Based on incremental and on transformative adaptation pathways, the author introduces the adaptation pathway method consisting of ten steps in order to get ready to implement a transformative strategy. According to that understanding he presents adaptation options and intervention points as well as opportunities to improve or change building rules. To be able to do so, the author identified all planned investments in the case study areas as well as expected long-term changes. As the findings show, necessary and challenging retrofitting of buildings to reach flood resilient urban waterfronts in the cases would require a longer-term perspective while as then, still, the vulnerability of the involved sewage as well as electrical infrastructure would not inevitably be reduced. And a large-scale integrated protection against floods and storm surges for the whole areas would require large-scale transformations of the urban waterfronts, which could be realizable theoretically if all opportunities generated by change processes were used and preconditions of implementation in urban planning and decision-making processes changed.

Ernst Schäfer and *Ulrich Scheele* deal in their chapter with an issue which is very relevant to resilient urban development: they focus on challenges posed to infrastructure evoked by the uncertainty of especially climate change and also further change processes as well as on barriers towards the transformation of infrastructure. The authors relate to the transition concept to overcome lock-ins and path dependencies of infrastructure development to transform the given infrastructure according to resilience principles. With reference to climate change, infrastructure planning and development find themselves in a tricky situation as with infrastructure are related both, climate change mitigation as well as adaptation purposes. Together with the uncertainty of future developments, with differing short- and long-term interests of stakeholder as well as with external and internal interdependencies of infrastructure systems, infrastructure planning and development become complex challenges. As a way to tackle these challenges and also in order to take into account the locally specific situations, the authors propose to

perform real life experiments through so-called living labs to foster innovation and transformation processes. In their chapter they are not only presenting the conceptual framework for those transdisciplinary living labs, but also the first practical experiences of implementing such a living lab in the Dutch-German border region, which included different municipalities at the border.

In the final chapter, *Katharina Klindworth*, *Aleksandra Djurasovic*, *Jörg Knieling* and *Katja Säwert* refer to climate change as well as peak oil as important change processes which ask for transformations of urban regions as focal points of human population as well as economic activities. The authors relate mainly to transition management as their main conceptual frame. By following a transformative approach towards a sustainable urban development, it is dealt with the question on how structures of governance, urban planning and development should be altered, changed or transformed to deal with change in a resilient manner and to increase sustainability. They focus on the energy sector and present the results of four case studies on European cities, which are Dobrich (Bulgaria), Modena (Italy), Munich (Germany) and Odense (Denmark). In these cases, the roles as well as activities and influences of local actors on urban energy transition processes as well as further governance structures were identified. Finally, these empirical findings are judged against the question to what extent the identified governance practices are meeting the characteristics and challenges of transition management. Here, the authors differentiate between strategic, tactical and operational transition management activities. They identified these activities following a comparative analysis of the four cases, where they spotted strengths and weaknesses of the cases within the different transition management activities.

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The Role of Monitoring Spatio-Temporal Change in Achieving Resilience of the Suburban Landscape

2

Eleni A. Athanasiadou and Maria Tratsela

Abstract

A city is a constructed landscape which epitomizes human intelligence and creativity, depicts social, cultural and economic development and still remains the most favorable and important habitat for the human species. Cities continue to grow, yet covering only about 3% of the earth's surface, causing major negative impacts to the environment such as the natural resources depletion, carbon emissions, pollution of ground water, etc. A resilient city is a flexible, adaptable to change organism which comes in a form of equilibrium to meet quality criteria of living. Change is always reflected in form. The hypothesis of this study is whether monitoring of spatio-temporal landscape change is an important method in examining landscape resilience. It focuses mainly on the notions of transformation, time and process using the principles of landscape ecology, in order to capture the way a landscape may respond to environmental, social and economic change. A relative research presented hereby was conducted between 2010 and 2012 and included the study of the spatio-temporal change in the suburban landscape east of the city of Thessaloniki, an area of approximately 10 K hectares. Results demonstrated change in LULC patterns of thirteen

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(13) different land use/cover types and the transformation of a once arable agricultural landscape into a suburban landscape with mixed residential and agricultural uses. Socio-economic and ecological factors influenced this drastic change in structure and function of the landscape in study. The study concludes that monitoring spatio-temporal landscape change contributes in examining the potentially of a landscape towards resilience.

2.1 Introduction

The 21st century has brought immense alterations on the socio-economic structures of mankind which are depicted onto the landscape causing a high degree of complexity and heterogeneity of the urban and the rural environment. More important though, is the pace of change and transition from one status to another, where the rate and speed of change is constantly increasing due to the rapid development of technology and globalization. Among the landscape impacts is the coexistence of incompatible and sometimes conflicting with each other features in terms of structure, function and perception. This simultaneity of incompatible features in space and time is a major challenge for designers and planners in order to bring the human environment again into a balance and moreover, insure the preservation of this balance into the future according to the imperatives of sustainability.

Nowadays in particular, these landscapes, urban or suburban, appear to be vulnerable systems that struggle to survive and develop through chronic stresses or acute shocks. The latter vary from natural phenomena (e.g. floods or earthquakes) to social and economic such as poverty or urgent need for refugee accommodation.

In the last decades, the concepts of "sustainability" and "resilience", both coming from the field of ecology, seem to prevail in most attempts aiming at the protection of anthropogenic environments and the wellbeing of man. Within the meaning of sustainability lay the concepts of 'balance', 'internal balance', 'prosperity', 'wealth', and the belief that the world could be a better place if humanity is to address major environmental problems and social issues by adopting strategies towards a more 'ethical' economic development.

The concept of resilience has two main variants (Perrings 1998): the first takes into consideration '*the amount of disturbance that can be absorbed before a system flips from one state to the other*' (Holling 1973) and the second takes into consideration '*the time that takes a disturbed system to return to its initial state*'

(Pimm 1984). Since Alberti's et al. (2003) first definition on urban resilience, where resilience was defined as '*the degree to which cities tolerate alteration before reorganizing around a new set of structures and processes*', within a decade, 25 more definitions were given by various academics and practitioners (Meerow et al. 2016) and after Meerow's et al. reviewing, a new one was compiled: '*Urban resilience refers to the ability of an urban system and all its constituent - socio-ecological and socio-technical networks across temporal and spatial scales - to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity*'.

"Resilient cities" and "resilient landscapes" are in the center of discussion nowadays. Regardless of its exact definition, the term 'resilience' seems to act as a positive social connotation, a common ground for discussion, seeking for solutions to common problems to all cities.[1] The term resilience focuses on the fact that cities are vulnerable to internal and external disturbances, yet at the same time possess mechanisms of auto-perseverance, auto-correction and auto-management. Thus, a resilient city is a flexible, easily transformed 'organism' which comes in a form of equilibrium to satisfactorily meet quality criteria of living.

[1]Urban projects under the resilience platform like 'TURAS' (Transitioning towards Urban Resilience and Sustainability) and '100 Resilient Cities' recognize common threats in cities and via a creation of a network, information is circulated and cities can learn from each other. In 100 Resilient Cities the capacity to strengthen the city's living conditions explores not only the physical vulnerability of some cities i.e. New Orleans' and Byblos' exposure to hurricane, typhoon, cyclone, but also social problems like inequity, which is apparent in Medellín, Colombia. For 100 Resilient Cities, 36 'resilient challenges' were identified. These are: aging infrastructure, chronic energy shortages, declining of aging population, depletion of natural resources, disease outbreak, drought, earthquake, economic shifts, endemic crime and violence, epidemic of drugs and alcohol abuse, flooding (coastal and rainfall), food shortage, hazardous materials accident, heat wave, high unemployment, hurricane, typhoon, cyclone, infrastructure failure, insufficient educational infrastructure, intractable homelessness, lack of affordable housing, landslide, overpopulation, pollution or environmental degradation, poor health infrastructure, poor transportation system, rapid growth, refugees, resource scarcity, riot or civil unrest, rising sea level and coastal erosion, social inequity, terrorism, tropical storms, tsunami, volcanic activity and wildfires. In TURAS, the challenge is focused in the acknowledgement that '*Many urban areas are vulnerable to gradual environmental change and many city dwellers are concerned with the impacts of rapid or unregulated land use change, environmental health and human well-being*' (http://www.turas-cities.org/challenges).

Megginson's commenting on the Darwinian Theory[2] considers change as the basic law of nature which affects individuals and institutions in different ways. According to his commenting, it is not the most intellectual of the species that survives, or the strongest. It is the one that is able to best adapt and adjust to the changing environment in which it finds itself. Applying this to the human communities Megginson (1963) suggests that the civilization which is able to survive is the one that "*is able to adapt to the changing physical, social, political, moral, and spiritual environment in which it finds itself*".

Nowadays, the notion of change is in the center of the scientific interest as concerns contemporary society and the urban or suburban environment. Lister (2015) considers change as an integral and crucial part of sustainability, or even an evolutionary state of the latter, and resilience as the new transformation of sustainability.[3]

Change is always reflected in form. In the case of the urban and suburban landscape, being able to read its form/spatial character, and monitoring change may form the first step among others in recognizing how a city functions.

Within this scope, the paper examines the advantages of monitoring the spatial pattern of a specific landscape within a certain period of time, in order to capture the way, the specific landscape has responded to any environmental, social and economic change which has occurred through the specific period. This would allow the recording of different kind of transformation and the way the different landscape features, such as land uses, spatial features, hydrology, geology, natural resources, landform, ecosystem, biodiversity, perception and aesthetics, have been affected, degraded or upgraded, diminished or increased, or simply transformed into something new. This recording, aims at evaluating the positive or negative impacts of change onto the landscape.

Monitoring the performance of a landscape through time is based on the idea that landscape is a space-time entity that needs to be dealt with as a dynamic system which is under continuous transformation, and thus any new balance should be dynamic as well. The temporal character of the landscape has always been taken

[2]Leon C. Megginson, a Louisiana State University business professor gave a speech at the convention of the Southwestern Social Science Association in 1963 where he presented his own idiosyncratic interpretation of the central idea outlined in Darwin's 'On the Origin of Species', yet as in many cases, it is believed that over time Megginson's remarks were streamlined and reassigned directly to Charles Darwin. Source: http://quoteinvestigator.com/2014/05/04/adapt/.

[3]She entitles here article in Topos Magazine 90, 'Resilience: Designing the New Sustainability'. (https://www.toposmagazine.com/topos-90-resilient-cities-and-landscapes/#!/foto-post-1219-3).

into consideration in landscape studies, beginning with the study of natural phenomena, such as the weather or the daily cycle, which cause linear and cyclical transformations on the landscape. With the introduction of the issue of historicity, a third type of temporality was added due to the simultaneity of the past, present and future when meeting in a specific place, within a specific moment in time. This spiral transformation of the landscape (Tratsela 2011) is a kind of temporal change particularly interesting when monitoring the performance of a landscape in time. Therefore, time, temporality and process are notions of significant importance as some of the basic factors in the whole research.

For that matter, landscape ecology, an environmental science which highly relates to the spatial factor, time and change is considered a valuable tool, as it offers useful concepts for the study of the landscape impacts through time. Landscape Ecology distinguishes itself from mainstream Ecology due to the study of five intertwined parameters: landscape, man, space, scale and time (Forman and Godron 1986; Forman 1995; Naveh and Lieberman 1990; Naveh 2007) and it focuses on the reciprocal interactions between spatial pattern and ecological processes (Rodiek 2004). Landscape spatial patterns and their 'translation' via Land Use Land Cover (LULC) constitute a common language between landscape ecologists, landscape architects and planners. According to landscape ecology, like all autonomous entities and living systems, a plant cell or a human body, landscape is characterized by structure, function and change (Duchateau and Eurostat 2002; Dramstad et al. 1996; Forman and Godron 1986; Forman 1995). Besides, according to Corner (2004): "*more important than what the landscapes are, is what they do, how they function and how they change*".

A city is a constructed landscape which epitomizes human intelligence and creativity, depicts socio-culture and economic development and still remains the most favorable and important habitat for the human species. Cities continue to grow, yet covering only about 3% of the earth's surface, causing major negative impacts to the environment such as the natural resources depletion, carbon emissions, pollution of ground water, etc. Considering urbanization as the most drastic form of land use change which affects biodiversity and ecosystem functioning far beyond the limit of cities, Wu et al. (2011) explains the importance of the quantification of spatiotemporal patterns of urbanization in order to comprehend the process of its development and the ecological consequences.

In this paper, the suburban landscape is not considered simply as an intermediate space between the dipole man and nature, a transitional zone between or in reference to a city; it is considered the critical meeting place of the two. The suburban landscape is in reference both with the nearby city and the semi-natural and agricultural canvas it lays upon. Multiple natural and anthropogenic elements

combined with each other create multiple land uses and land-cover types of familiar or new typology, forming a spatial matrix of high heterogeneity. It is a ground of high tension among species and interests,[4] a semi-natural, semi-urban landscape exhibiting higher diversity in elements, functions and processes, mobility and competition.[5] In an attempt to find terminology from the biological sciences to describe the suburban landscape, the term "ecotone"[6] is used. Due to the tendency of the latter for increased variety and diversity as a community junction (Odum 1971), known as the edge effect, ecotones are more prone to disturbance than the two main/core habitats. Higher disturbance triggers mechanisms to deal with upcoming change, thus aiding resilience. If the suburban landscape is considered an ecotone, an edge zone, could it be more resilient as well?

2.2 Materials and Methods

In order to study the past, evaluate the present and plan for the future, spatio-temporal analysis has been involved in studies of urban and suburban landscape change (Antrop 2001; Antrop and van Eetvelde 2000; Botequilha Leitão and Ahern 2002; Botequilha Leitao et al. 2006; Kong and Nakagoshi 2006; Başkent and Kadioğullari 2007; Anguilera et al. 2011; Pham et al. 2011; Athanasiadou 2012). The suburban landscape east of the city of Thessaloniki is subject to continuous transformations, with far-reaching repercussions to the

[4]Resources which cause species to compete in the suburban landscape are land, water, energy and others.

[5]Competition as a law of nature is defined as the interaction between two organisms which occurs in their attempt to possess/attain a resource which is important for both species, this resource is either abundant or rare, yet in the attempt of having it or using it, the one species effects unfavorably the other one (Birch 1957; Krebs 1972 in Gerakis 1975).

[6]An ecotone is a transition area between two biomes, it is where two communities meet and integrate. An ecotone may appear on the ground as a gradual blending of the two communities across a broad area, or it may manifest itself as a sharp boundary line. The word ecotone was coined from the two word *eco* and *tone*, from the greek tonos or tension. McCay (2000) has discussed the diverse and productive nature of edges, proposing that the edge effect may be used as a metaphor for the bringing together of people, ideas and institutions. Turner et al. (2003) suggests that 'cultural edges', rather than being border zones between discrete social entities, are zones of social interaction, cross-fertilization, and synergy wherein people not only exchange material goods but also learn from one another and support that '*key to the maintenance of resilience is the presence of diversity, which, as we will argue, is often found to be at its greatest in ecological and cultural edge situations'*.

#	X	Y
0	409341.978	4496206.813
1	420805.763	4496160.332
2	420965.222	4484498.727
3	414494.162	4484477.339
4	414494.162	4485641.508
5	412821.992	4487345.428
6	412813.319	4489623.967
7	409360.394	4489628.755

Fig. 2.1 The landscape in study. Geographical coordinates (*Source* by authors)

economic and social geography, as well as the identity of the landscape. Initially the landscape's boundaries were set as shown in Fig. 2.1. The total area of the landscape is 100.222.069 square meters = 10.022 ha. Spatial data of two chronological periods were selected for monitoring landscape change. On line access of georeferenced (in Greek Grid) digitized aerial orthophotographs of the area in 1945 and 2007–2009 were provided by KTIMATOLOGIO A.S. 1 m spatial resolution for the map of 1945 and 20 cm for urban areas and 50 cm for the rest of the areas for the map of 2007–2009 were used.

Thirteen (13) LULC land use/land cover types, or 'classes' according to landscape ecology principles and G.I.S., were classified and are presented below[7] (Athanasiadou 2012):

1. *Continuous urban fabric*. Most of the land is covered by buildings, roads and artificial surfaces cover almost all the ground. Non-linear areas of vegetation

[7]Types 1, 2, 3, 6, 9, 10 and 13 appear in CORINE land cover. Type 11 is a combination of CORINE land cover 3.2 and 3.3 categories and type 12 of various categories. Types 4, 5, 7, 8 and 12 are unique to this study.

and bare soil are exceptional. This type is selected in many studies for the study of spatial expansion, urban sprawl, urban and suburban landscapes.

2. *Discontinuous urban fabric*. Most of the land is covered by anthropogenic structures. Buildings, roads and artificial surfaces associated with vegetated areas and bare soil, occupy discontinuous, but significant in size, surfaces. This type is selected in many studies for spatial expansion, urban sprawl, urban and suburban landscapes.
3. *Road and rail networks*. This type includes mobility networks, mainly motorways and railways and is selected due to its direct role in urban sprawl development and habitat fragmentation.
4. *House/buildings with outdoor vegetated or bare ground space*. This type includes (a) houses/single homes residences/buildings solitary or in clusters accompanied with gardens, vegetation or bare soil and (b) buildings accompanied with 'free' space (bare soil or vegetation of some kind more than 50% of the total unit. Informal field research, in the form of perception of the landscape with the aid of observation and photography led to the inclusion of this type of LULC, which exists in the suburban area east of the city of Thessaloniki and is considered typical to other Greek suburban landscapes.
5. *House with olive/fruit grove*. One private house with olive grove or other fruit trees. This type also originates from, preliminary to categorizing types, informal field research and it is distinctive of this landscape and many other Mediterranean landscapes.
6. *Arable land*. This category includes cultivated areas with arable crops, annual and perennial crops, which could also be used as grazing fields. Changes in agricultural land are very important for the state of a given landscape. Furthermore, this category appears to be the major non-built land use for the landscape in question back in 1945.
7. *Arable land with trees*. Cultivated areas with arable crops, annual and perennial crops in combination with trees and other atypical vegetation, a form of mixed cropping, typical to the Mediterranean region.
8. *Agricultural/Fruit trees*. Olives and other fruit tree species. This type of land cover appears repeatedly in the Mediterranean where trees are in a typical planting manner to assist agricultural management techniques.
9. *Vines*. This type is selected due to its extensive appearance in the landscape back in 1945.
10. *Forests*. An area covered with forest trees which adds to >80% of the total unit.
11. *Mixed forest/semi-natural areas*. Vegetation composed principally of trees, including shrub and bush understories, where broadleaved and coniferous

species co-dominate. Garrigue and maquis may be present. In this type open spaces—parks and gardens are included. This type appears repeatedly in suburban mediterranean landscapes, an easily distinguishable transitional land use between natural, agricultural and semi-urban areas.

12. *Open spaces/fallow land*. This type includes open ground, bare soil, fallow land and rocky formations. Fallow land and fields that are not cultivated, although they are characterized as agricultural land are very common in suburban Mediterranean landscapes. Additionally, open ground is also very common. These spaces are very important for future planning procedures.
13. *Water bodies*. Rivers, swales, canals, lakes and wetlands. Monitoring changes in water body formations in this landscape is very important. Thessaloniki's suburban landscape use to hold in the past numerous rivers which have been mostly lost due to urbanization processes.

Visual photo-interpretation of the aerial orthophotographs using a minimum mapable unit (MMU) of 60 m^2 was applied using ArcGIS 10, a GIS package of ESRI (Environmental Systems Research Institute, Inc.). Subsequent digitalization created vector shapefile features in feature classes and all were saved into a geodatabase. The advantages of using geodatabases is that through the attribute table various geometrical and arithmetical calculations are possible. The product of digitalization was two digital maps classified in terms for the 13 land cover categories described above. Check of any mistakes in digitalization was able through the aid of the command 'topology' using two rules: (a) must not have gaps, (b) must not overlap (ArcGIS, ArcToolbox → Data Management Tools → Topology → Create Topology). The creation of a digital elevation system DEM was created through the aid of Globar Maper version 12,000 (64-bit)•a shapefile was added to ArcGIS 10 and the DEM.[8]

2.3 Results

Results show high degree of transformation of the landscape during 64 years occurring from 1945 to 2009. Figure 2.2 shows the landscape east of the city of Thessaloniki back in 1945, a rural-agricultural area with urban development still being at its initial stages. In the years followed, urbanization occurred and subsequent conversion of agricultural land and open space into urban fabric took

[8]Or more actually a Triangular Irregual Network-TIN was superimposed on top of the maps (ArcToolBox → 3d Analyst Tools → Tin management → Create Tin).

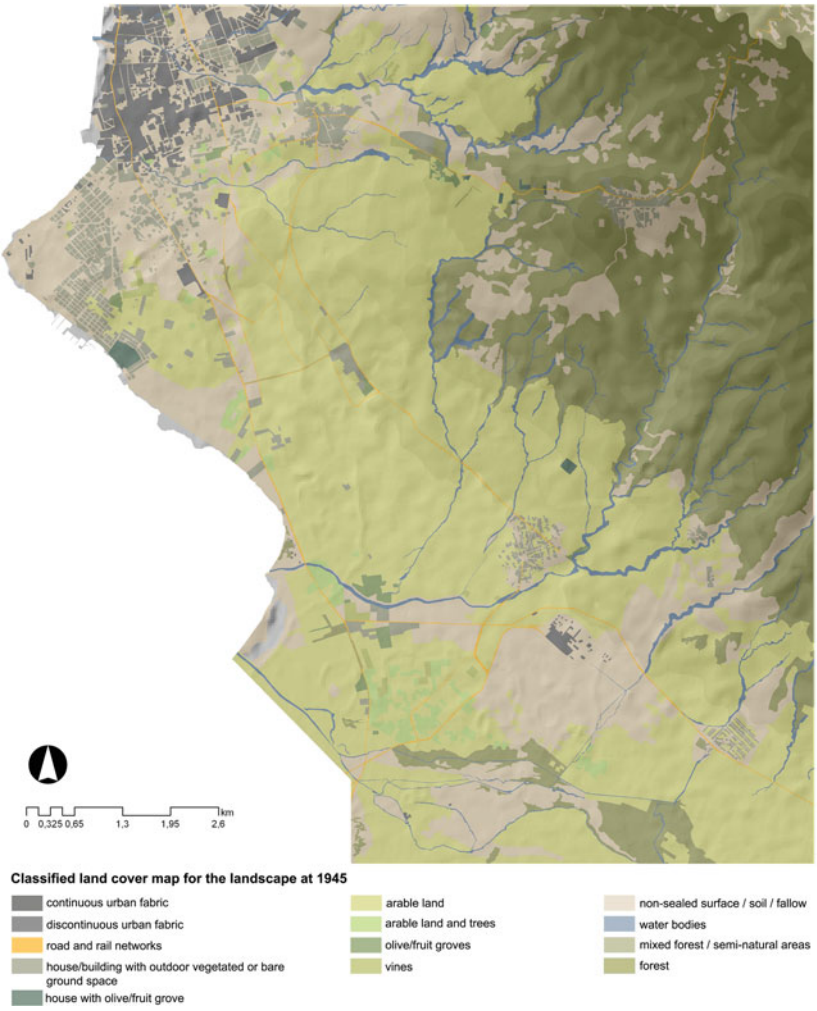

Fig. 2.2 The landscape at 1945 (*Source* by authors)

place, as it is demonstrated in Fig. 2.3. Landscape type diversity is evident both in 1945 and 2007–2009, yet landscape pattern structure (composition of patches) and configuration (proportion of different patches) is highly altered, thus presenting both spatial and temporal heterogeneity. Spatial distribution of land cover for the

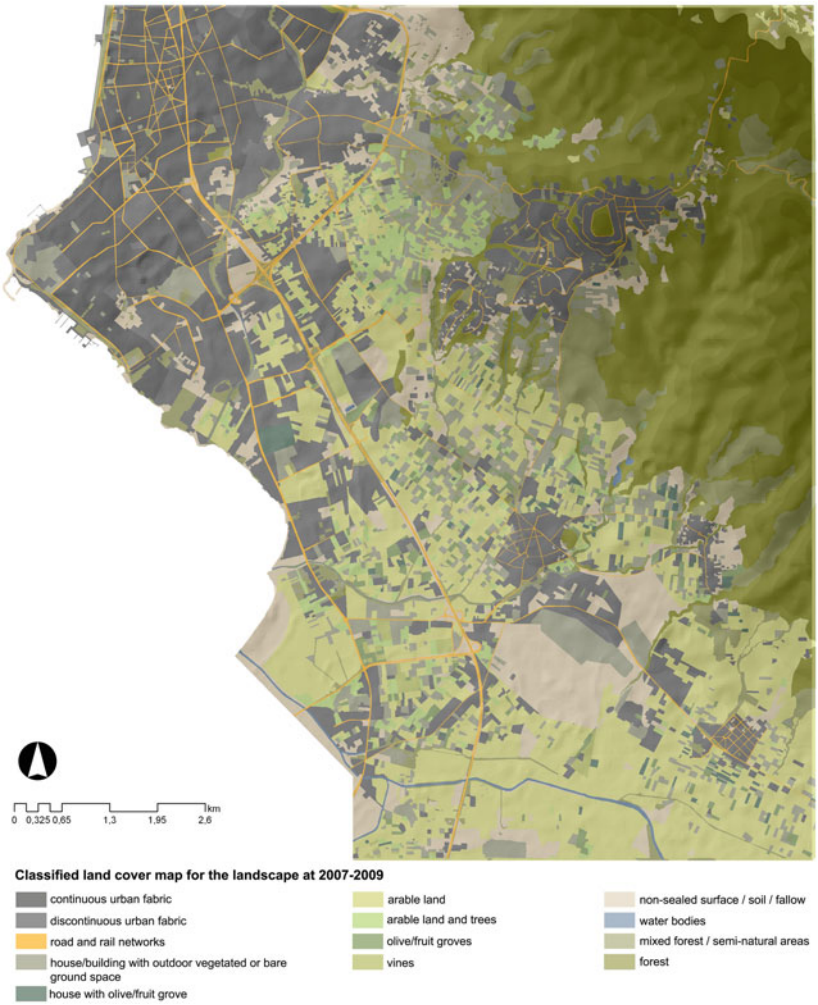

Fig. 2.3 The landscape at 2007–2009 (*Source* by authors)

landscape in 1945 and 2007–2009 is exhibited in Figs. 2.2 and 2.3 respectively. In the landscape of 1945, built-up areas are limited and there are vast open areas which are either cultivated or left bare. Numerous streams intersect the landscape. Land use cover categories appear in clusters with a low fragmentation degree.

Furthermore, clusters of certain types are spatially situated at certain areas• built up areas in the east, arable crops and trees centrally, and mixed forest/semi-natural areas north-east. After 64 years, the landscape has been transformed radically presenting a more scattered and unorganized character, a multi-use mosaic. Urban sprawl is evident, 'endowing' the landscape with a more geometrical form. The big agricultural cluster, dominating the landscape in 1945 is divided and non-continuous urban fabric is added. Continuity of land cover types is disrupted and all types appear highly fragmented in the landscape of 2007–2009. The quantification of LCLU change for all 13 categories is presented in Table 2.1 and reveals the unique spatial signature of each land cover type in the different years.

A comparison of data from the two chronological periods indicates a significant overall increase in the landscape of all elements related to urbanity. 'Continuous urban fabric' which was not apparent at all back in 1945 amounts 771.58 ha. 'Discontinuous urban fabric' and 'road and rail networks' increased by 557.68 and 278.57% respectively during the two chronological intervals. There is also been a substantial increase of a somewhat distinct land cover uses of the suburban Mediterranean, 'houses/buildings with outdoor vegetated or bare ground' (156.49%) and 'houses with olive/fruit grove' (315.96%). Despite the expected

Table 2.1 Quantification of LCLU change for the landscape in study at 1945 and 2007–2009 (Source by authors)

Types/classes	1945	2007–2009	Increase/decrease (ha)	
Continuous urban fabric	0	771.58	↑ 771.58	
Discontinuous urban fabric	252.25	1659	↑ 1406.75	557.68%
Road and rail networks	69.26	262.2	↑ 192.94	278.57%
House/buildings with outdoor vegetated or bare ground space	318.18	816.11	↑ 491.93	156.49%
House with olive/fruit grove	15.98	66.36	↑ 50.38	315.96%
Arable land	3970	2027.85	↓ −1942.15	−48.92%
Arable land with trees	110.32	265.08	↓154.76	140.28%
Agricultural trees	43.13	155.59	112.46	260.74%
Vines	35.62	44.83	↓ 9.21	28.85%
Forests	0	2225.33	↓ 2225.33	
Mixed forest/semi-natural areas	2580	721.87	↓ 1858.13	−250.40%
Open spaces/fallow land	2206.57	965.46	↓ 1241.11	−128.55%
Water bodies	275.33	40.78	↓ 575.15	−675.15%
Total landscape area 10.022 ha				

result of decrease of more or less 'natural' elements like agricultural land, forests and water bodies, which is apparent in many urban sprawl studies, the analysis reveals some surprising results: although there is a dramatic decrease in water bodies (675.12%), a new suburban forest appears[9] (2225.33 ha) and despite the decrease in arable land in almost half (−48.92%), there is an increase of multi-cultures like 'arable land with trees' (140.28%) and 'olive/fruit groves' (260.74%). Thus, new mixed forms of agriculture in the suburban landscape indicate that suburban agriculture possess a unique character, which is very different from the extensive monocultures of arable crops more apparent in main Greek agricultural areas e.g. Thessalia. Furthermore, this small scale of plots and the appearance of agricultural landscape elements is important for the biodiversity as a whole. The introduction of trees either with the form of a forested area or through agricultural practices is evident for the landscape in question. Yet, there has been an overall increase of all urban growth patterns occupying 35.5% of the total landscape.[10]

Land cover changes in urban growth patterns (Figs. 2.4, 2.5 and 2.6). Of the four distinct urban growth patterns of the suburban landscape in study, urban sprawl patterns such as continuous and discontinuous urban fabric, road and rail networks accelerated, occupying 27.8% of the total landscape. Yet there has been an increase in other, distinct for suburban Mediterranean landscapes, residential forms• house/buildings with outdoor vegetated or bare ground and detached houses with olive/fruit groves increased 156.49 and 315.96% respectively, nominating very distinctive uses of space in suburbia.

Land cover changes in agricultural patterns (Figs. 2.7, 2.8 and 2.9). Over 64 years the agricultural landscape has been radically transformed. Arable land has decreased by half, yet 'arable land with trees' has increased by 140.28% and trees in the form of olive/fruit groves by an impressive 260.74%. Finally, viticulture has roughly maintained the same coverage. Overall, there has been a shift from arable monocultures and big homogenous patches of land, to mixed cropping/multiple cropping and smaller heterogeneous patches. Fragmentation of farms in the urban fringe is very common, and the spatial pattern is affected both by urban sprawl and

[9]The suburban forest of 'Seih-Sou' was planted in the 1930s with pines. During digitalization, in the landscape of 1945 these planted areas fell under the category 'mixed forest, semi-natural areas'.

[10]Values for individual urban growth forms in 2007–2009 are: 'continuous urban fabric' = 7,7%, 'discontinuous urban fabric' 16.5%, 'road and rail networks' 2.6%, 'house/buildings with outdoor vegetated or bare ground' 8.1%, 'houses with olive/fruit groves' 0.65%.

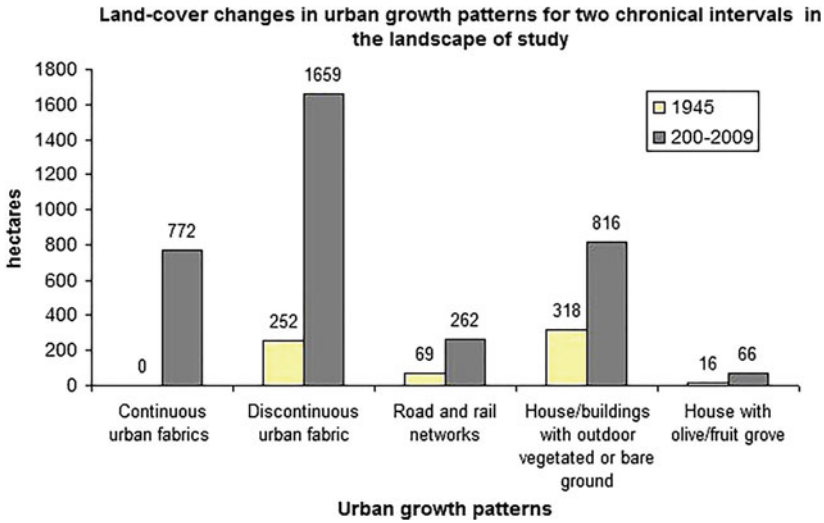

Fig. 2.4 Land-cover changes in urban growth patterns for two intervals in the landscape of study (*Source* by authors)

management techniques. Fragmentation of agricultural land is generally seen as a negative consequence of urban sprawl, yet the landscape in study appears more diversified with many more trees and cropping systems which signals the uprising of multiple forms of suburban farming and diversity of managing systems.

Land cover changes in natural elements patterns (Figs. 2.10, 2.11 and 2.12). Newly planted seedlings back in the 1930s grew to fully mature pine trees, justifying the decrease of mixed forest/semi natural areas and the uprising of a substantial 2.225 ha suburban forest. Throughout 1945–2007/09 open space/fallow spaces have been reduced to more than half and water bodies have experienced a severe loss of coverage (−675.15%).

2.4 Discussion

Monitoring space transformation through time, and in particular the interactions between the continuously changing social structures and ecological processes, as depicted on the image of the physical form, patterns, and identity of the suburban landscape, is used (as a method) to aid more effective planning. To know a

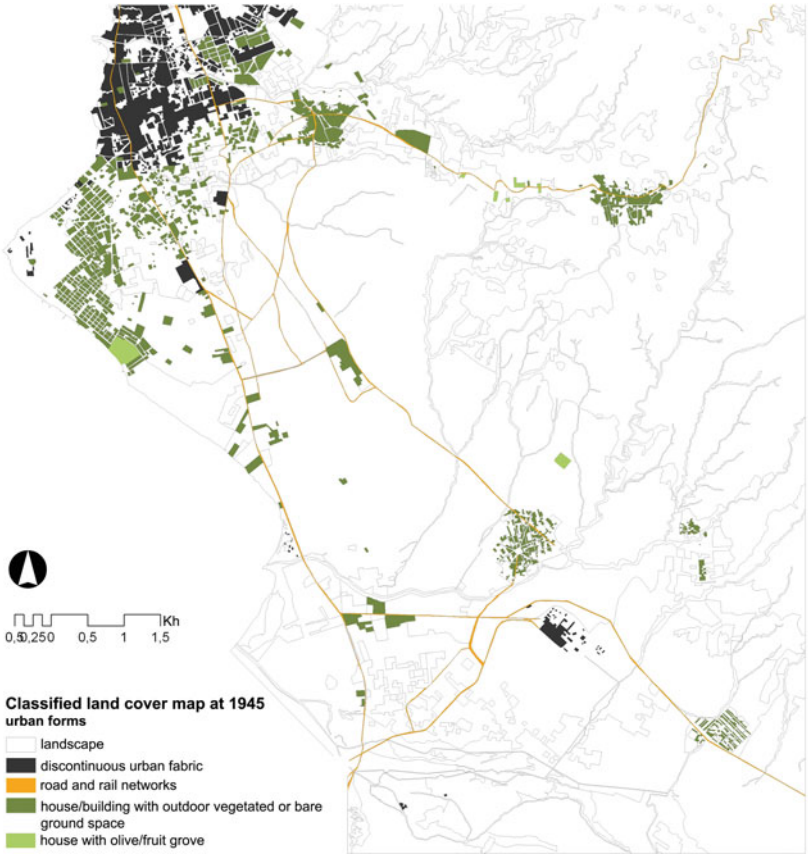

Fig. 2.5 Classified land cover map at 1945, urban forms (*Source* by authors)

landscape's behavior is essential and spatio-temporal analysis aids the search for a landscape's ability to resilience, this being the hypothesis of this study.

The quantification of land uses demonstrated in Table 2.1 aids the comprehension of the changes in area (hectares) that land uses have underwent. There are land uses that did not exist at all back in 1945 and do in 2007–2009, others increased in area and others have decreased in area. Combined with Figs. 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11 and 2.12 one can also see the spatial character of each individual land use type, landscape pattern structure and configuration. The

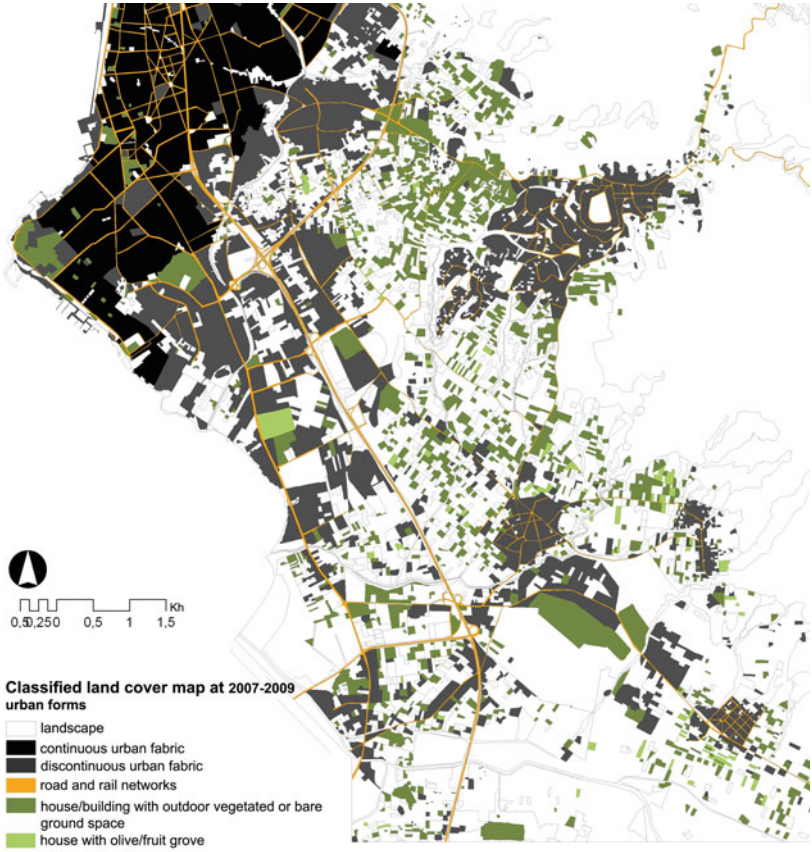

Fig. 2.6 Classified land cover map at 2007–2009, urban forms (*Source* by authors)

suburban landscape of east Thessaloniki has radically been transformed during 64 years of contemporary socio-economic models application, trends and forces of local and broader geographical scale internal and external refugee settling, automobile increase, mechanization of agriculture, urbanization, globalization. Yet, although part of an increasingly globalized network, new local qualities can be detected, identifying distinct socio-ecological and economic typology of land use in the suburban landscape in question.

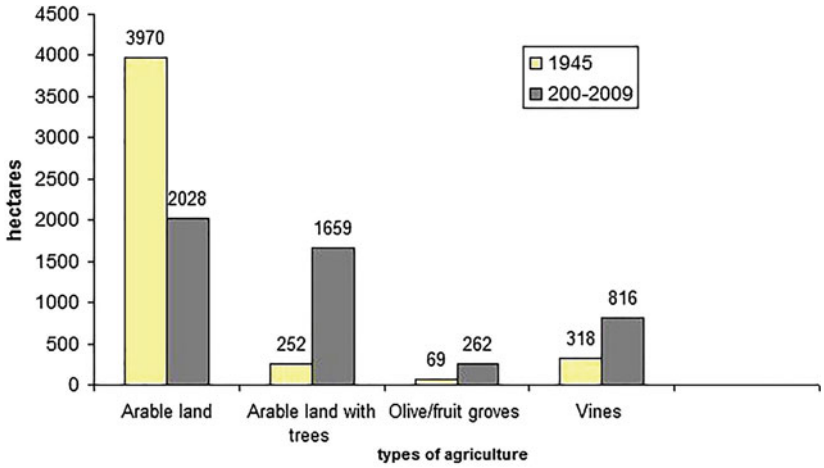

Fig. 2.7 Land-cover changes in agricultural patterns for two intervals in the landscape of study (*Source* by authors)

Suburban landscapes are highly dynamic 'ecotones' exhibiting the edge effect, a meeting place and interface zone of natural and human habitats. Instead of dichotomizing the landscape into natural and anthropogenic elements, land cover categorization in this study tries to identify cognitive, yet pragmatic, 'clusters' or 'units', which contain both natural and anthropogenic elements. For example, type 'house/building with outdoor vegetated or bare ground space' is a pragmatic unit and possesses a special meaning for the landscape in study, and multiple farming systems, of small, non-intensive scale adumbrate new forms of suburban agriculture which could provide multiple economic opportunities. Natural elements like the suburban forest indicate a need for the inclusion of nature in anthropogenic living patterns. Future research and additional studies specifically appointed for hydrology, geology, natural resources, landform, ecosystem and biodiversity aspects ought to take place. Yet this study reveals the general condition of the landscape which is the first step in recognizing gross problematic areas i.e. depletion of water bodies or opportunities i.e. creation of a forest, thus creating a landscape profile.

Vulnerable to change, the landscape in study underwent transition and '*responded and adapted to change, by taking a new form based on the previous state of its evolution'*, this being Czerniak's (2007) definition of resilience. Yet, the question of whether the landscape in study is a resilient one, cannot be answered

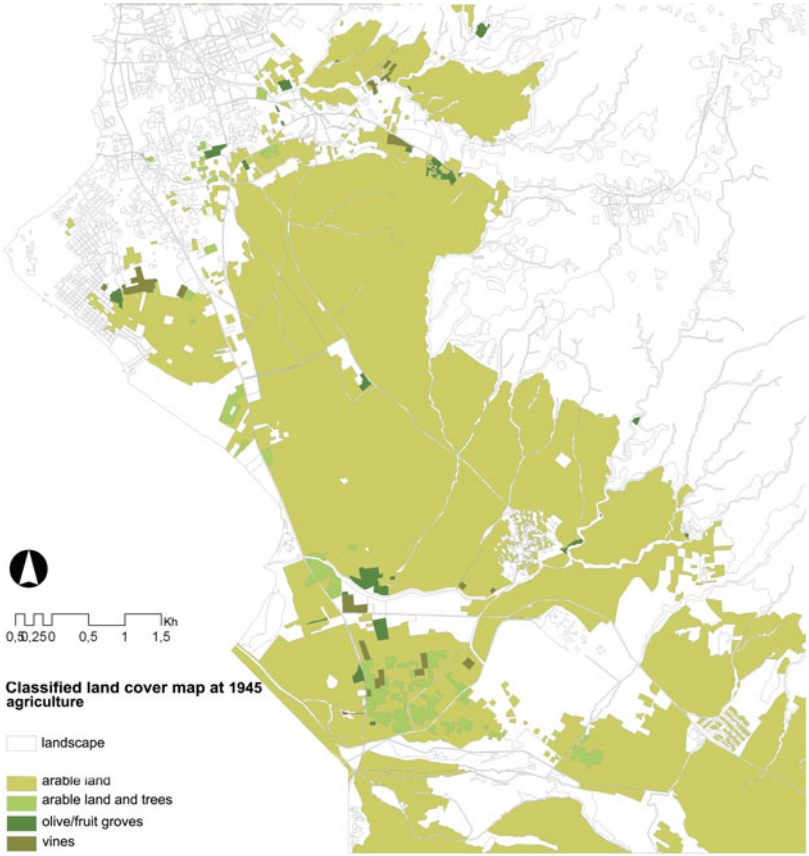

Fig. 2.8 Classified land cover map at 1945, agriculture (*Source* by authors)

with a 'positive' or 'negative' answer, or superficially following logical assumptions. For example, one should take the time to examine all three categories and subcategories of LULC, since their typology differs and their transformation in time exhibits different patterns and inter-correlations. For this, there ought to be a set of specific questions, depending on what one tries to discover i.e. '*Does the appearance of trees make the overall landscape more resilient, due to the increase in diversity of habitats which include trees and birds that prefer them for building their nests?*', if for example one studies bird population and their relation to the

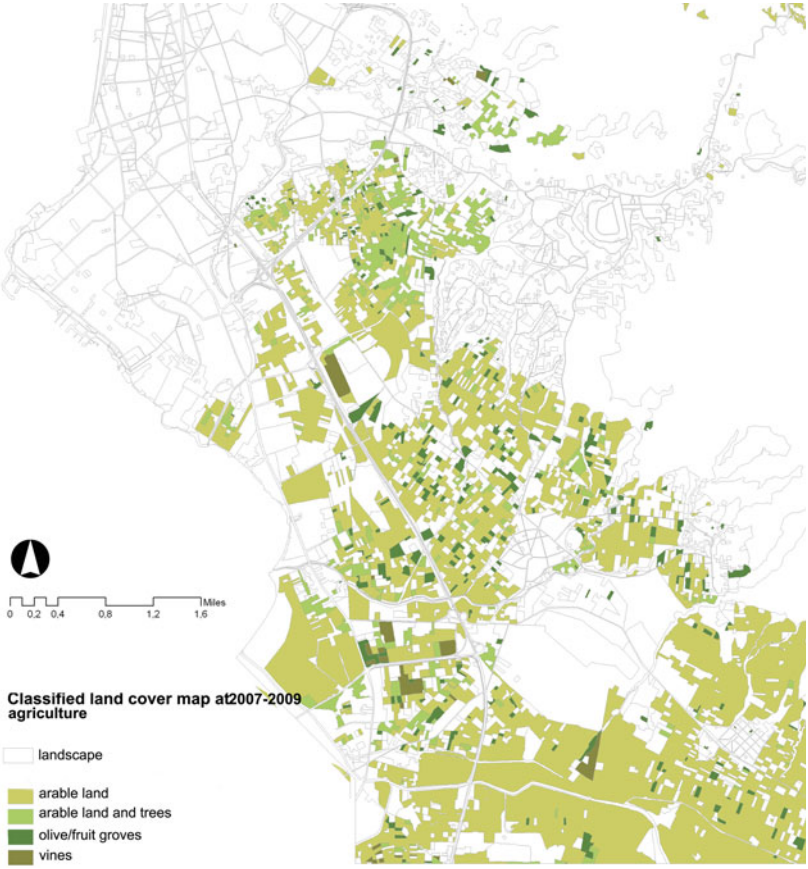

Fig. 2.9 Classified land cover map at 2007–2009, agriculture (*Source* by authors)

suburban landscape; or '*Does the increase of road network assists socio-economical connections between new small settlements in the landscape in study*?', if one examines the new types of social structure such as the benefits of linking athletic facilities in small suburban settlements, local economy trends etc.

Furthermore, since sustainability is a social, economic and environmental three core cognitive entity, what does transformation in the landscape of study reveals in terms of balancing the three parameters?

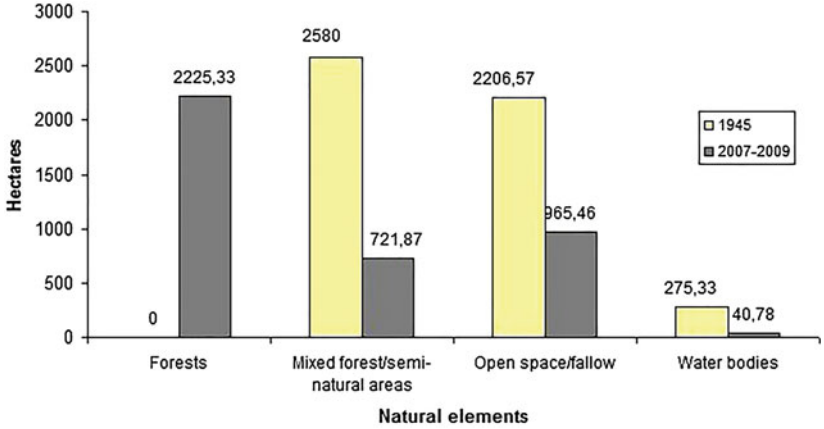

Fig. 2.10 Land-cover changes in natural element patterns for two intervals in the landscape of study (*Source* by authors)

In terms of the environmental change the landscape has underwent increase of all urban type land uses, indicating chronic stress on the hydrology of the landscape, not only due to the decrease of open fresh water bodies by almost 700%, but also to the over use of the existing water sources. Lack of freshwater bodies is a result of urbanization of the area combined with engineering strategies and policies adopted between 1940 and 2000, in many developing countries. Channelizing rivers and placing them underground was a common practice among them. Although one can easily conclude that man-made habitats put stress and have a direct negative impact on water and to the natural resources, this may not be directly the case for changes in landform, ecosystems (creation of new, extinction of existing) and biodiversity. Habitat formation and biodiversity was influenced with the appearance of a new forest, totally absent back in 1945. The appearance of the forest nowadays, due to its planting in the 1930s is clearly influenced by the ability of the involved parties to foresee the expansion of the city and the need for a 'city forest' for future generations. Furthermore, the landscape in total appears more diverse in natural and agricultural elements.

In terms of social progress, the fact of the appearance of detached homes with green surroundings indicates an effort for improved quality of living conditions and a better connection with natural elements. Thus, although sprawling, fragments of human habitat scattered on the agricultural-natural canvas may cause fragmentation of natural main-core habitats and alternations in agricultural practices, more

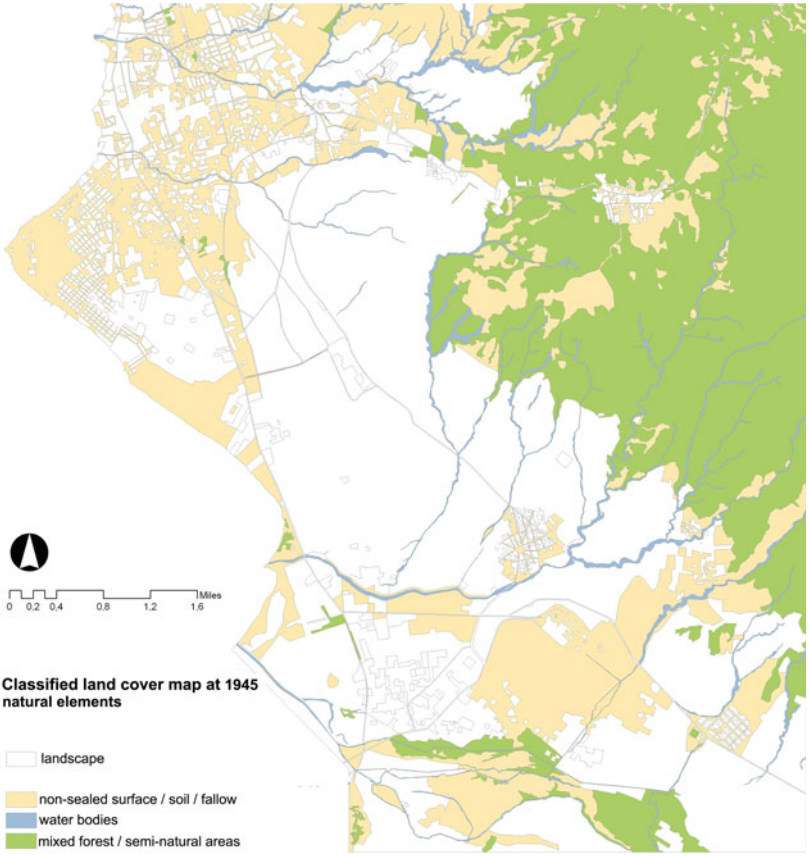

Fig. 2.11 Classified land cover map at 1945, natural elements (*Source* by authors)

research is needed of these new hybrid, half-human, half-natural habitats in relation to human preferences.

Economic progress is in most cases oppositional to nature. The increase of discontinuous urban fabric of almost 600%, includes many forms of suburban economical activities, i.e. market malls, combined and aided with the increase of road and rail networks. Whether market malls are the key to economic progress or fit the profile of a suburban Mediterranean landscape is a debatable question. There are new forms of suburban agriculture, which appear in a scatter manner through

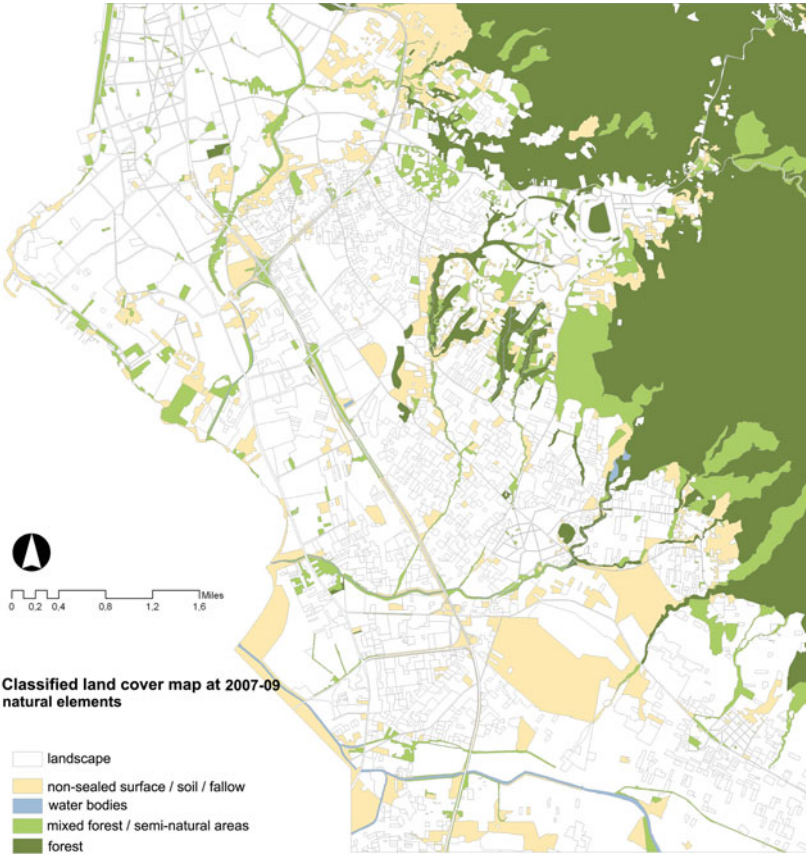

Fig. 2.12 Classified land cover map at 1945, natural elements (*Source* by authors)

the landscape. These could be the springboard for many opportunities of organic/integrated mixed farming which would socio-economically boost local economies.

Whether there will be an ultimate theory or not in creating the most 'sustainable' and 'resilient' urban or suburban landscape, monitoring change of existing ones, provides data for analysis, as the first step in planning and ultimately contributes in examining the potential of a landscape towards resilience.

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3 Beyond a Fragmented and Sector-Oriented Knowledge for a Sustainable and Resilient Urban Development. The Case of the Metropolitan City of Naples

Adriana Galderisi and Giada Limongi

Abstract

Numerous scholars have recently focused on the multiple challenges—from the environmental crisis to the impacts of climate change and natural and man-made hazards—threatening cities' future. Most of them have clearly highlighted the increasing interdependencies among these threats, their close dependency on urban development processes, as well as the need for avoiding policy silos and promoting cross-sectoral strategies in the face of these challenges. In this line, the contribution explores the interactions among urban development processes, loss and/or degradation of natural resources, climate change and disaster risks. Then, focusing on the Metropolitan City of Naples, it highlights difficulties and opportunities arising from a better integration of the available fragmented and sector-oriented knowledge, as a key step to provide planners and decision makers with a comprehensive understanding of human and natural dynamics capable to support cross-sectoral strategies for a sustainable and resilient urban development.

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3.1 Introduction

The vast literature developed in the last decade on the threatening factors challenging cities' development has largely stressed the opposing roles played by cities in respect to these factors. On the one hand, current urbanization patterns, combined with the growth of urban population and urban lifestyles, act as responsible of a wide range of environmental problems, from the depletion of natural resources to the loss of biodiversity or to the greenhouse gas (GHG) emissions. On the other hand, due to the increase of urban population and the concentration of activities and assets, cities are more and more vulnerable to a large variety of natural and man-made hazards, comprising climate-related hazards, as well as to the decreasing availability of resources (energy, water, food), crucial for sustaining current urban lifestyles.

Therefore, cities are nowadays often described as "hotspots of disasters and risk" (Wamsler 2014) and numerous scholars have emphasized the need for better exploring the complex relationships and interdependencies between cities and environment as a key step for supporting cross-sectoral strategies that, by connecting across different policy sectors, may succeed in reversing current trends (Wilkinson 2012; Childers et al. 2015; Memhood 2015).

Nevertheless, to better explore relationships and interdependencies between human and natural dynamics it is crucial, first of all, to re-shape current approach to knowledge, overcoming the fragmentation of available data and information that clearly mirrors the fragmentation of competencies, responsibilities and intervention tools. This requires a shift from a single element/sector approach to the different threatening phenomena towards a holistic approach to cities development, capable to link different knowledge domains as well as to emphasize linkages and interactions between natural and social systems as a key step to identify priority areas and interventions and support cross-sectoral strategies aimed at enhancing urban resilience.

The need for re-shaping current knowledge arises also from another issue that has been largely discussed in recent literature: uncertainty. Cities are nowadays largely interpreted as complex, dynamics, self-organizing systems, continuously changing under the pressure of perturbing factors due to internal processes or external factors: these systems are characterized by evolution paths that are difficult to foreseen in advance. Many scholars have also emphasized that a changing climate is putting new uncertainties to the table (Handmer 2008; Head 2014). Thus, the relevance currently attributed to uncertainty—typical of urban systems and emphasized by the peculiarities of hazards in a changing climate—calls for new approaches to knowledge, capable to shed light on interdependencies, by

integrating and combining existing knowledge developed by different actors, on different geographical scales and in different domains, but also to monitor the temporal and spatial dynamics of coupled socio/ecological systems, allowing the establishment of a continuous learning process enabling policy makers to adapt, change or further develop undertaken strategies and measures.

According to these premises, in this chapter we will firstly analyze and discuss the complex relationships and interdependencies between urban development processes and the heterogeneous factors currently threatening cities. Then, focusing on the Metropolitan City of Naples, in the South of Italy, we will examine the relationships among urban development, environmental issues (pollution, land take, etc.), traditional (seismic, volcanic, etc.) and climate related risks, according to the priority areas of concern in this area and to the availability of data and information. The reference to the case study, although focused on specific sectors and interactions, will allow us to shed light on the difficulties arising from the integration of the heterogeneous and currently fragmented data and information related to different issues as well as on the potential of GIS tools for building up an integrated and dynamic knowledge base, capable to support multi-objective strategies in the face of the heterogeneous and interconnected factors threatening urban development.

3.2 Urban Development, Environmental Decay and Risks: Linkages and Interdependencies

During the last century, cities have been characterized by a continuous growth of population; an expansion, often uncontrolled, of the built-up areas; the emergence of highly energy-consuming lifestyles. These phenomena have led to an increasing demand for resources (from food to water and energy) and, meanwhile, to a constant decrease of fertile available soil, a significant pollution of soil, air and water: in one, to a widespread loss of biodiversity with a consequent reduction of natural systems' capacity to provide basic services, crucial to human life. Moreover, most of the cities all around the world are located in hazard prone areas and the growth of urban population is further pushing the demand for urban land uses and the consequent land occupation in hazardous areas, let increasing risk levels, mainly in urban and periurban areas. Finally, it is worth reminding that human dynamics are widely recognized as responsible for the alteration of the climate system due to the GHG emissions, with a consequent increase of climate-related hazards (floods, heat waves, fires, droughts, etc.), which affect, in turn, both cities and natural/rural ecosystems.

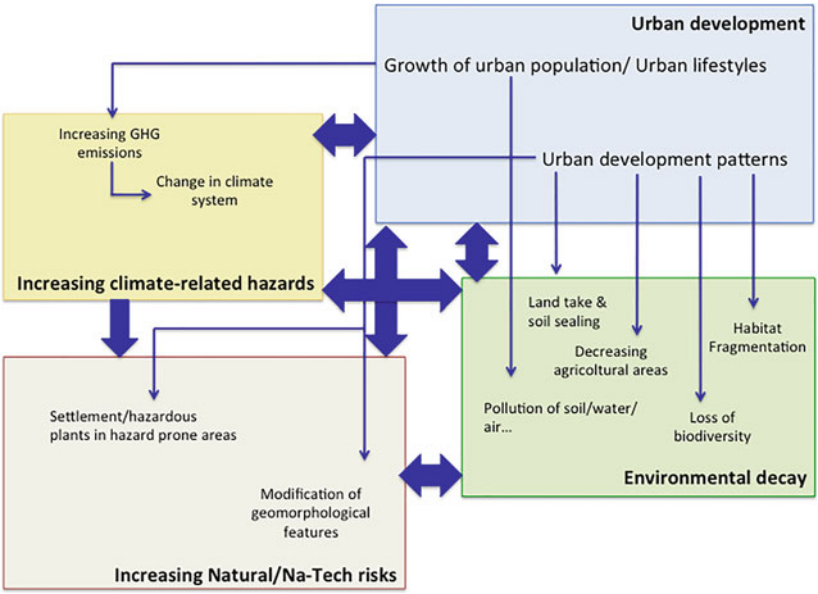

Fig. 3.1 Relationships and interdependencies among urban development, decay of natural and rural ecosystems, risks and climate change (*Source* By authors)

Thus, in the following we will try to shed light on this complex net of inter-dependencies, by highlighting on the one hand, the close dependency of the main threatening factors (environmental decay, increase of natural and technological risks, climate change and climate-related hazards) on urban development; on the other hand, the mutual relationships among these threatening factors (Fig. 3.1).

Nowadays over the half of the world's population lives in urban areas and in 2050, population is projected to be 66% urban (UN 2014). The data are even more alarming for Europe, where urban population is expected to increase from current 73 to 80% by 2050. The global area covered by the cities is currently almost the 0.5% of the total area of the planet, although this percentage significantly varies, according to "the definition of urban and the spatial grain of analysis" (McDonald et al. 2013). In Europe, starting from the mid Nineties, the total urban surface has increased by 78%, whereas population has grown by only 33% (EEA 2006).

Land take and soil sealing phenomena—intended the former as the increase of the settlement areas over time, also through urban sprawl and the conversion of land within urban areas (densification), and the latter as the permanent covering of

an area by impermeable artificial material, such as asphalt or concrete—have largely increased in the time span 1990–2006. As reported by Stolte et al. (2015) "artificial areas covered 4.1, 4.3 and 4.4% of the EU territory in 1990, 2000 and 2006, respectively. This corresponds to an 8.8% increase of artificial surface in the EU between 1990 and 2006".

Unfortunately, soil has been only recently recognized as a limited and non-renewable resource, an important reservoir of biodiversity, providing a wide range of services, ranging from the filtering of water flows to the food production. Moreover, while land take reduces the availability of fertile soil, the growth of urban population increases the demand for food-production land.

Changes in land uses (from natural/rural to urban) significantly affect the quality of natural resources and represent the most direct impact of cities' development on biodiversity. It is largely recognized that changes in land cover and use, combined with climatic features, may affect quantity and quality of available water (surface or groundwater), whose demand for human uses is on the opposite rapidly increasing. Urbanization affects local infiltration and runoff characteristics, reducing the potential of groundwater recharge; meanwhile, urban and rural land uses may increase the concentration of pollutants (fertilizer and pesticides, pet waste, trash, pollution from vehicles and pavement materials, and chemicals from industrial and commercial activities) in water bodies (EPA 2013). The expansion of impervious surfaces is also responsible for the reduction and fragmentation of the areas available for different species of plants and animals as well as for the significant simplification of natural ecosystems (McKinney 2008; McDonald et al. 2013).

Alteration, fragmentation and destruction of natural habitats significantly contribute to the overall loss of biodiversity, on which structure and function of ecosystems across the planet depend (EPA 2013), and lead to a widespread reduction of the ecosystems' capacity to deliver the basic services to human life. Despite the concept of ecosystem services has been firstly introduced in the late Sixties, it is only in the Nineties that research and studies on ecosystem services have dramatically grown. These services have been categorized according to different perspectives, although the most shared one refers to provisioning services (such as food, fiber, and fresh water); regulating services (as pollination, water purification, climate and hazard regulation); cultural services (recreation, education, etc.); supporting services (as photosynthesis and nutrient cycling) (EPA 2013). It is worth emphasizing that most of these services cannot be easily replaced: for example, although artificial levees can prevent flooding, by replacing in a way the regulating function of natural levees, they cannot replace their multiple functions, ranging from the production of organic matter to the large variety

of habitats for water life and to the regulation of atmospheric carbon dioxide and methane levels (Costanza et al. 2008; EPA 2013).

Focusing on natural and na-tech risks, it has to be remarked that many cities all over the world are historically located in hazard prone-areas (seismic, volcanic, coastal areas, flood plains, etc.) and that human activities often contribute to increase local hazard levels. Soil sealing, for example, is largely perceived as a driver of flood risk (Pitt 2008; Pistocchi et al. 2015). Recent data on hazards and risks (Munich-RE 2014) show an increase in the total number of disasters over the last decades, with a significant percentage of hydrological, meteorological and climatological events (tropical storm, flooding, mass movement, heat waves, etc.) in respect to geophysical events.

According to EM-DAT, in Europe the total number of reported disasters in 2014 was equal to their annual average disaster occurrence from 2004 to 2013, but "the number of hydrological disasters showed a 45% increase compared to its decennial average" (Guha-Sapir et al. 2014). Hence, numerous scholars have recently emphasized the impact, which is likely to increase in the next future, of climate change on the frequency of natural hazards (Gencer 2013; Banholzer et al. 2014). Furthermore, the growth of urban population and the consequent concentration of assets, strategic activities and infrastructures in urban areas are leading to an increase of urban vulnerability. Despite human fatalities related to natural and technological events are going to decrease over time, in fact, the economic losses are going to escalate, due to the increasing amount of economic assets, generally gathered in urban areas, as well as to the higher level of wealth and living standards. Furthermore, in a world characterized by closer and closer economic and functional interdependencies, the consequences of local events often reverberate largely beyond the borders of the hit areas.

Finally, the increasing frequency of some natural hazards and the likely growth of the interactions among extreme natural phenomena and technological accidents are bringing out a growing concern about the potential increase of Natural-Technological (Na-Tech) accidents, often neglected both in natural hazard assessment and in safety assessment of industrial plant (Krausmann et al. 2011; Ancione et al. 2014), even though they represent a serious threat both to urban areas and to natural and rural ecosystems.

Climate change is perhaps one of the most discussed issues in current planning literature, as witnessed by the increasing amount of books and articles (Davoudi et al. 2009; Richardson and Otero 2012; Carter et al. 2015) as well as of International and European Reports on this topic (EEA 2012; EFDRR 2013). This is mainly due to the growing awareness that climate change is closely related to the growth of urban population, to urban lifestyles as well as to changes in land uses.

Meanwhile, it is widely recognized that the impacts of climate change will be particularly severe in urban areas, likely worsening the "access to basic services and quality of life in cities" (van Staden 2014), and that they will exacerbate existing environmental problems, by further reducing biodiversity due to the rise of global temperatures and increasing meanwhile current risk levels (EEA 2015a).

On summing up, being environmental decay, natural and na-tech risks, climate change and related impacts interconnected phenomena depending on, and meanwhile challenging, urban development, a better understanding of—and even more an improved capacity to deal with—these issues require a radical change in current approaches to knowledge, based on a shift from a sectoral towards a holistic perspective as well as from a city centered viewpoint towards a better consideration of urban/rural/natural interfaces (Colucci 2015).

3.3 Beyond the "Silo" Approach: Reframing Knowledge for a Sustainable and Resilient Urban Development

The "silo" approach—which is the result of the reductionism that has for long driven scientific knowledge, permeated education and training programs, studies and researches as well as the organization of public administration and, consequently, policies and tools on different levels—is still the prevailing one among scholars, practitioners and decision-makers.

The term is generally used as a metaphor to describe a system, a process or also a department within a given organization that operates as an individual entity, in isolation from others.

The silo approach is nowadays largely recognized as one of the major barrier to an effective integration of social, economic and environmental dimensions of sustainable development, as well as of environmental, risk and climate change issues into land use planning processes.

Although since the Nineties some scholars have emphasized the need to overcome a sector-oriented approach, by integrating available knowledge in respect to areas of concern rather than to disciplinary boundaries (Gambino 1995), the persistence of the silo approach has led to the paradox that the wider and wider amount of available knowledge results often ineffective in reversing negative trends (White et al. 2001; Norton et al. 2015). This is likely a consequence of the failure of scientists in sharing and exchange knowledge and information out of the disciplinary boundaries and, in so doing, in understanding interactions and feedbacks (Hoff 2011).

The lack of communication among different disciplinary and practice communities limits the understanding of complex phenomena, with serious repercussions on the effectiveness of the resulting strategies to counterbalance them. Hence, nowadays numerous scholars are emphasizing the need for avoiding knowledge and the following policy silos (Davoudi and Cowie 2016), highlighting that the "disconnect between the different scientific communities and related knowledge and practice hampers comprehensive diagnosis of the problems at stake and the mounting of more effective actions to address it" (Loevinsohn et al. 2014).

The debate on sustainability has been largely focused on the need for better integrating development goals and environmental issues, recognizing that this "integration is not only possible, but necessary" (Boltz et al. 2013). The Report RIO + 20—"The Future we want", issued in 2012—expands this concept, clearly emphasizing the need for integrating both disaster risk reduction and adaptation to climate change in all public and private investments and, especially, in urban planning (UN 2012).

Also the more recent and lively debate on resilience significantly stresses the importance to overcome the silo approach to the complex phenomena threatening cities' development, by favoring on the opposite transdisciplinary and interscalar perspectives. Referring to other studies for deepening the resilience concept (Davoudi et al. 2013; Galderisi 2014; McPhearson 2014), it is worth here emphasizing that resilience is nowadays largely recognized as an "evolutionary" process (Davoudi et al. 2013), based on a "continual learning" (Cutter et al. 2008), pushed by inter/trans-disciplinary research involving complementary disciplinary areas, "(…) informed by the environmental, ecological, social, and economic drivers and dynamics of a particular place, and integrated across a range of linked scales" (Ahern 2011).

Despite the importance attributed to the need for overcoming the silo approach to the interconnected challenges threatening urban development, the road to shift from a sector-oriented towards a holistic approach and, meanwhile, from a human centered vision towards a better consideration of the complex interdependencies among human activities and natural dynamics is still hazy, long and scattered with obstacles.

A crucial step along this road, in our view, is to improve and re-frame current knowledge, by integrating the fragmented and sector-oriented knowledge currently available and, in so doing, shedding light on interdependencies and feedbacks among different factors and sectors. The building up of a knowledge base capable to combine, according to common criteria and standards, existing data and information developed by different actors, in different domains and on different geographical and temporal scales, is crucial to support planners and decision-makers in outlining successful strategies for a sustainable urban development as well as to

enhance a learning-based urban development process, largely considered as one of the pillars for increasing urban resilience.

Nevertheless, numerous barriers hamper the development of an integrated knowledge base. Among them:

- the fragmentation of existing data and information among different bodies of local administration, in charge of specific issues (risk reduction, water management, energy, transport, etc.);
- the heterogeneous criteria and methods to collect and organize data and information (e.g. different spatial or temporal scales of reference);
- the lack of disaggregate information on key aspects and variables (e.g. on vulnerability of exposed elements and systems to the heterogeneous hazard factors);
- the lack of continuous monitoring of key aspects and variables.

All these factors prevent a more effective use of the large body of available data and information and hinder the overcoming of the fruitless criticism to the side-effects of urbanization processes.

Thus, based on the above and focusing on the Metropolitan City of Naples, limitations and shortcomings arising from current segmentation of competencies and knowledge as well as the potential of GIS tools for re-shaping existing knowledge in respect to areas of concern rather than to disciplinary boundaries will be explored.

3.4 A Fragmented and Sector-Oriented Knowledge: The Case of the Metropolitan City of Naples[1]

The Metropolitan City of Naples—threatened by multiple and heterogeneous stress factors that seriously undermine its future development—is one of the ten Metropolitan Cities established by the Italian National Law 56/2014. These cities, which comprise the majority of people, strategic assets and economic activities, are autonomous entities with their own statutes, powers and functions, to which crucial responsibilities, such as the strategic development of their territory, are currently assigned. Focusing on this area, we will highlight how the persisting silo approach to knowledge hinders the building up of an integrated and dynamic knowledge base, crucial to support cross-sectoral strategies addressed to promote a more sustainable and resilient development of the Metropolitan city.

[1]Data and information related to the Metropolitan City of Naples are updated to January 2016.

Limitations and shortcomings of data and information currently available for the Metropolitan City of Naples will be discussed in respect to the different areas of concern previously presented (urban development, environmental decay, natural and technological risks, climate change and climate-related risks) by cutting the focus on some specific issues according to their relevance in the case study area and to data availability.

3.4.1 Population Dynamics

Data related to population dynamics are regularly collected, elaborated and disseminated by the Italian National Institute of Statistics (ISTAT). The latter, starting from the 1861 and every ten years, provides the Population Census, the widest database on consistency, structure, distribution and socio-economic features of population. ISTAT data are collected in respect to census tracts (or units)—whose dimension is designed to be quite homogeneous with respect to population consistency and may range from a building block to larger areas in less densely populated areas—and can be easily aggregate on different geographical scales.

According to the ISTAT data, population in the Metropolitan City of Naples is constantly increasing, with a rapid growth after the Fifties and a tendency to stabilization in the last three decades. Among the ten Italian Metropolitan Cities, Naples is the third one for number of residents, being one of the smallest in terms of land surface. Hence, this area shows the highest value of population density in respect to the Italian Metropolitan Cities (Fig. 3.2).

3.4.2 Environmental Dynamics

3.4.2.1 Land Take and Soil Sealing Phenomena

The growth of urban population, occurred since the Fifties, has resulted into a significant development of urbanized areas: nevertheless, it is difficult to find out data on land use changes over the years. Studies on land take and soil sealing phenomena are gaining relevance only in the last decade and at present "there are not accessible databases sufficiently accurate informing about current and retrospective land-use trends" (Attardi et al. 2015).

The Institute for Environmental Protection and Research (ISPRA) is the main data source for land use analysis in Italy.

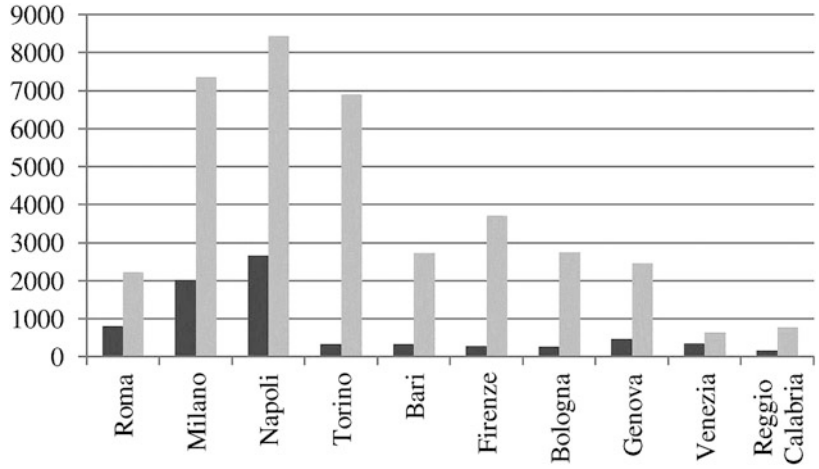

Fig. 3.2 Population density: a comparison between the ten Italian Metropolitan Cities (*in grey*) and their major Cities (*in black*) (*Source* By authors on ISTAT data 2011)

Starting from the 2014, the Institute is in charge of the Annual Report on Soil Consumption,[2] which provides data on soil consumption and sealing for the whole Italian territory, in respect to different geographical scales: from regional to municipal. It is worth noting that data related to soil sealing are available only at regional scale and for the major cities. Data and information, updated to 2012, result from the integration of different sources: from the Corine Land Cover to the Italian Network for soil consumption monitoring.

Despite the large amount of data freely accessible in an open data format, most of them are available only in respect to the regional scale, whereas a limited number of information are available on the municipal scale, making hard an effective understanding of local dynamics as well as the identification of priorities and criticalities within the boundaries of the Metropolitan City.

In detail, in respect to the Metropolitan City of Naples, according to the last Report on Soil Consumption (2015), the percentage of soil consumption is equal to the 30% of the total surfaces of the area, the highest value among the ten Metropolitan cities (Fig. 3.3).

[2]The concept of soil consumption is defined as a land use change from a not artificial coverage (soil not consumed) to an artificial coverage (soil consumed) (ISPRA 2015).

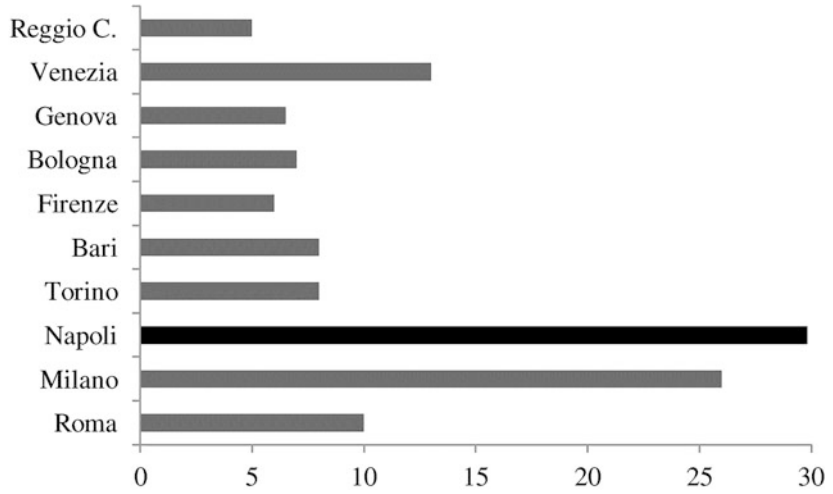

Fig. 3.3 Percentage of soil consumption in the ten Italian Metropolitan cities (*Source* ISPRA 2015)

3.4.2.2 Agricultural and Natural Areas

Since the 1961, data and information related to agriculture are collected, elaborated and disseminated every ten years by the Italian National Institute of Statistics (ISTAT). By comparing the data of the latest Agricultural Census (2010) with the previous ones (1990 and 2000), it is possible to notice that the values of the Utilized Agricultural Area, which comprises agricultural crops and pastures, and those referred to the Total Agricultural Area, which includes the forests too, have been more than halved in the Metropolitan City of Naples (Fig. 3.4).

Data related to the consistency and features of natural areas are in charge of a large number of Bodies, such as the Ministry of Environment, the Regional Agency for the Environmental Protection, the Campania Region, Park Authorities, the State Forestry Corp, each focused on specific aspects or areas.

According to the data provided by the Ministry of Environment (MATTM 2013), the Metropolitan City of Naples, despite the widespread and increasing urbanization, still comprises a large amount of areas of high natural value, with a significant variety of natural habitats, national and regional parks, and different types of protected areas comprised in the net "Natura 2000" (SCI and SP). In detail, the protected natural areas cover a surface of about 21,000 ha, accounting for 17.71% of the whole territorial surface of the Metropolitan City of Naples.

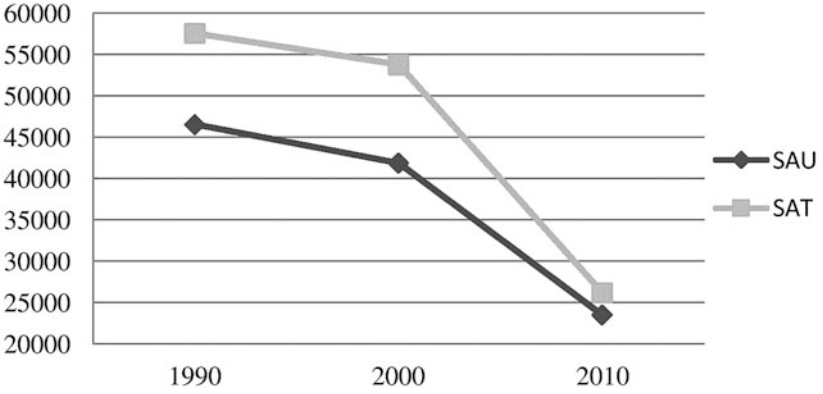

Fig. 3.4 Changes in the values of utilized agricultural areas (SAU) and total agricultural areas (SAT) from 1990 to 2010 (*Source* By authors on ISTAT data)

A classification of the Metropolitan Area of Naples into five biodiversity levels has been developed in 2002 by the Province of Naples, based on the Regional Land Use Map (Fig. 3.5).

3.4.2.3 Soil and Groundwater Contamination

The serious contamination of soil and groundwater in the Metropolitan City of Naples is documented by surveys and studies carried out by the Ministry of Environment, the National Institute for Environmental Protection and Research (ISPRA) and the Regional Agency for the Environmental Protection (ARPAC).

In Italy, since the 1998, numerous Sites of National Interest (SIN) have been identified and classified. These sites represent large contaminated areas requiring interventions for soil as well as for groundwater and/or surface water remediation.

Among these sites, six are located (totally or partially) in the Metropolitan City of Naples. Two of them are in charge of the National Authority, the others of the Regional Authority. The list of contaminated and potentially contaminated sites included in the SIN as well as the boundaries of the SIN have been updated by the ARPAC between 2013 and 2014 (Fig. 3.6).

Nevertheless, detailed surveys on agricultural soils contamination as well as on groundwater contamination are available only for specific areas within these Sites, such as the so-called “Land of Fires”.

Hence, the collection and processing of data and information on environmental issues are highly fragmented in the Metropolitan City of Naples and relevant

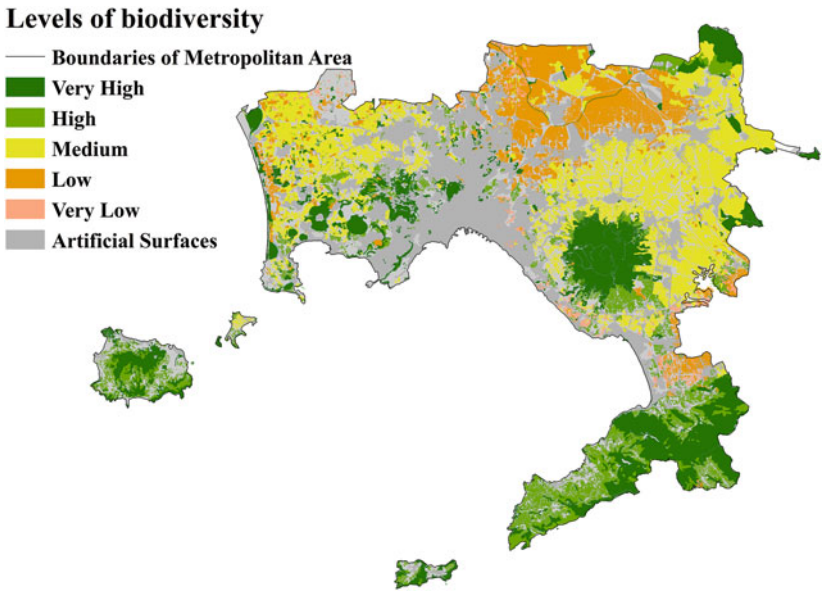

Fig. 3.5 Biodiversity levels (*Source* Province of Naples 2014—revised by the authors in GIS environment)

information is often missing or available with reference to recent time periods and/or to wide geographical scales. It is worth noting, for example, that data on land take and soil sealing have been collected only with reference to the last two years and are available only for the whole Metropolitan area or for the major cities, whilst data related to soils and water contamination are available only in respect to very limited areas.

3.4.3 Hazards and Risks

The Metropolitan City of Naples is prone to different natural and man-made hazards. Despite the widespread awareness that the "agent-specific" approach is one of the main weaknesses of current hazard knowledge (Quarantelli 1993), so far knowledge related to the different hazards is largely fragmented among different Authorities, whilst data related to exposure and vulnerabilities, crucial to an effective understanding of risk levels (Komendantova et al. 2014), are still limited.

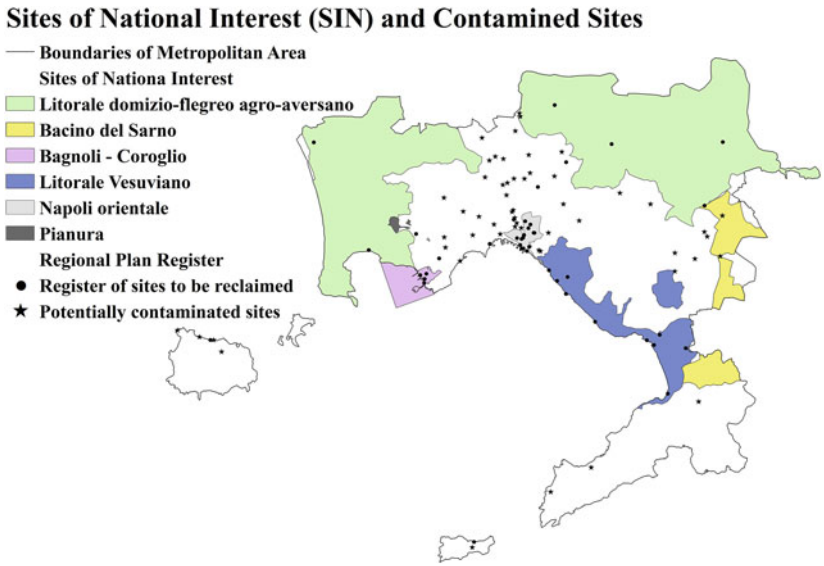

Fig. 3.6 Boundaries of the sites of national interest (SIN) and location of the contained sites (*Source* Province of Naples 2014—revised by the authors in GIS environment)

In detail, the Civil Protection Department, established in 1982, is in charge of the prevention, forecast and monitoring of seismic risk.

According to the seismic classification of the Italian territory—updated in March 2015—most of the municipalities within the Metropolitan Cities of Naples are classified as seismic Zone 2 (medium level of seismicity, PGA between 0.15 and 0.25 g). So far a limited number of Municipalities has carried out seismic micro zonation studies, even though after the L'Aquila earthquake in 2009 these studies have been largely pushed and supported through national economic incentives.

Moreover, a comprehensive analysis of exposure and vulnerabilities of the Metropolitan area of Naples in the face of earthquakes is still missing, despite the numerous studies developed in respect to specific vulnerability facets and/or to specific areas.

The Department of Civil Protection is also in charge of monitoring and management of volcanic risk. The Metropolitan area of Naples comprises two volcanic areas: the Mount Vesuvius and the caldera of Campi Flegrei. For these areas the

Department of Civil Protection is in charge to carry out and constantly update the National Emergency Plans.

These Plans, whose most recent update was between 2014 and 2015, provide hazard and risk zones, alert levels, actions to be taken in case of eruption and guidelines for monitoring and updating activities.

In respect to hydrogeological hazards and risks, according to the Italian legislation (Law 183/1989 and its following modifications), Basin Authorities are in charge of developing knowledge, planning and management activities. The Metropolitan City of Naples is mostly included in the Basin Authority of the Central Campania and partially in the Basin of the Southern Campania and Interregional Basin of the Sele River, which are the result of the aggregation among two or more previous Authorities. Whilst the former has established in 2015 the new Extract Plan for Hydrogeological Risk, which homogenizes the Plans carried out by previous Authorities, in the area comprised in the Southern Campania Basin, three different Extract Plans (approved between 2011 and 2012) are still in force. All the existing Plans provide a classification of the territory in four hazard and risk zones (from the lower = 1 to the higher level = 4), according to the criteria and methods provided by Law in 1998 (DPCM 29 September 1998). Nevertheless, the differences among the classifications provided by each Plan would require a homogenization and the less recent Plans should be updated according to the European Flood Directive (2007/60/CE), transposed in Italy by the Legislative Decree 49/2010 and devoting large room to the consequences of climate change on the occurrence and severity of flooding events as well as to the potential for na-tech events.

Focusing on technological hazards, it is worth noting that the list of the hazardous industrial plants in Italy is provided and regularly updated by the Ministry of Environment (MATTM).

Moreover, since 2001, the Agency for the Environmental Protection of the Campania Region periodically provides a Report on the hazardous industrial plants. The latest Report, issued in 2014, provides the UTM coordinates of all the existing plants, classifying them in respect to the type of activity and their risk classification. Moreover, for the first time, it provides for each plant the values of local seismic hazard expressed in terms of maximum ground acceleration, whilst the likely chains of floods/landslides events and industrial accidents are neglected.

The assessment of forest fires is in charge of the Campania Region that, in 2013, provided an updated Plan for Forest Fires Prevention. Nevertheless, the only available information in respect to each Municipality is related to the number of forest fires occurred in 2013 and the percentage of burnt surfaces.

From the above, it clearly arises that data and information on hazards and risks affecting the Metropolitan City of Naples are largely fragmented among a large number of different Bodies. Moreover, whilst information related to the different hazards potentially threatening the City—despite referred to different spatial units, updated at different times and very lacking in considering the interactions among different hazard factors—are generally available, data and information related to the exposed elements and systems as well as to their vulnerabilities in the face of the different hazard factors are still partially or totally missing.

3.4.4 Climate Change

Despite the importance of this issue in the European, National and local policies, data and information related to GHG emissions—considered the main contributor to climate change (IPCC 2014)—in the Metropolitan City of Naples are scarce, not regularly updated and not sufficiently disaggregated. Some data result from the European Project EUCO2 80/50 focused on energy policy and climate change. The first phase of the Project (2007–2009) involved, among the others, the Province of Naples and was addressed to carry out the GHG emissions inventory. The data referred to the whole area and updated to 2005 show that the energy sector is responsible for the 85% of emissions, industrial processes for the 7%, the waste sector for the 4% and a further 4% is due to the agriculture sector (EUCO2 2009).

More information and data on GHG emissions might be gathered from the surveys carried out on a Municipal level for the development of the Sustainable Energy Action Plan (SEAP), which requires the setting up of a Baseline Inventory Emission. Nevertheless, only few Municipalities within the Metropolitan City of Naples have carried out the SEAP and even less have started regular monitoring activities aimed at updating emission values.

Shifting to the knowledge of local climate scenarios, crucial to support adaptation policies, the Euro-Mediterranean Centre on Climate Change has carried out different climate scenarios for the Central Campania Basin in 2013.

In detail, two emission scenarios have been taken into account; in respect to them the likely future changes in cumulated precipitations and average temperatures on a seasonal scale have been assessed on two different temporal spans (2021–2050 and 2071–2100). Both the emission scenarios show an increase of average temperatures in all seasons (Table 3.1) and an overall reduction of cumulated precipitation in the dry seasons (spring MAM and JJA summer) (Regional Authority of the Central Basin Campania 2014).

Table 3.1 Expected change in the average value of the seasonal temperatures in different time periods and according to different emission scenarios (*Source* Regional Authority of the Central Basin Campania 2014)

Future scenarios based on radiative forcing trend			Time range	Average expected variation in °C			
				DJF	MAM	JJA	SON
Intermediate scenario	Representative concentration pathway	RPC 4.5	2021–2050	1.4	1.5	1.8	1.8
Extreme scenario	Representative concentration pathway	RPC 8.5	2021–2050	2.1	1.8	1.9	2.1
Intermediate scenario	Representative concentration pathway	RPC 4.5	2071–2100	2.8	2.9	3.5	3.5
Extreme scenario	Representative concentration pathway	RPC 8.5	2071–2100	5.1	4.7	6.3	5.4

During the wet period (DJF autumn and SON winter), the values related to cumulated precipitation show a general increase, which varies according to the different geographical areas. So far, no studies on the vulnerability of the Metropolitan City of Naples to the different climate-related hazards are available.

A picture of the fragmented and sector-oriented knowledge in the Metropolitan City of Naples is synthesized in the Table 3.2.

3.5 A GIS-Tool for Reframing Knowledge in the Metropolitan Area of Naples

According to the above, different Institutional Bodies (National or Local Authorities, Sectoral Agencies, etc.) are currently in charge of collecting, processing and providing data and information on human and natural dynamics in the Metropolitan City of Naples.

These Bodies act on different scales, applying different methodologies to collect, elaborate, organize and communicate information. Moreover, data and information are often collected and updated in respect to different spatial units, to different time spans, making even more difficult to compare and correlate available information (Table 3.2).

Thus, in the following some hints for building up a GIS tool addressed to re-frame, integrate and improve current knowledge will be provided. Such a tool, tailored to planners' needs, will provide them with a knowledge base capable to support effective strategies for a sustainable and resilient development of the Metropolitan City.

Table 3.2 A picture of the fragmented and sector-oriented knowledge available in the Metropolitan City of Naples

Topic	Type of survey	Collected data	Organization/institution in charge of the survey	Scale of the survey	Minimum spatial reference unit	Update frequency	First available survey	Last available update	Accessibility
Population dynamics									
Population Growth	Population Census	Consistency, structure and distribution of population	Italian National Institute of Statistics (ISTAT)	National	Census units	10 years	1861	2011	On-line
Urban lifestyles	Population Census	Statistical socio-economic information (e.g. households, education, employment, etc.)	Italian National Institute of Statistics (ISTAT)	National	Census units	10 years	1861	2011	On-line
Urban development patterns									
Soil consumption	Environmental report	Percentages of soil consumed	ISPRA	National	Provinces and capital municipalities	1 year	2014	2015	On-line
Decreasing agricultural areas	Agricultural census	Utilized agricultural surfaces, total agricultural surfaces, etc.	Italian National Institute of Statistics (ISTAT)	National	Municipalities	10 years	1961	2010	On-line
	CUAS	Land use	Campania Region	Regional	Homogenous territorial units	7 year		2007	On-line (geo-Portal of the Campania Region)
Loss of biodiversity	Regional land use map	Biodiversity levels	Province of Naples	Metropolitan area	Homogenous territorial units	Not defined		2014	On-line (SIT of the Metropolitan City of Naples)

(continued)

Table 3.2 (continued)

Topic	Type of survey	Collected data	Organization/institution in charge of the survey	Scale of the survey	Minimum spatial reference unit	Update frequency	First available survey	Last available update	Accessibility
Soil pollution	Location of contaminated sites of national interest	Prioritization of contaminated sites	MATTM	National	Perimeter of contaminated sites	Not defined	1998	2014	On-line
	Remediation Plan	Register of contaminated sites requiring remediation	Campania Region	Regional	Perimeter of contaminated sites	Annually		2013	On-line
Groundwater pollution	Environmental report	Water quality monitoring	ARPAC	Regional	Major watersheds	Not defined	1998	2009	On-line
Natural and technological hazards/risks									
Seismic hazards	Seismic classification	Seismic zones	Civil protection	National	Municipalities	Not defined	1981	2015	On-line
Vulcanic hazards	Vesuvius – National emergency plan	Red and Yellow Zones	Civil protection	Affected areas	Municipal districts	Not defined	1995	2014	On-lim
	Campi Flegrei – National emergency plan	Red and Yellow Zones	Civil protection	Affected areas	Municipal districts	Not defined	1984	2015	On-line
Floods and landslides	Hydrogeological setting plan	Levels of risks to floods and landslides	Watershed Authorities	Hydrogeological basins	Homogenous territorial units	Not defined		2014	On-line
Forests fires	Fire prevention plan	Number of fires	Campania Region	Regional	Municipalities	Not defined		2013	On-line

(continued)

Table 3.2 (continued)

Topic	Type of survey	Collected data	Organization/institution in charge of the survey	Scale of the survey	Minimum spatial reference unit	Update frequency	First available survey	Last available update	Accessibility
Industrial accidents	Report on hazardous industrial plants	Localization and classification of dangerous industrial plants	ARPAC	Regional	Individual plants	4 years	2001	2014	On-line
Climate change									
Temperature and additional rainfall	Environmental report	Regional maps on registered variations	ARPAC	Regional				2009	On-line
	Hydrogeological setting plan	Maps on likely future scenarios	Watershed Authorities	Central hydrogeological basin				2015	On-line

Reminding the spur of the Italian planner Gambino (1995) to integrate available knowledge in respect to areas of concern rather than to disciplinary boundaries, the first step for re-framing current knowledge is to articulate the whole area of concern (the Metropolitan City) into Spatial Reference Units (SRU), to which all available data and information will be referred.

These units can be shaped according to the administrative boundaries (census units, their aggregations or municipal boundaries) combined with the urban morphological zones (UMZ) defined by the Corine land cover classes (Fig. 3.7). Then, available data and information can be arranged and elaborated into the GIS environment to provide planners and decision makers with synthesis maps—aimed at identifying both the areas where potential interactions among different pressure factors may occur and the priority intervention areas (hotspots)—as well as with comparable maps, focused on single issues and addressed to support the singling out of counterbalancing strategies and measures.

The synthesis maps have been introduced in environmental planning since the late Sixties (Mc Harg 1969) and more recently entered into the tradition of some planning schools significantly concerned with sustainable development (Menoni and Galderisi 2016). Hence, their usage could be further enlarged in order to better

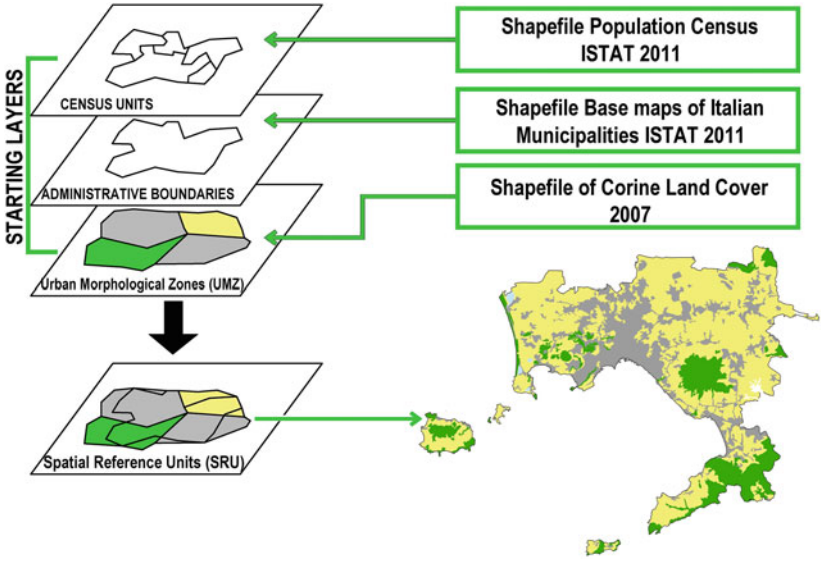

Fig. 3.7 The main steps for identifying the spatial reference units (*Source* By authors)

explore linkages and interactions among environmental, risk and climate related issues as well to effectively mainstream these issues into land use planning processes. To provide an example of the potential of synthesis maps, it is worth reminding that, as mentioned above, current knowledge related to the different hazard factors is largely fragmented among different Authorities, whilst data on exposure and vulnerability are often scarce or even missing. On the opposite, available data and information on the different hazards could be collected and homogenized into the GIS environment, resulting into a classification of each SRU, according to the number and severity of existing hazard factors as well as to the potential interactions among them.

The resulting multi-hazard map might allow us to identify the potential "hot-spots" in the Metropolitan City of Naples (Fig. 3.8), critical areas to which allocate resources to carry out in-depth surveys on exposure and vulnerabilities or to develop detailed hazard/risk scenarios or even to promote tailored prevention and mitigation strategies.

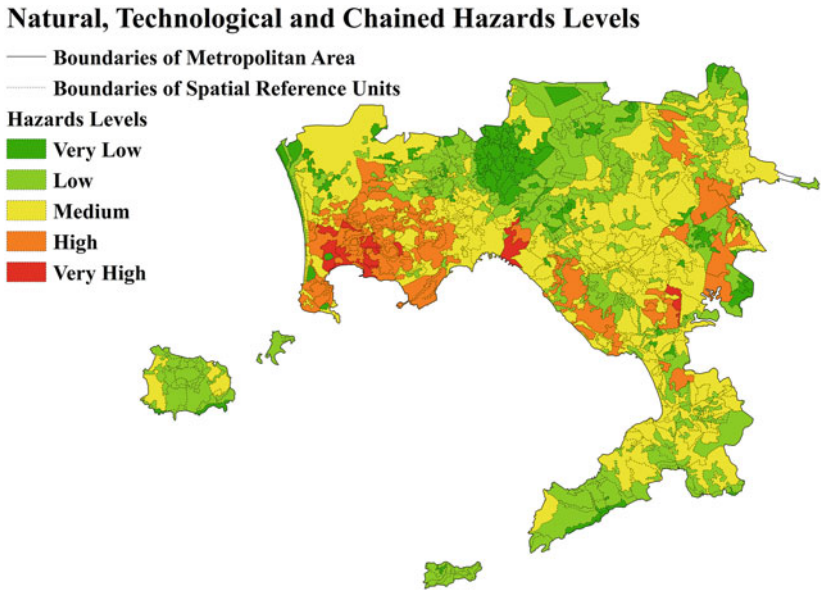

Fig. 3.8 Natural, technological and chained hazard levels in the Metropolitan City of Naples (*Source* By authors)

The opportunities provided by the proposed approach are related both to the potential of synthesizing and optimizing existing knowledge and of increasing our capacity to build up new knowledge, by correlating existing information.

For example, available information on population dynamics, urbanization patterns, comprising land take and soil sealing phenomena, consistency and features of green areas might allow us to fill up current gaps in local knowledge on urban vulnerability to climate related events and, in so doing, to better support adaptation efforts.

Based on the limited amount of available data and according to the hints provided by the EEA (2015b), indeed, a rough classification of urban fabrics' vulnerability to heat waves can be defined according to the following indicators:

- population density;
- ageing index;
- urbanization levels (based on the Corine classification of urban fabrics in continuous and discontinuous);
- proximity of urban fabrics to green areas;
- biodiversity levels.

Data related to population density and ageing index are provided by the ISTAT (last update 2011) and can be easily related to SRUs, by summing the data related to the census units comprised into each SRU.

Population density represents a common indicator of the exposure of a given area to hazardous factors, whilst the ageing index significantly influences the sensitivity of a given area to heat waves, being elderly people the most affected category.

Urbanization level is a proxy for soil sealing (or imperviousness) degree, since the Corine classes (continuous and discontinuous fabrics) are basically distinguished by their degree of soil sealing. According to numerous studies, green areas play a key role in reducing the impact of UHI. Here, we will consider the role of green areas combining the proximity of urban fabrics to green areas—measured through the ratio of the perimeter of each SRU adjacent to a green area and the total perimeter of the SRU—and the level of biodiversity of the green areas.

Even though the presence of green areas significantly increases urban resilience to heat waves, by lowering air temperatures, this contribution varies according to the type and the state of health of the vegetation as well as on its arrangement (Petralli et al. 2014). Thus, due to the lack of detailed information on the features of the green areas, we refer here to the available classification into different levels of biodiversity carried out in 2014 by the Province of Naples.

Taking into account that the highest levels of biodiversity are generally attributed to forests and the lowest to agricultural areas characterized by horticultural greenhouses, we consider that the higher the level of biodiversity of adjacent green areas is, the greater its contribution to reduce UHI impact will be.

The briefly described indicators have been calculated for all the SRUs of the Metropolitan City of Naples and related to five vulnerability classes (from very high to very low).

It is worth noting that, since the finest classification of the discontinuous fabric into four more classes (from dense to very low density) is available only for the Capital Cities, all the SRUs characterized by a continuous urban fabric have been attributed to the highest vulnerability class, whilst all the discontinuous ones to the lowest.

The obtained values for population density, ageing index and proximity of urban fabrics to green areas have been sorted and grouped into five classes through the natural breaks method.

The final map (Fig. 3.9) allows us to identify the most vulnerable urban areas in the Metropolitan City of Naples, to which allocate resources to carry out in-depth vulnerability surveys or to promote tailored to the site adaptation measures.

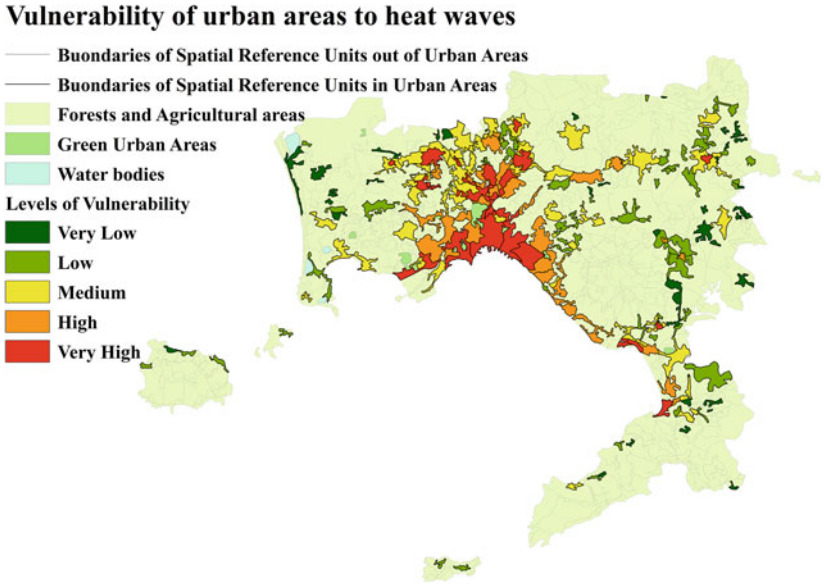

Fig. 3.9 Vulnerability of urban areas to heat waves (*Source* By authors)

The provided examples highlights the potential of GIS tools for optimizing existing knowledge as well as for filling up current gaps in knowledge, providing planners and decision-makers with a more comprehensive understanding of human and natural dynamics on which the identification of priority areas and interventions, the evaluation of the impact of alternative land use choices, the choice of cross-sectoral strategies aimed at enhancing a sustainable and resilient urban development have to be based.

3.6 Final Remarks

This contribution has been focused on the increasing awareness that the numerous pressures challenging cities' development, largely arising from the interactions among human and natural dynamics, can be counterbalanced only by overcoming the so far prevailing fragmented and sector-oriented approach to knowledge, which largely informs current and often ineffective sectoral policies and tools.

The growing complexity of the interactions among urban development processes, loss and/or degradation of natural resources, climate change and disaster risks demands for a "comprehensive diagnosis of the problems at stake" (Loevinsohn et al. 2014), capable to grasp interactions and feedbacks among the different phenomena. Missing this target may lead to the paradox that the wider and wider amount of available knowledge results as ineffective in reversing current negative trends.

To shed light on the need for reframing current approach to knowledge, the contribution has focused on the recently established Metropolitan City of Naples, by highlighting on the one hand, limitations and shortcomings arising from the current segmentation of competencies and knowledge; on the other hand, the potential of GIS tools for re-shaping existing knowledge in respect to areas of concern rather than to disciplinary boundaries.

The in-depth analysis of available knowledge related to urban development processes, loss and/or degradation of natural resources, climate change and disaster risks in the Metropolitan City of Naples clearly highlights both the difficulties to compare available data and information collected and elaborated in respect to different geographical scales, time periods, classification methods and so on and the persisting gaps in the knowledge (e.g. the lack of widespread analysis related to soil sealing phenomena or to exposure and vulnerability to natural and na-tech hazards or even to climate change and climate vulnerability).

Therefore, some hints for building up an integrated and dynamic knowledge base have been given, highlighting the potential of GIS tools for better

understanding the temporal and spatial dynamics of coupled socio/ecological systems as well as for establishing a continuous learning process, crucial for supporting sustainable and resilient development processes.

Despite GIS tools can significantly contribute to re-shape current knowledge—by integrating, for example, different knowledge sets arising from heterogeneous disciplines—the most ambitious goal to overcome currently fragmented and sector-oriented approach to knowledge, for shedding light on the complex network of ecological, social, economic, climatic factors that shape urban metabolism, can be achieved only through a wider process of change, nowadays only partially initiated, both on cultural and organizational level. In detail, the effective reframing of current knowledge requires on the cultural level, the overcoming of the reductionist approach that has for long permeated knowledge in different scientific fields and the consequent shift towards a systemic thinking capable to reconnect which is currently disjointed and compartmentalized (Morin and Kern 1999).

On the organizational level, the building up of an integrated and dynamic knowledge base requires a stronger cooperation/coordination among the different institutional bodies that, on different scales, are currently in charge of knowledge, planning and management activities related to the interconnected challenges at stake.

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Resilience, Sustainability and Transformability of Cities as Complex Adaptive Systems

4

Marta Olazabal

Abstract

Cities can be understood as complex-adaptive systems that have the opportunity to manage their resilience towards sustainability through processes of transformation. The concept of 'urban resilience' has been applied in many different disciplines (climate change, disaster risk reduction, planning, economy, sociology and psychology) which enrich the study of its tenets. Yet there is a lack of a shared framework, of a widely accepted definition and a lack of an operative approach to urban resilience. In addition to this, the concept of 'transformation' has been discussed and used in the study of different types of systems such as socio-technical systems (STS) and socio-ecological systems (SES). In this chapter the 'umbrella' concept of 'Sustainable Urban Transformation' (SUT) and the specific notion of 'Urban Resilient Sustainability Transition' (URST) are proposed to provide a conceptual framework for resilience and transformability and answer the question of how cities should plan and manage their processes of change towards sustainability. Further, three challenges are identified: investing in technology, grey and green infrastructures; understanding institutions and actors in SUT; and fostering knowledge generation and management for enabling urban resilient sustainability transitions.

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4.1 Introduction: Urban Complexity and Change

Urban complexity starts with the characterisation of the urban area itself. Satterthwaite (2011) asserts that there is no widely accepted definition for an urban area or for a city; that assertions attributing population or consumption data to cities are often incorrect due to definition divergences. Urban areas vary in size, domestic economy, urbanisation patterns, etc. These differences are frequently influenced by geo-political needs, history and cultural heritage among other factors. Together with lifestyle patterns, they determine to a large extent the energy and material consumption levels that can be credited to urban areas. For example, urban areas that are undergoing shrinkage or expansion face different challenges which affect the urban development strategies and the resources available to support them. However, even when the huge divergences in cities' social, ecological, economic and institutional contexts and their development stage are acknowledged, not all cities are equally complex. This is an important issue in the context of transformation as challenges and targets regarding sustainability and resilience in cities will be then context-dependant.

Cities and the systems of cities can be understood as bringing together human and natural complex nested systems (Ernstson et al. 2010; Liu et al. 2007). This view is required to encapsulate the dynamics of the following three dimensions: (i) natural biophysical processes and metabolic flows generated by the demands of urban users; (ii) the effects on human wellbeing of changes in the flow of ecosystem and human services; and (iii) the gradual reactive socio-technical and economic adjustment of cities to shifts in their contextual landscape such as those that may arise in the context of global economic and environmental change.

From this point of view, it is important to discuss what it means to understand a city as a system. In the context of complexity thinking and systems theory, cities are often observed as complex adaptive systems (hereafter CAS) (Alberti et al. 2003). The concept of CAS has a certain level of abstraction and is understood differently by mathematics and physicists and by biologists. The most important characteristics of CAS that arise from both understandings is that complexity may be hidden in a very simple system, and that complex global systems patterns may emerge from interactions at local level (called emergence) (Lansing 2003). Also, the property of self-organization that characterises CAS is relevant for our discussion. In this context, CAS evolve through four phases of transformation: conservation (K), release or collapse phase (Ω), reorganization or renewal phase (α), and exploitation or consolidation phase (r). A new conservation phase starts again forming what is understood as the adaptive cycle (Holling 1986).

As CAS, cities are seen as microstructures that gather forming systems of cities that work better and adapt in better conditions as a macrostructure rather than individually. Therefore, when urban areas are understood as social and ecological complex and adaptive co-evolving systems, the physical scale of the social and economic network becomes relevant, especially regarding the implications for its energy, material and information flows. Any city is part of a 'system of cities' which gives rise to particular cross-scale interactions between the technical and social networks that tie urban areas together and sustain those energy, material and information flows (Ernstson et al. 2010).

For this reason, focusing on the local (administrative) scale of cities has its pitfalls, as it fails to take account of those cross-scaling feedbacks, given the globalisation of resource provision. As argued above, urban areas are not self-sufficient, sustainable units (Rees and Wackernagel 1996; UNU/IAS 2003), and the ecosystem services provision on which they depend is often on a scale that extends well beyond the urban administrative boundaries where local interventions take place. Likewise, the environmental impacts of urban activities cannot be considered as contained within those boundaries. This makes the analysis of cities challenging, especially since they operate as open systems from the viewpoint of metabolism (Grimm and Redman 2004). These system dynamics cause the complexity which characterise urban areas presenting multiple challenges to decision-makers and therefore to those that aim at studying urban change (Grimm et al. 2000; Pickett et al. 2001).

In line with the above, and recognising the social and environmental challenges that cities need to deal with, I assert that new operational tools need to be provided to support long-term urban decision-making under climate change and resource scarcity. This is partly translated into analytical frameworks to help understand the complexity of the interdependencies in ecological, social and economic systems across scales and time which could help forecast and avoid unintended effects.

In this chapter I attempt to advance in this direction from a conceptual point of view by exploring the benefits of applying resilience theory and the sustainable transformation idea as frameworks to understand change and its management in urban complex systems. Particularly, the theory of resilience is used to conceive scenarios of long-term sustainability through processes of transformation.

To fulfil with the objective above, this chapter is structured as follows. First in Sect. 4.2, the concepts of urban resilience, sustainability and transformation are presented and the 'umbrella' concept of 'Sustainable Urban Transformation' (SUT) discussed based on current literature. In Sect. 4.3, an approach to conceptualise urban transition alternative pathways through the specific notion of 'Urban Resilient Sustainability Transition' (URST) is elaborated to answer the question of

how cities should plan and manage their processes of change towards sustainability. Then, in Sect. 4.4, I focus on three important challenges of URST: investing in technology, grey and green infrastructures; understanding institutions and actors in SUT; and fostering knowledge generation and management. Section 4.5 concludes.

4.2 From Urban Resilience to Sustainable Transformation

4.2.1 Context and Basic Definitions

Managing processes of transformation is becoming an urgent need if cities aim to achieve sustainability and resilience in the context of a rapidly changing world (Olazabal and Pascual 2016).

In the management of anthropogenic systems, sustainability and resilience are essentially two intertwined concepts. In the context of urbanization, this is restated in the Goal 11 of the recently formulated Sustainable Development Goals (UN 2015) "make cities and human settlements inclusive, safe, resilient and sustainable". Although sustainability—or sustainable development as in the Brundtland report (UN 1987)—has diverse understandings for different people when it comes to practise, its importance is clearly stated in both science and policy domains (Bolis et al. 2014; Holden et al. 2014). Globally conceptualised, sustainability can be understood as the development that will guarantee the needs of current and future generations and that builds on the welfare of at least three main pillars: society, economy and environment. In practise, sustainability responds to all that we conceive is currently good and desirable in society (Holden et al. 2014) and thus, it might lack from a long term view. As per definition, it defines a desirable status; it does not provide tools on how to achieve the aspirational objectives. In the context of cities, sustainability is still a buzzword used in policy making meaning different things depending on the interests at stake (Rydin and Goodier 2010; Rydin 1999). Although there is a lack of consensus about what a sustainable city might mean or what shape can take both in research and practice, however, sustainability might be understood as a process that encompasses change towards environmental integrity, social equity, economic growth… and also towards normative societal goals (Ernst et al. 2016; Pickett et al. 2013).

From a conceptual point of view, how is sustainability connected to resilience and transformation? Through the concept of such aspirational change. Resilience is associated with the ability to adapt to shocks and reorganise without suffering

significant changes in structure and identity (Walker et al. 2004). However, an important feature of resilience that brings sustainability and the capacity to transform to play a critical role is that systems may be trapped in resilient but undesirable states (Walker et al. 2006) which also applies to cities (Chelleri and Olazabal 2012). This explains the two-sided nature of urban resilience, or non-equilibrium view of resilience as put by Pickett et al. (2004), and requires societies to foster desirable resilient futures which necessarily relate to alternative pathways of sustainable development, i.e. sustainability futures. From this point of view, transformability, i.e. the capacity to undertake a process of transformation, requires society to view itself as being locked into an undesirable (unsustainable) state and with a need to reconfigure a given system by means of new system components and dynamics (Walker et al. 2004). Hence, management of resilience is about making it possible to deliberately alter the fundamental properties of the system and undertaking a process of transformation in order to better cope with emergent conditions (Nelson et al. 2007).

Resilience thinking thus encompasses the way in which change, drivers of change and reorganisation are conceptually understood. In academia, many disciplines use the term 'resilience' to address the concept of shocks and rebound mechanisms, but the link between environmental systems and human drivers comes originally from research into socio-ecological systems (SES). Today, the concept of resilience as a critical factor for sustainability has gained popularity in a number of different policy domains (Davoudi et al. 2012).

Here resilience theory is proposed as a useful approach to long-term sustainability thinking through the concept of transformation.

4.2.2 Urban Resilience and Transformation

The idea of urban resilience as a boundary concept bridging ecology, planning and social sciences was born in urban ecology studies (Alberti and Marzluff 2004; Pickett et al. 2004) and has evolved ever since. To my understanding, the first integrated multidisciplinary approach on the concept of urban resilience was published by Resilience Alliance (2007). This report understood that urban resilience should focus on the amount and kinds of disturbances that urban areas can absorb without shifting to other, less desirable regimes in their quest to balance between urban and ecological functions. Following the complexity discourse of the Introduction, it is key to assume that cities as CAS, are highly dependent, open systems which means that their resilience is contingent on the resilience of

coevolving (sub)systems in accordance with the 'systems of cities'. This highlights the role of metabolic flows in sustaining urban functions, human wellbeing and quality of life. The report also stresses the importance of governance networks and "the ability of society to learn, adapt and reorganise to meet urban challenges and the social dynamics of people […] and their relationship with the built environment which defines the physical patterns of urban form" (Resilience Alliance 2007, p. 10).

Although, during the last 10 years there has been a vast, growing literature on urban resilience (see Fig. 4.1), there is a rather abstract understanding of the concept of urban resilience which is still is far to be operationalised. Yet, many authors agree on the usefulness of resilience as a boundary concept that can bridge disciplines (Brand and Jax 2007) and this responds to the context of cities as CAS that cannot be understood or explained using a single lens. In spite of the unclear boundaries of the concept and the lack of a shared understanding and dialogue among scientists, resilience theory adapted to the urban context maintains a huge popularity in urban studies.

While multiple, isolated combinations of approaches enrich the study of urban resilience, there is a lack of a basic shared approach, and indeed of a widely accepted definition of urban resilience. More empirical and analytical work at urban level is needed. Applications tend to vary depending on the space and time boundaries for the resilience phenomena being analysed (Pendall et al. 2010). To this end, the heuristic question: resilience of what to what? (Carpenter et al. 2001) still applies to the context of cities (Meerow et al. 2016) and it would be useful to supplement it with a clear definition of the spatial and temporal scales involved (Chelleri et al. 2015).

The concept of urban resilience has been used in the context of risk and vulnerability assessments, institutions and communities capacity to adapt, infrastructures and built environment resistance, resilience in (or of) different sectors (e.g. ecosystems, economy, etc.) and transformations of urban areas. It has been reflected in many disciplines such as urban planning, urban ecology, urban and regional economics, disaster management studies and extensively in the context of climate change (Olazabal et al. 2012). If not rooted in bouncing back principles but in learning, self-organisation and adaptive management, whatever the application, this new outlook onto urban governance complements sustainability science by providing new, longer-term perspectives.

In this line, Leichenko (2011) defines Urban Resilient Sustainability (URS) as a long-term sustainability, which requires flexibility and adaptability to undergo processes of transformation. Transformation is an underlying idea which is often present in urban resilience research. Innovation (and technological change) is seen

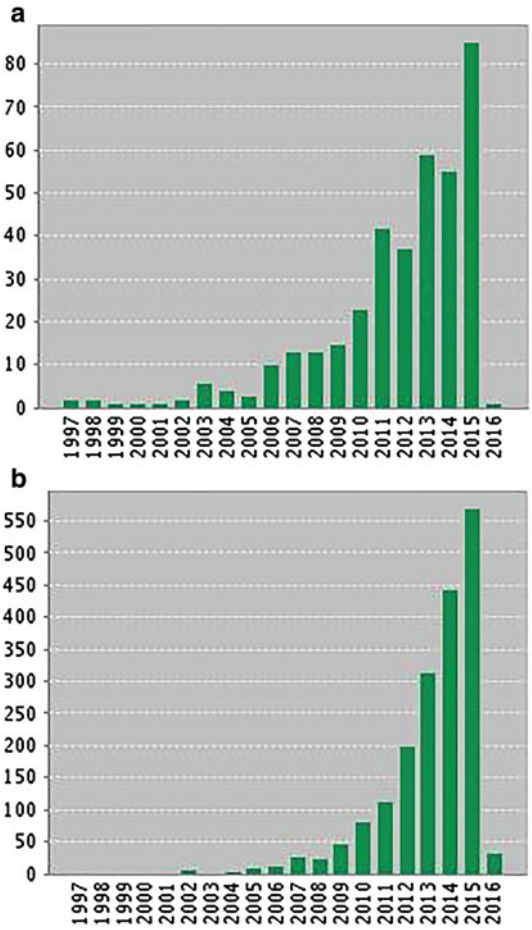

Fig. 4.1 Indexed articles published on urban resilience **a** and evolution of citations **b** (*Source* Thomsom and Reuters Web of Science (WOS) database. Search criteria applied: TI = ((resilient OR resilience) AND (city OR cities OR urban*)) NOT TS = (mental OR psycho* OR medical OR child* OR adolescen*). Results found: 382 publications; H index: 22; 1671 times cited without self-citations. As of February 1, 2016)

as a fundamental element in the process of transformation. So far, however, few studies have shed light on the question of how to integrate resilience, sustainability and transformation into urban decision-making. Some of them deserve special attention:

Pelling and Manuel-Navarrete (2011) tentatively analyse urban governance structures and how they address transformation, with explanations in terms of the adaptive cycle. This is an important contribution which maps the relations of social power into the discourses of resilience, sustainability and transformation. On the

other hand, Pickett et al. (2013) build on principles of urban ecology and assume that the key to resilient, sustainable transformation is the successful integration of ecological principles into urban management. Although this approach is helpful in working towards the integration of ecosystems services into urban development, it sheds little light on urban policy practises as it is still at a conceptual stage. However, in line with the approach followed in this chapter, Pickett et al. (2013) see resilience as a tool for urban transformation to sustainability and sustainability as a normative social goal which has two key features: one related to achieving inter- and intra-generational equity and the other related to achieving resilient social, economic and environmental processes.

4.2.3 Contextualising the Concept of Sustainable Urban Transformation

Here, I argue that cities need to take on a more active role in sustainability transitions, which here understood as the different alternative pathways in which transformation towards sustainability can take place (Olazabal 2014; Ernst et al. 2016). As resource consumers, cities might be drivers of impacts, but they can be also drivers of positive change. As asserted by Dawson (2011, p. 183), "there is an urgent need to adapt our cities to first reduce their impacts, but also to transform them into positive economic, social and environmental forces".

However, according to several authors (Hodson and Marvin 2010; Smith 2010; Truffer and Coenen 2011; Westley et al. 2011), cities have a limited role in global transitions to sustainability due often to their poor or even lack of competencies in policies in many sectors, e.g. strategic planning of critical infrastructures such as waste, water or energy (depending on national and regional regulatory frameworks). Up to now, research on the determinants, driving forces and mechanisms of sustainable transformation has focused on higher scales rather on the urban scale (Yang et al. 2010). However, there is still consensus that, regardless of who should be the agency of change, if cities are hubs of development and places where consumption and production take place then urban sustainability transitions are critical in the quest for global sustainability (Nevens et al. 2013; Ryan 2013).

There are two communities that are contributing to the concept of sustainable urban transformation. One is rooted in socio-technical systems (STS) research and the other on socio-ecological systems (SES) research.

Research on the application of the socio-technical approach to transitions for fostering urban sustainability is currently emerging (Ernst et al. 2016; Næss and

Vogel 2012; Nevens et al. 2013). While the overall contribution of this research and its integration into the existing debate have not yet been articulated, it provides useful insights into the management of transition processes (Loorbach 2007) and the innovation needed to stimulate niches which can upscale sustainable transformations (Nevens et al. 2013). Romero-Lankao and Gnatz (2013) build an approach to conceptualize and put into practice urban transformations in which insights of urban political ecology (metabolic flows within urban networks) are contextualized in a STS transitions framework where transformations are stimulated at niche level and need favourable landscapes for the uptake of innovations. They illustrate these through two Latin-American cities where there are similar sustainability and resilience challenges: one where innovation was stimulated via a top-down approach (scientists, technical experts and entrepreneurs, actors with decision-making power) and the other where systemic changes where promoted through a bottom-up, more participatory, more innovative approach. The results show that more profound systemic changes were achieved in the case that used the top-down approach, supporting the idea of niches of change.

As argued by Kemp and van Lente (2011), sustainability transitions involve two major challenges: long-term change of technologies and infrastructures; and changes in the options facing consumers, which are needed to support the first change. These insights come from broad experience in the study of socio-technical transitions (see e.g. Geels and Kemp 2007; Rotmans et al. 2000). In relation to urban areas, Geels (2010) states that cities may play a role in technological transitions in three ways: (1) city governments and agencies may be important actors for specific sustainable interventions related, for example, to transport, water, waste management, etc.; (2) cities may be the locations for experiments with low-carbon innovations; but (3) cities might have a limited role compared to market dynamics and other actors. In this line, he argues that as regards technology, successful transitions exclusively focused on cities cannot be guaranteed.

Clearly, market dynamics and technology dynamics are much bigger than cities or systems of cities and often drive (un)sustainable development by establishing certain consumption patterns or providing new ways of solving environmental, economic or social problems. However, the point here is that cities are CAS formed by coupled economic, technological, social and environmental networks. This means that whatever the scale that drives the agency of change in sustainable (technological) transitions may be, cities need to engage with it in a sustainable way, driving and controlling the transformation at local level so that it spreads into other systems too. As argued above, it is in cities that innovation, development and consumption take place. This deserves special attention and specific agents to enable them to be articulated.

Research on how to operationalise the concept of transformation in cities from a SES perspective is lacking. There has been attempts to establish a framework such as the moves defined by Ernstson et al. (2010) or the studies of Pelling and Manuel-Navarrete (2011) and Pickett et al. (2013). However, further research is needed.

Although the literature on transition research, urban sustainability and resilience and on its linkages is recent, the need for a common approach to them is increasingly argued. On the positive side, research and experience gained in socio-technical transitions research and the socio-ecological resilience theory provide good frameworks for the development of an adapted framework for sustainable urban transformation.

4.3 An Approach to Conceptualise Urban Transition Alternative Pathways

When the local scale rather than the global one is considered, the responsibility of the actors shifts from facilitation to implementation (Klein 2004). Because 'implementation' requires identifying visions, objectives and means to achieve them, it is at this point when we need to reflect on the idea of sustainability and sustainable development.

As previously argued, there exist different models of 'sustainable development' and a variety of visions of what a sustainable city is, however it is necessary to recognise the diversity of pathways in which sustainable urban development could be achieved in an attempt to accommodate the different social and political interests that need to find a shared goal in the long-term run (Rydin and Goodier 2010; Rydin 1999). Cities should seek to become sustainable in the context of their own environment and challenges (Dawson 2011). This translates into a variety of urban futures built through different combinations of technical, social and economic dynamics.

One other important issue refers to the diversity of stakes on urban development pathways among urban agents or others at higher scales. Hidden interests in cities may foster a steady-state environment that locks them into unsustainable resilient patterns. This follows the theory that resilience, unlike sustainability, can be desirable or undesirable (Carpenter et al. 2001). It is 'sustainability' that confers 'resilience' of a desirable objective.

This raises the need to define a new term that brings together URS and alternative transition pathways. Here I use the concept of "urban resilient sustainability transitions" (URST) to describe specific processes of transformation that guarantee

long-term sustainability. The need then arises to establish sustainable management objectives and specific characteristics of these processes that can support sustainable transformation. Pathways for transitions refer to the alternatives found when the processes of transformation are implemented. Such pathways can achieve different degrees of sustainability.

Conceptually, the first step in a USRT process is to break out of potentially existing unsustainable traps by providing elements to bring enough flexibility and adaptability to the system for it easily to embrace the process of transformation. However, there are many possible sustainable, resilient states. I illustrate this idea of multiple alternative states in Fig. 4.2.

The idea of multiple states is a fundamental contribution of resilience theory. In line with complex systems theory is the understanding that most social-ecological systems, as complex systems can organise around a number of possible stable states (Beisner et al. 2003; Berkes et al. 2003; Holling 1973), all of which lie within the same function and structure. This means that a handful of alternatives might be possible around a desirable state. These alternatives are known as Multiple States.

In Fig. 4.2, multiple states are represented by dots, in four types of regime in urban systems characterised by their degree of resilience and sustainability [(1) Low sustainable and low resilient, LS + LR; (2) Highly sustainable and low resilient, HS + LR; (3) Low sustainable and highly resilient, LS + HR; and (4) highly sustainable and highly resilient, HS + HR].

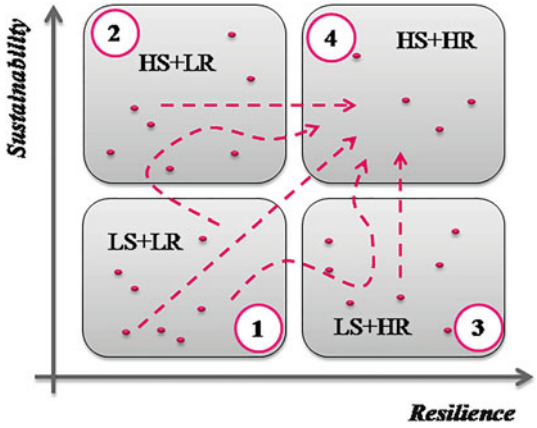

Fig. 4.2 Characterisation of desirable states and alternative pathways of transformation

Dotted arrows symbolise a theoretical illustration of examples of transformation pathways in cities towards the most desirable regime (represented by 4 in Fig. 4.2). To break out of unsustainable states (1 or 3 in Fig. 4.2) it is important for policy makers and in particular managers to focus on the costs and benefits of fostering major transformations in the urban system rather than trying to trigger the adaptive processes necessary to maintain the status quo.

Clearly, for transitions to be stimulated at city level cities need to cross thresholds, which can sometimes be contextualised as crises (i.e. collapse phases). Adapting previous literature (Foliente et al. 2007; Loorbach 2007), Fig. 4.3 frames the concept URST and identifies three potential pathways for urban transformation depending on the type of governance used when facing (or perceiving) a crisis (or the need to change).

With favourable conditions and clear instruments and in a context of innovation and maximisation of opportunities, a successful transition path can be taken, thereby saving critical (human and natural) resources and time. This is represented by **Path 1** in Fig. 4.3, which offers the most sustainable outcome, as it is strongly driven by socio-technical transformation, innovation and creativity where collective efforts stimulate change. **Path 2** is associated with crisis and is embraced

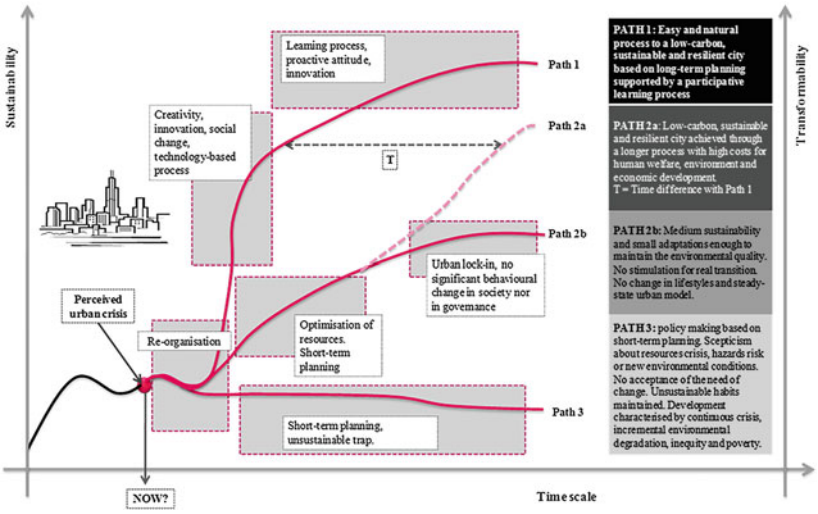

Fig. 4.3 Potential transition pathways in cities (adapted from Loorbach 2007; Foliente et al. 2007)

within policies on optimisation of resources and efficiency, though short term planning is still present in urban management and planning. This can lead potentially to two paths: **Path 2a**, where a slow process of social behavioural change improves sustainability but at greater cost than on Path 1, and **Path 2b**, where urban planning lock-in hinders sustainable development. Finally, in **Path 3** the crisis is ignored and unsustainable patterns are maintained.

As evidenced, URST management entails actors taking decisions on multiple possible pathways and weighing up the pros and cons involving where and how those pathways will be taken and by whom. Multiple interests come into play in urban transitions as sustainable urban transformation is not only about technology, building processes or markets but also about how culture and social values influence the path towards a transformation (McCormick et al. 2013).

Thus, an important question is raised: who are the actors in URST?

Transitions might be initiated from top-down or bottom-up approaches or a combination of the two. While the key role of communities in transitions must be acknowledged, there is also a need to recognise the importance of a cascading top-down strategy to support urban transitions (Cruz-Peragon et al. 2012). Informal networks are good for the early stages of transitions, where testing and innovation is important, whereas formal networks and centralised policy decisions enhance the uptake of innovation through knowledge sharing and through the efficient use of resources (Rijke et al. 2013).

4.4 Challenges of Urban Resilient Sustainability Transitions

URST and the adaptive processes involved include management, monitoring, policy reorientation, which must also encompass continuous adaptations (intensive or extensive) and mitigation of impacts (of policies and interventions). They are defined by a set of actions and a management structure in which experimenting, learning, timing, governance and financing are key influences.

In this regard, I would like to focus here on three important challenges that interact significantly with the above and need to be taken into account in URST governance processes. These challenges are (i) investing in technology and infrastructures as critical in supporting urban transitions (Hodson and Marvin 2010) while understanding the role of green infrastructures in sustainable urban transformation (Gill et al. 2007; Jansson 2013; Lovell and Taylor 2013);

(ii) understanding institutional culture and consumption choices (McCormick et al. 2013); and (iii) storing knowledge of the system, covering both socio-technical and socio-ecological elements and their interactions (Rijke et al. 2013).

4.4.1 Investing in Technology, Grey and Green Infrastructures

Historically, energy, water, waste and transport infrastructures have been fundamental in supporting urban transitions (Hodson and Marvin 2010). In addition, the role of technology is essential to support the construction and use of resilient, efficient infrastructures, means of transport and services, looking to energy and matter flows, their generation sources, processes of production, uses and interdependencies among the elements of the technological network. Although this has been seen to date as a challenging engineering and administrative issue, new pressures such as urban growth, climate change and resource scarcity call for a reconfiguration of these networks (Hodson and Marvin 2010). Governing and planning for sustainable transitions in infrastructures systems and technologies is essential with a view to supporting change in society that needs to face those pressures. Likewise, urban infrastructures can only be managed in a sustainable way by including a demand-side assessment. Technology and infrastructure networks are closely linked to the demand for consumption from society and also to the legal and financial framework in place. According to Kemp (1994), a change in technology induces fundamental changes in production, organisation and the way in which people live their lives. It is for this reason that technology neither can nor should be prioritised as the main guiding principle for a transition but viewed as a compendium of alternatives to achieve a specific objective such as regards climate change mitigation, where at higher levels technology-neutral policies are recommended (Azar and Sandén 2011). However, Jacobsson and Bergek (2011) and Azar and Sandén (2011) also argue that in some cases where there is a high level of self-knowledge, technology-specific policies are necessary. This seems to be the case of cities too, where self-knowledge and historical data can help bring about robust, well-informed decisions about technology development investments in urban areas. In fact, cities are in a far better position to weigh up the individual costs and benefits of using different technologies for highly specific purposes (Kemp 1994).

In this regard, a new perspective that can capture opportunities at better costs is required. Green and blue infrastructures and the assessment of resulting ecosystem services and their co-benefits in cities seem to represent such an opportunity. As argued by Chapin III et al. (2010), recognising the social-ecological interdependencies of human activities and ecosystem services is crucial in identifying opportunities for managing transformation to a long-term sustainability that guarantees such services for future generations. In fact, one of the most important focus of resilience thinking is the significance that this theory puts on the connection of nature and human society (Olsson et al. 2014). Arguably, this human-nature complex connection helps understanding how a sustainability transformation can take place within planetary boundaries, i.e. without trespassing critical planetary ecological thresholds. An integration of nature and its services in urban decision-making would help, thus, to conceive sustainability transformations guaranteeing future ecological services.

Focusing on ecosystem services as the uptake of resilience management in cities and relating this to the built infrastructures that contribute to maintain or co-produce such services should be one of the main focal points of URST governance based on the need for sustainable, continuous provision of ecosystem services to maintain human activities in cities (Olazabal 2014).

4.4.2 Understanding Institutions and Actors of the Sustainable Urban Transformation

Resilience management requires institutions that are flexible, multidisciplinary, diverse, store knowledge and empower learning and cope with uncertainties and surprises (Folke et al. 2002). According to Barbier (2011, p. 60), institutions are defined as "all the mechanisms and structures for ordering the behaviour and ensuring the cooperation of individuals within society". Barbier (2011) also argues that as societies develop they become more complex, and consequently their institutions are more difficult to change. This institutional inertia is thus one of the challenges which URS practices must face when planning for transitions. In line with the discussion in the above section, civil society is also a crucial driver for sustainability transitions as its actions are driven by maximum utility choices. Choices are assumed and fixed by market drivers which establish patterns of growing consumption (Fournier 2008; Mishan 1967; Schumacher 1973). This makes individuals, as causal agents, to influence urban inertia towards unsustainable consumption patterns. In a context where current sustainable policies only

"sustain the unsustainable" (Blühdorn 2007), "the politics of sustainability transitions requires a redefinition of societal interests" (Meadowcroft 2011). Transitions should be accompanied by changes in people's values and beliefs, and society must acknowledge the consequences of individual decisions in costs and benefits for health, competitiveness, environmental quality and global environmental change. However, the consequences of individual actions are not taken on board by society and are often attributed to bad governance and management practices. Over the last decade, there has been an upturn in community-led initiatives which are seen as a key ingredient for successful transitions at city level (Smith 2010). The work done to date by the Transition Towns movement is a key example of this discourse. More and more initiatives all around the world are emerging and this can be seen as an opportunity to stimulate top-down strategies to support them too.

Stakeholders and private actors have a role in URST too, as their objective is to maximise profit from their activities, which affects how and when transitions should take place. There is an evident need to engage businesses to reorient their innovation-related and economic activities and influence general economic conditions and consumer practices (Evans 2011; Geels 2010). In line with this, Whiteman et al. (2011), for example, stresses the need to better understand what conditions can encourage effective bridging activity by companies with a view to facilitating stronger networks of actors and to more tightly couple information flows.

In decision-making, new 'sustainability' criteria have to be internalised, and for this theory the criteria and methods used to meet the desires of people and attain sustainability transition goals need to be reviewed (Geels and Kemp 2007; Kemp and van Lente 2011). Thus, it becomes necessary to analyse vested interests in cities and how they can influence decisions to be made in a context of potential transformation.

The practical barriers to transformation for decision makers continue to be strongly associated with uncertainty about success before interventions are decided, especially as transformative decisions are often seen as politically risky with benefits being accrued in the medium to long run (Kates et al. 2012) and thus not generally in tune with electoral cycles. Best practices are a necessary input to guide urban decision makers in the quest for effective adaptation and transformation. But the practical context-specific barriers to both processes evidence a lack of established models for successful transition initiatives. Cultural values, business models and lifestyles all generate path-dependent dynamics which influence the ability to adapt and transform. It is for this reason that continuous experimentation and learning are central in urban resilience management and to promote robust transition processes (Dawson 2011; Dieleman 2013; Ernstson et al. 2010; Evans 2011;

Hodson and Marvin 2010; Smith 2010). As a result of this, stakeholders' discourses, perspectives, theories and beliefs have great implications for sustainable urban development.

4.4.3 Fostering Knowledge Generation and Management

Identifying the most appropriate and desirable management options for sustainability and resilience requires a process where different management approaches can be tested while emphasising learning, monitoring and continuous knowledge acquisition (Olazabal and Pascual 2016).

The use of learning, knowledge and experience in governance processes is core to resilience thinking (Lebel et al. 2006). From this point of view, the process of learning from past experiences to gain knowledge about how to face future challenges becomes crucial and helps to build a shared vision about the future. As discussed, sustainable urban development is about accommodating the different interests of stakeholders in order to build a common vision of how a sustainable pathway might be. In this mission, there are huge implications of the different discourses, perspectives, theories and beliefs (Wenger 2000). In this regard it is also imperative to recognise the importance of social learning as a process of gaining individual and collective knowledge and experience.

Both, social-ecological and socio-technical perspectives, attempt to understand complex systems and emphasise the importance of continuous processes of learning and adjusting (Van der Brugge and Van Raak 2007) and the need to innovate in means for knowledge acquisition (Beratan 2007). As a result, both resilience and transition management research, recognise the importance of participatory processes in governance approaches to motivate and engage stakeholders in the process of dealing with change. Furthermore, stakeholders' knowledge and experience is also seen as necessary to better plan for any system's transformation, in order to foster understanding and develop a shared vision for alternative pathways required by resilience and transition management. This, points out directly at the need to recognise the importance of the cognitive dimension, mediated by values and cultural contexts, to analyse drivers of change towards resilience and transformation management, especially in complex and uncertain decision-making environments.

Expert knowledge is essential in gaining an understanding of the non-linearities, interdependencies and complexities characteristic of urban systems. Informed decisions influencing these systems must take into account such complexities in

order to avoid unintended impacts and plan alternatives or compensation measures accordingly. In practise, cities still lack operative tools applied to the urban context which can address the need to model transitions and build maps of alternative actions (Hodson and Marvin 2010). It is unclear how this challenge should be addressed because, as argued by Dawson (2011), it would be naïve to pre-define sustainable transitions when uncertainties and surprises need to be addressed through flexible strategies.

The idea of visions in transition management is critical for developing strategies and giving direction to learning processes. New tools now include methodologies for generating visions of low carbon urban futures or the so called "transition arena" (Nevens and Roorda 2014). First and foremost, identifying the need to think about potential scenarios is a cornerstone of successful pathway envisagement (Hodson and Marvin 2012). However, this very first step is already affected by knowledge and cognitions and both are influenced by values and culture and may determine adaptation and transformation capacities in cities.

In this context, the assessment of potential alternatives and the implementing of monitoring processes along with the transition plan could provide good support for governance and prevent undesirable outcomes, enabling transition policies to be forecast and reoriented and abatement/mitigation measures to be put in place to offset negative indirect impacts. This way cyclic and continuous processes of learning and adaptation can take place through evaluation processes drawn up from a long-term, multi-scale, cross-sectoral perspective (Dawson 2011). Yet knowledge does not only influence policy making. Data availability and transparency is a key issue in social participatory resilience building as society's choices are often influenced by a lack of information.

4.5 Conclusion

Cities as Complex Adaptive Systems (CAS) evolve through processes of transformation. Because of the complexity of cities and the systems of cities, management for sustainability is not a simple task. Adding to this, there are multiple understandings of what sustainability might mean in the context of cities and although it often responds to current normative social goals, it depends on the interests at stake. For this reason, implementing a long-term view in sustainable management is required. In this chapter I propose to use the concept of resilience as a useful approach to long-term sustainability thinking through the concept of transformation. Through an extensive review of literature and a conceptual framework proposal, this chapter seeks to answer three core questions: what are the

connections between urban resilience, sustainability and transformation? How might sustainable urban transformation be stimulated? And what are the main challenges involved?

Resilience complements sustainability approaches by providing a framework to conceive pathways of change. Based on socio-ecological and socio-technical systems research, I have presented in this chapter a framework to understand Sustainable Urban Transformation (SUT) as the global process that can be realised through alternative pathways of change, i.e. transitions. Understanding that resilience is two-sided, based on the definition by Leichenko (2011), I define Urban Resilient Sustainability Transitions (URST), as the group of alternative pathways of change towards long-term sustainability. When and how transitions are managed is critical. I conceptually demonstrate the importance of the time scale after reorganization and how creativity, innovation and learning from past experiences might help to achieve higher levels of sustainability in the long term upon higher levels of change.

For this to happen, three challenges are identified in this chapter: investing in technology, grey and green infrastructures; understanding institutions and actors in SUT, and fostering knowledge generation and management. Cities as complex human-natural systems need to be managed on the basis of the resources available, the demand and also, on the basis of the means to acquire, distribute and consume those resources. For this reason, URST need to be planned including technology needs and a reasonable planning of infrastructures for water, energy, waste and transport that can satisfy the demand without surpassing the limits of the provision of the ecosystem services available. Alternatives are multiple and decisions are context-dependant and will need to adapt to changing future conditions. Accordingly, institutions and actors that are flexible, multidisciplinary, diverse, store knowledge, empower learning and cope with uncertainties and surprises are critical in URST. For this, understanding interests, desires and visions of actors in SUT is fundamental in order to generate processes that are inclusive and facilitate engagement of actors to build more robust visions of desirable futures. In this process, learning is key. To understand the complexity of cities and their complex dynamics, continuous processes of knowledge acquisition, learning and adjusting to new conditions are required. Cities need to innovate in the means to collect and use knowledge so that the direction of transitions can be continuously reconsidered in light of new conditions.

Considering the above, some conclusions can be made regarding URST: Transitions are context-specific; there are no widely accepted models of what a sustainable city is; rather, cities should seek to become sustainable in the context of their own environment and challenges, and depending on the common interests at

stake. Transitions can be stimulated from top-down and/or bottom up (community led) initiatives and obtained through a combination of technology development and mobilisation of society taking into account the provision and management of the ecosystem services on which cities depend. Integrating urban-regional ecosystems in decision-making processes, and taking into account how infrastructures and technology may shape urban transformation and vice versa is essential. Finally, the level of long-term success of transitions depends on the combination of measures, the timing of the implementation, the engagement of different socioeconomic groups, their will to change and the ability to foresee opportunities. With this purpose, not less critical is how they generate and make use of context-specific knowledge.

Cities still need to 'learn how to learn' and learn how to manage uncertainties in decision making to generate the flexibility that true implementation of urban transition requires in a rapidly changing, urbanised, technocratic world. We are now at a juncture where cities must move away from traditional management approaches and towards innovative and inclusive urban planning and management that takes into account the complexity of dealing with numerous challenges (resource scarcity, climate change, poverty, quality of the urban environment, social equity and justice among others), it is based on learning and experimentation and builds on flexible but robust solutions in line with the long-term thinking. Responding to this need, the approach to Sustainable Urban Transformation presented in this chapter and the challenges of Urban Resilient Sustainability Transitions identified, can be used to design pathways of desirable and stable change.

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The Challenge of Change: Planning for Social Urban Resilience

5

Anna Widborg

Abstract

Recent research has shown that the main challenge regarding urban resilience planning is to broaden the views and go beyond resilience in relation to climate change, and incorporate other important societal aspects. The aim of this chapter is therefore to analyse contemporary planning aims and practices relating to the adaptation and resilience of urban social change. How and to what extent is social change incorporated within the aims and practices of contemporary planning for urban resilience? What means are needed to bridge the gap between urban resilience planning for environmental and social change? The method used is a textual analysis of five case studies; three international and two Swedish studies, which results in a comparative and theme based analytical matrix. The main findings show that urban resilience is still dominated by its environmental change aspects, and that social urban resilience is not yet a commonly used phrase within contemporary urban planning. By adapting some of the approaches used within environmental urban resilience when planning for social changes however, cities can be more resilient and be able to better identify, adapt to and improve the changing social patterns such as demographic changes and social exclusion.

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5.1 Introduction

Urban resilience is a relatively new concept that still lacks a clear definition. The term resilience originates from the biological discipline, which is a biological system's or organism's ability to resist and recover from a shock, disaster, illness or other type of change (Arefi 2011; Folke et al. 2010). Defining urban resilience from this perspective "generally refers to the ability of a city or urban system to withstand a wide array of shocks and stresses" (Agudelo-Vero et al. 2012). Since this is an adaption of the ecological perspective it does not completely embody the complexity of urban functions. Instead urban resilience can be viewed as "the degree to which cities are able to tolerate alteration before reorganising around a new set of structures and processes … a society that is flexible and able to adjust in the face of uncertainty and surprise is also able to capitalise on positive opportunities the future may bring" (Resilience Alliance 2007). This suggests that resilience does not always require that the system will return to its previous state or equilibrium, but rather has the possibility to adapt and transform into a state that will allow it to survive further and future change (Folke et al. 2010). Cities share these resilience abilities, since urban areas are subjected to a various range of changes (Arefi 2011).

Urban planners and policy-makers are making efforts to adapt to various global processes that impact cities today. However, these are often related to spatial (i.e. urban densification), economic (i.e. economic crisis) and environmental (i.e. global warming) changes and tend to leave out the complex of problems regarding social costs (Kerr and Menadue 2010). This includes social exclusion elements such as poverty, deprivation, poor housing and other types of social change within urban areas. The challenge here lies within planners' ability to forecast and react to these changes, or else there will be an unbalance between planning policy intention and impacts (Ward 2004).

In summary, urban resilience can be viewed as having the concept of resilience applied to that of cities. This means viewing cities and urban space as 'systems' that are constantly exposed to both internal and external types of change. In order to gain resiliency, cities need to be adaptable in the sense that they need to be able to withstand and adjust to disruptions. As discussed earlier, urban resilience is not only about surviving potential risks and threats, but rather about grasping the positive outcomes these changes and transformations might bring. Urban planners and other involved actors such as policy-makers and local governments play an important role within the shaping of resilient cities. Because urban resilience is still

a debated and complex matter, urban planners are facing various challenges when applying this concept to planning practices and policy implementations.

The main challenge regarding urban resilience within planning today, both theoretically and empirically, is to broaden the views and go beyond resilience in relation to climate change and to further include social, cultural, economic and spatial aspects. This will help to better understanding the resiliency of cities and how they should move towards a more resilient state (Jabareen 2012). In relation to the discussion above it is of importance and relevance, both from an academic and from a planning perspective, to further examine urban resilience and especially so to incorporate a broader variety of dimensions that goes beyond climate change and the ecology discipline.

The aim of this chapter is therefor to analyse planning aims and practices relating to the adaptation and resilience of urban social change. Since most of the literature within the subject has focused on studies within the US and Australia (Hamin and Gurran 2009; Kerr and Menadue 2010) it is of interest to compare international experiences with an examination of local practices in Europe. This will lead to a further clarification of contemporary urban resilience planning, and how well the strategies that are being used today are able to meet the challenges of change in the future. Based on this aim, two research questions have been defined. How and to what extent is social change incorporated within the aims and practices of contemporary planning for urban resilience? What means are needed to bridge the gap between urban resilience planning for environmental and social change?

The method used in this study is a textual analysis of a few case studies on contemporary planning aims and practises. The first part of the analysis is a contextual and international study, with examples from the city of Keene in the US, the city of Salisbury in Australia and the city of Birmingham in the UK. This is followed by a study of Swedish urban resilience planning using two local cases. The first case is the municipality of Karlstad, which is working with resilience and disaster risk reduction (DRR) approaches connected to flooding. The second case is from Rosengård in the city of Malmö. This study looks at a specific adaptation and social sustainable development project called “Bennets bazaar”, which transforms an old residential area to meet the changing needs of the community. The result of the textual analysis is shown in a comparative and theme based analytical matrix.

5.2 Planning for Social Urban Resilience

Holling, a theoretical ecologist, introduced the academic term *resilience* in its original meaning in 1973. It is derived from the Latin word resilire, which means 'to rebound' or 'to recoil' (Holling 1973). The definition of resilience varies depending on discipline, perspective and scientific background. A common denominator that determines resilience is the ability or capacity to deal with disturbance. Disturbance can take many shapes such as stress, crisis, disaster or shock. Although they carry slightly different meanings, what they really point at is some sort of internal or external change. Because of this, resilience is often seen as a process rather than as a fixed state. The process starts with some sort of disturbance, as discussed above, and continues with phases of adaptation and transformation.

Incorporating the notions of adaptation and transformation within the concept of resilience, which traditionally stands for the power of resistance, might seem counterintuitive yet they play an essential part, in particular the dynamics between change and the capacity to adapt for persistence (Folke et al. 2010). Folke et al. (2010) defines adaptability as "the capacity to adjust responses to changing external drivers and internal processes and thereby allow for development along the current trajectory […]" (Ibid., p. 1). This implies that adaptability is the ability to adjust to change. It is seen as a process that does not completely alter from its previous state, but instead grasps the benefits and possibilities of change in order to reach further development. A system that fails to have this capacity is seen as vulnerable as opposed to being resilient.

Vulnerability is thus a related concept to that of resilience and can be seen as "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt" (Carpenter et al. 2012, p. 3250). In order to counteract vulnerability there is a need to increase knowledge in how resilience can be strengthened, in both society and nature and other forms of resilience investments, to create an insurance against future change and extreme events (Moberg and Hauge Simonsen 2011).

Resilience has come to be explored in various types of research: environmental studies, disaster prevention, climate change reduction strategies and other forms of nature related forecasting. Expanding even further, it has recently been adapted as a research concept used within social as well as human geography studies. Urban resilience, which means using the concept of resilience within an urban context, has therefore been borrowed from Holling's definition of the term and its ecological connections. Resilience has recently been applied to that of cities by researchers, urban planners and local governments alike. Examples of this are new

urban resilience models such as "the eco-efficient city", "the carbon-neutral city" or "the place-based city" (Arefi 2011).

Urban areas are in a constant process of internal and external change. They decline or expand developing new form and function and are dealing with various difficulties such as segregation, changing demographics and spatial patterns, economic crisis and global competition (Marcuse and van Kempen 2000a, b, c). Cities and urban areas never fully enter a state of stability, and keep on shifting causes, appearances, scales and effects. In this sense, urban areas are similar to other human or natural systems. Arefi (2011) argues that cities and organisms have two key elements in common: the ability to recover from a disaster (or an illness), and the ability to absorb and adapt to change.

Subsequently, urban resilience refers to learning, planning, forecasting, resisting, absorbing, accommodating to and recover from unforeseen changes within cities (Jabareen 2012). Because urban resilience is a complex and multidisciplinary phenomenon, it requires cooperation between various actors working within governance, spatial, economic and social urban dimensions (Olazabal et al. 2012). It is an emerging concept within both urban planning and designing, and requires increasing efficiency such as sustainable energy production; decreasing reliance of oil and non-renewable resource consumption as well as localizing economic development (Arefi 2011).

There is a distinctive difference between mitigation and adaptation in order to increase the resiliency of systems such as cities. Mitigation stands for reduction efforts in order to avoid future impacts, while adaptation focuses on coping with and adjusting to already unavoidable events caused by disturbance and change (Hamin and Gurran 2009). Mitigation efforts generally have had a greater breakthrough than adaptation efforts within policy making and urban planning. Sussman (2009) argues that this is due to the fear that one effort might lead to the exclusion of the other. For example, shifting current mitigation efforts to adaptation could mean an increased acceptance of change and might then lead to unsustainable values and activities. This fear might also be seen as by adapting to unwanted change the responsibilities to prevent the actions that have led to these consequences might lessen (Zolli 2012).

In resilience theory, there is a common division between what is referred to as *specified resilience* and *general resilience*. Specified resilience is resilience applied to a specific set of problems, aspects of a system or more or less known disturbances or changes and is dealt with particular adaptability effort approaches (Folke et al. 2010). The latter, general resilience, refers to when preparing for all kinds of shocks, disturbances or changes which includes does that cannot yet be foreseen (Ibid.). Being too focused upon specific types of changes poses the danger of

losing the overall resilience of a system when struck by unprepared disturbances. On the other hand, managing and creating policies for general resilience often has its costs, when having to "[…] overcome budget limitations, address trade-offs, be acceptable to competing interests, and overcome barriers in politics and the structure of existing agencies and institutions." (Carpenter et al. 2012, p. 3255). This might lead to implementation and investment difficulties and instead creates barriers in striving towards further resiliency.

Asking the questions "resilience of what, to what?" is common when dealing with specified resilience, and especially so within social-ecological systems (SES) (Folke et al. 2010). The questions are often applied to rural resilience approaches, where the system tends to be defined by its boundaries, attributes and components in ecological terms, including ecosystem services (Waters 2012). From an urban perspective, the same questions need to involve more social and economic dimensions and includes administrative boarders and attributes connected to the locality, such as livelihood and urban services. Recent research argue that urban resilience approaches must further incorporate social analyses, such as social dynamics and its relation to urban problems such as poverty, rapid urbanization or informal settlements (Cote and Nightingale 2012; ICLEI 2012). This requires insights in the role of power and culture in adaptive capacity, and a shift from the normative question "for what" to "for whom" (Cote and Nightingale 2012), which incorporates a social and human dimension to urban resilience.

An alarming transformation is taking place around the world, with increased disasters and crisis yearly (Gunderson and Folke 2011), which has encouraged further adaption and resilience approaches worldwide. These rapid changes are affecting the majority of cities and their citizens globally, with impacts on the economy, the environment and communities. These impacts are affecting people differently however, and is most devastating to those already facing marginalising and disadvantaging situations within society (Kerr and Menadue 2010).

Unknown societal changes and transformations are often viewed upon with anxiousness and fear; an increasingly occurring condition due to what Georgantzas (2012) defines as 'our modern temporality'. This is created by constant transformations within and between educational, economical, societal and political systems. Disruptions and fundamental changes have always been present within society, and will most likely continue to do so. Such radical changes are known as societal *transitions*, and in order to better prepare for transitional impacts it is of importance to further understand their functions and influences (de Haan and Rotmans's 2011). Marcuse and van Kempen (2000a, b, c) has identified a few factors that shapes our societies and creates such transitions, which can help in better understanding them: the unclear impacts of globalisation; patterns of

migration and other demographic developments; "race" and racism; the changing role of the public sector and finally changing patterns of choice.

Social changes and transitions are usually caused by developments taking place on higher spatial levels than the local, be it regionally, nationally or even globally (Marcuse and van Kempen 2000a, b, c). Societal processes that are taking place in one part of the world are likely to shape other parts as well. A few examples of this are demographical and migration changes, together with various transforming urban processes: urbanisation, suburbanisation, de-suburbanisation and re-urbanisation caused by urban development and economic opportunities. The notion of "race" and racism is generally used within an US context, but there are also examples of racist attitudes within Western European communities (Ibid.). Another change that has had similar impacts upon society, according to Marcuse and van Kempen (2000a, b, c), is the changing role of the public sector and the overall declination of the welfare state. One example is social housing and how it has been decreasingly subsidised resulting in negative bearings on urban neighbourhood resulting in increased poor and deprived areas in contemporary cities.

The final factor is 'changing patterns of choice', which might seem minor in comparison to the other transitional forces mentioned above, but still has great impacts upon society. These patterns are caused by lifestyle shifts that take place globally, yet mainly in western societies (Ibid.). They differ from the traditional work, family and dwelling standards of the past, and are characterised by flexibility, individuality and increased freedom. This shift has so far had an unevenly distributed development and such lifestyle choices and preferences are not available to everyone. As a consequence of this, low-income and educational groups might instead be affected by a decline in opportunities and choices, due to being 'stuck' in political and economical structures (Marcuse and van Kempen 2000a, b, c). This relates to the previous discussion of 'bad resilience states' and creates traps for already vulnerable communities, and the concept of social exclusion will further be examined later on in this chapter.

Urban spatial form tends to change more slowly than that of social changes such as social relations, economic practices and political aims (Beauregard and Haila 2000). However, the human investment such as relationship and identification of urban spaces are often unchanged. Since cities are a cultural and social product, the human aspect and values, lifestyles and opinions of their citizen's must be incorporated into urban planning in order to create resilient and livable cities. It is of importance to incorporate several time dimensions when developing and regenerating urban space. This includes the lessons of the past and difficulties of the present with the aims of the future. Past trends, investments and social commitments affects the pace of spatial change (Jabareen 2012), which becomes even

more important when tackling the challenge of social planning. Social planning can be seen as planning for enhanced social circumstances and relations within a society or community, often in an urban context.

In conclusion, urban social patterns are changing at an increased pace, affected by societal and global transformational forces. Political and economic structures are changing, together with people's lifestyle choices and preferences, which creates larger demographical changes on society. Urban and social planning plays a vital part when assessing such changing patterns and dealing with their outcomes. Recent challenges include dealing with community deprivation and social exclusion. In an urban context, human activity shapes our cities and their spatial form, defined by social investments and identification processes, yet urban spaces tend to change in a slower pace than social change. This requires cities that are flexible and able to adapt and adjust.

The concept of urban adaptation planning is closely related to what Jabareen (2012) defines as *uncertainty oriented planning*. Urban planning needs to move beyond established approaches and instead become uncertainty oriented and adaptive. Change and uncertainty challenge the way cities are being planned, which often looks at past trends and known problems instead of dealing with uncertainties. This relates to the previous discussion of specified versus general resilience. Also, resilience planning needs to rethink current methods, and to broaden planning dimensions beyond that of physical planning.

As discussed in the previous sections, adaptation relates to adjusting to the impacts of change and disruptions. Jabareen (2012) adds to this discussion by stating that there are two types of adaption management available to urban planners. The first one is "ex-ante management", which is connected to risk reduction, while the second one is "ex-post management" and relates to recover actions after a disaster or disruption. Urban uncertainty planning is in need of both types of managements in order to be fully prepared for change. Urban planning can thus be seen as "the provision of future certainty" by striving for increased resilience within the built environment, physical security approaches and environmental and socio-spatial policymaking (Jabareen 2012). As mentioned previously, urban form and spaces has impact on urban resilience. While urban adaption planning works on a macro level; adaptive spatial form has direct and micro level impacts upon structures within society. This includes public policy, multiculturalism, health, environmental and social justice as well as economic and sustainable development (Ibid.). Urban spaces are shaped by human activities, and simultaneously shape them back in return. Spatial form and design thus becomes a powerful tool when making cities resilient.

Increased resilient thinking is making urban planners within cities to update important urban systems. Zolli (2012) uses an example from New York, where the infrastructure, such as the sewer system, manages to cope with ordinary and daily pressure but fails to handle unanticipated disruptions. Also, cities such as New York and London are currently conducting detailed risk assessments, while others are using generated local scenarios to deal with change (Carmin et al. 2012). Although no single manual or handbook can be made within adaptation planning, due to the locality of the matter, one of the most important approaches is to implement resilience and adaptation-planning efforts into mainstream plans and policies into all aspects of urban development (ICLEI 2012). This will help defining present and future difficulties, increase commitment from stakeholders and citizens, and improve the overall resilience status of cities and local governments. Whether the change is internal or external, harmful or beneficial, environmental or social; a system—be it a city or society—that does not have flexible or adaptable abilities is made liable to various planning related difficulties.

5.3 Case Studies

Although many cities are becoming increasingly aware of the importance of urban adaptation planning, it is still in an early stage globally. Regional differences and trends makes it difficult to set general guidelines and to cooperate worldwide. Many cities are still facing various challenges regarding adaptation, as discussed above. Even so, as the work continues and more resilient planning projects are being initiated, examples of previous experiences can create the motivation and inspiration needed to gain further commitment (Carmin et al. 2012). The case studies that make up the textual analysis have been selected to incorporate a wide scope of different contemporary urban resilience planning practises, geographically as well as thematically.

The first case study is Keene, a rural community with a population of about 22,000 in the state of New Hampshire, which is located in the north-eastern parts of USA. In April 2000, the city of Keene signed the Cities for Climate Protection (CCP) campaign, an ICLEI pilot program (City of Keene 2007). As part of the CCP effort, Keene developed and published a Local Climate Action Plan (CAP) in 2004, one of the first climate action plans within the state. The main goal was to cut community greenhouse gas emissions by 10–20% by the year 2015 (Ibid.). The work changed slightly after the year 2006 when ICLEI launched its Climate Resilience Communities (CRC) program, as the focus shifted from climate change mitigation to adaptation, or rather, a combination of both. ICLEI approached

Keene to become the first municipality within the CRC program due to previous actions towards resilience and combating climate change (ICLEI 2010).

The second case study, Salisbury, is a large metropolitan council in the northern region of Adelaide in southern Australia. In 2006, it had a population of about 118,500 (City of Salisbury 2008a, b). The area is characterised by low-income earners, working in semi-or low-skilled occupations and has an ageing population, of which many has migrated from the UK and rest of Europe during the early 1960 to work in the manufacturing sector (Kerr and Menadue 2010).

In contrary to the climate change adaptation efforts in the city of Keene, the city of Salisbury has instead focused upon resilience planning from a social perspective, which can be explained by the area's unbalanced social structure and problems with social exclusion. The Planning Institute of Australia defines *social planning* as planning that encompasses the needs and aspirations of people and communities through strategic policy and planned actions that integrate with urban and regional planning, management planning and other planning processes (Ibid.). It is based on social justice, and combats the negative effects that social exclusion and segregation has on a community. Social exclusion is viewed as something connected to poverty, deprivation, poor housing and health conditions as well as the incapacity to participate and be included in society, and that urban planning is a significant tool in combating these problems (Ibid.).

The city of Birmingham is the regional capital and the main economical driver of the West midlands region and second largest city in the UK, with a population of a million people (City of Birmingham 2008; Norman 2012). It has long been an increasingly growing city, due to its manufacturing economy since the industrial revolution. However, like many other industrial cities around the world, the city has been declining since the 1950s although recent trends show that the city is once again heading towards trending growth in both its population and economy (City of Birmingham 2012).

The case study is based on a report by Norman (2012) from 'The Young Foundation', a research centre that works towards achieving positive social change within communities. Its main focus is resilience, with a research question that asks what it is that makes communities not just bounce back from adversity but thrive when faced with long-term challenges (Norman 2012). Geographically it is defined to two wards within Birmingham, Nechells and Shard end, both which are among the most deprived areas due to the consequences of de-industrialisation. To help understanding how Birmingham, and other similar cities and communities, can improve their resiliency to disruptions caused by social change, such as deindustrialization and declining population, The Young Foundation has developed the innovative 'Wellbeing and Resilience measurement (WARm) tool'. The tool is developed and designed to "help communities understand their underlying needs

and capacities" and combines two community concepts: *wellbeing* and *resilience*. It elucidates both community strengths and weaknesses, and combines subjective and objective data (Norman 2012).

The last two cases are local studies in Sweden. The Swedish national aims and directions for resilience in an urban context generally refer to environmental resilience with a holistic approach. It includes perspectives such as economy and social dimension, yet mainly refers to changes caused by climate change. Lindahl Olsson et al. (2012) aims towards preparing for social urban change is present, but in the form of social sustainability and social planning. Since social exclusion and segregation are two current challenges in Sweden, using resilience aspects to urban planning can increase the overall preparedness to social change and disruptions, and increase community resilience (Fredriksson and Marntell 2013).

Karlstad is a municipality located in the middle of Sweden and close to Vänern, which is the country's largest inland lake. It has a population of about 87,000 citizens (UNISDR 2016). The municipality was announced as a "Resilient City" in the year 2010, by participating in the "Making Cities Resilient" campaign, initiated by the UN (Karlstad kommun 2012a, b, p. 1; Sida 2011). Because of this, Karlstad is seen as a resilience role model as it was the first municipality in Sweden to do so. Today, five other local governments in Sweden have reached this status: Arvika, Gothenburg, Jokkmokk, Jönköping and Kristianstad. In the case of Karlstad, what makes the municipality unique is its geographical location, surrounded by water because it is situated in the delta between Vänern and the river Klara (Sida 2011). Its closeness to nature and water has benefits for both its citizens and tourists, but also leaves several difficulties when dealing with impacts of environmental disasters and climate changes. The most threatening risk for Karlstad is flooding and rising water levels. An analysis of the present and future flooding risks in Karlstad from 2007 has concluded that its current environmental situation will change drastically during the next 50 or so years, with rising temperatures, increased annual downfall and rising water levels together with increased wind and storm levels (Bergström and German 2007; Bergström and Andréasson 2009).

The final case study is the 'Bennets bazaar' planning project, which was developed and completed between the years 2006–2009 (Hållbar stad 2012). It is located in a centrally situated yet suburban area of the city of Malmö called Rosengård. The area is mainly residential, built in 1967 with typical Swedish post-war suburban architecture. Examples of such modernistic form are the location of the main entrances, which are facing the inner yards of the buildings (Ibid.), or with the ground floors solely used for accommodation (MKB 2010). This limits the amount of street life and variation of activities present in the area. A residential building block was targeted by the project, located by an important node

connecting the inner city parts of Malmö with the rest of the Rosengård. The inhabitants here have during the past years developed temporary and provisional local business within the buildings, located in basements and storage rooms. This showed that the area had the potential to change, as it did not accommodate the current needs of its inhabitants (Ibid.).

The city of Malmö identified an increased need to enhance the social character that defines Rosengård (Malmö Stad 2016), which had a population of about 22,000 in 2008 (MKB 2010). It was originally a country estate, but the area's characteristics have changed drastically over the years, mainly as a result from the "Million Program" developments during the 1970s (Eriksson and Björnson 2012). Today it is struggling with problems resulting from separated community functions and increased segregation (Ibid.).

To improve the area, the solution was the creation of *bokaler*, which stands for a combination of the Swedish words for accommodation and premises (bostad + lokal) (Hållbar stad 2012). Although innovative in the way it has been applied in this context, the idea is originally an old concept but is seldom used today. A bokal is a combined space that accommodates both living and commercial space and activities (Malmö Stad 2016). This enables a new type of rental contracts to entrepreneurial inhabitants and has several benefits, both from an individual and a neighbourhood scale level. Some individual benefits include the reduction of having to commute to work and increased family presence and security, while the neighbourhood benefits from increased local liveliness and street activity (MKB 2010).

5.4 Analysis

The result of the textual analysis of the selected case studies above is summarised using a comparative and theme based matrix in Fig. 5.1. A few emerging themes has been identified, and a total of 17 urban resilience aspects have been incorporated into the matrix based on the theoretical discussion as well as the findings of the case studies. As shown in the matrix below, aspects 1 and 17 relates to the urban resilience discussions regarding resilience and adaptation versus sustainability and mitigation. Various researches argue that it is important to incorporate both adaptation and mitigation efforts into urban planning since one approach does not exclude the other bur rather needs to work in harmony. While the city of Keene and municipality of Karlstad uses adaptation as well as mitigation efforts, the city of Salisbury and the Malmö/Rosengård example uses neither. Birmingham focuses on adaptation efforts solely.

Urban resilience aspects	Keene	Salisbury	Birmingham	Karlstad	Malmö/Rosengård
1. Adaptation and/or mitigation efforts	Adaptation and mitigation efforts	Neither	Adaptation efforts	Adaptation and mitigation efforts	Neither
2. Planning for environmental and/or social urban change	Environmental urban change	Social urban change	Social urban change	Environmental urban change	Social urban change
3. Spatial transformation	Greening new development and existing buildings	Affordable housing	No	Spatial flooding reduction efforts	Physical development
4. Innovative and experimental solutions	Using the Milestones method	With grass root level programs and mentor systems	Using the WARm tool	Local adaptation of national and global guidelines	Bokaler
5. Specified or general resilience	Specified (flooding)	Specified (demographic and diversity related changes)	Specified (wellbeing)	Specified (flooding)	Specified (community needs)
6. Resilience of what, for whom?	Resilience of the built, natural and social environment, for its citizens	Resilience of the demographic structures, for marginalised and poor households	Resilience of the social community, for community members	Resilience of the flooding management, for the city and its citizens	Resilience of the built and social community, for community members
7. Societal systems	Infrastructure, buildings, health and educational institutions	Housing, public transportation	Infrastructure, health and educational institutions, social capital	Infrastructure, health and educational institutions	Housing, public space
8. Type of urban planning	Climate community resilience planning	Social planning	Community wellbeing planning	Using a local DRR approach	Sustainable development initiatives
9. Active risk and vulnerability assessment	Vulnerability assessment, divided into three sectors	No	Measuring current state in local area	Identifying, assessing and monitoring disaster risk	No
10. Identification of priorities	Prioritising areas for action	No	Identifying assets and vulnerabilities	Defining and taking measures	No
11. Scale of strategy or plan	Action plan and general plan	Holistic sustainability vision	Planning to set targets and prioritise resources	Flood risk reduction strategy and contingency plan	Local development plan
12. Accessibility to and level of information	Information via ICLEI	Using demographic data to see patterns of change	Outputs of affected community members	Expert coordinator, UNISDR and Hyogo guidelines	Dialogue with stakeholders and community members
13. Cooperation	Climate committee including various stakeholders	Social planners, citizens and volunteers	Local stakeholders, volunteers and community members	Crisis management committee with local stakeholders	Planners, stakeholders and community members
14. Funding	Financing included in the action plan	Sustainable model without using public subsidy	Localised micro funds	Allocation of financial resources	Governmental funding
15. Incorporation of several dimensions	Physical, environmental, social and economical dimensions	Economical, ecological and social dimensions	Cultural, human, political, economical and social dimensions.	Social, economical, environmental and land-use dimensions	Social, ecological and economical dimensions
16. Clear definition of resilience aspects	Adaptation actions that reaches beyond greenhouse gas reduction	No	To thrive when faced with long-term challenges	Impacts of change occurs also in the present day	No
17. Resilience and/or sustainability efforts	Both are present	No	Both are present	Both are present	No

Fig. 5.1 Analytical matrix (*Source* by author)

There is a relation to this pattern when examining aspect 12, the presence of both resilience and sustainability efforts: in the cases of Salisbury and Rosengård, neither have been present. This might result from the fact that they both focus upon social urban change and social planning efforts (aspects 2 and 8). Because the concept of urban resilience is used within its social aspects, resilience efforts have not been expressly defined within the two case studies (aspect 16). In this sense, the matrix thus shows a visible difference between them and the cities of Keene and Karlstad. Both of the latter examples use resilience to adapt to environmental change (aspect 2), and follows global resilience guidelines developed by institutions such as ICLEI and UNISDR.

Aspects 3, 4 and 5 show some common denominators between the five case studies. The first one relates to the theoretical discussion regarding the importance of spatial space within urban resilience. As argued by Kärrholm et al. (2012), adaptability efforts in coping with urban changes are often resolved around spatial issues, and so spatial transformations is a key aspect in urban resilience. Most of the case studies have had spatial outcomes, although they vary in their scope and degree. Only within the case of Birmingham there had been no specific spatial transformations as an outcome of the studied example. Instead, it focused upon learning, planning and acting on a local scale. The second aspect with a common denominator shows that all of the cases have used innovative and experimental approaches to urban planning to certain degrees. In the case of the five city examples, this is mainly accomplished by new and creative methodology uses.

Aspect 5 shows that all of the cases have used efforts that target specific types of resilience, in opposed to general resilience. These efforts range from flooding to demographic changes and community needs, which is beneficial when dealing with known changes and disturbances. The reason to why none of the cases were preparing or adapting to general resilience can be due to its budget limitations or implementation difficulties (Carpenter et al. 2012).

Urban planning has played a vital part in all five cases, but as aspect 8 shows, the approaches to planning differ depending on the overall resilience perspective. When the resilience of environmental urban changes is the main driver, the planning measures are usually connected to climate change and disaster risk, as in the cases of Keene and Karlstad. When the resilience perspective is focused upon social urban change, such as in Salisbury, Birmingham and Rosengård; the measures are more bound to social and community planning measures. This also results in differing plans types, whether they are more strategically and general or more detailed. As shown in aspect 11, all of the city cases have differing approaches. What they have in common however is the overall connection to planning in order to take *action*; be it through specific action plans, strategies or planning to set

targets and prioritising resources. As pointed out earlier, idealistically, urban resilience planning requires the need to make assessments of vulnerabilities and assets (aspect 9), to set up strategies and prioritisation (aspect 10) and to take necessary actions to adapt to the impacts of change. The approaches and chosen methods must be adapted to the local context, as have been done in the five different case studies.

As the global adaptation planning survey has shown, local governments, urban planners and other stakeholders around the world are often facing similar challenges when dealing with impacts of change. Some of these challenges are represented through aspects 12, 13 and 14. The accessibility to, and level of information vary in the five case studies, as shown in aspect 12. While some gathers information through resilience guidelines and statistic data, others use outputs from stakeholders and affected community members. Also, it is seen as valuable to include some kind of coordinator in the resilience process, such as shown in Karlstad and is soon to be implemented in Keene. Other challenges included commitment and involvement of politicians and the community (aspect 13), as well as allocating funding and resources specifically to adaptation and urban resilience planning (aspect 14). The result of the matrix shows that in these cases, the cities have been successful in involving various actors, including citizens and community members. One critical point is that although these groups have been mentioned to be involved, it does not show the level of commitment or the scale of inclusion. As stressed in the study of the city of Birmingham, it is of importance not to 'ignore the quiet communities' (Norman 2012).

This brings us to the importance of incorporating aspect 6 when examining and assessing urban resilience, by asking the questions *resilience of what, for whom?* (Cote and Nightingale 2012). Just as the approaches to resilience perspectives and planning approaches varies, so does the extent as to how these questions can be answered in the five case studies. Interestingly, this is mainly in regards to the first question (of what), since all of the case studies are similar in the sense that they are striving towards resilience for their city in general, its citizens, and community members. Even so, the cities can benefit from further social analysis and how the social dimensions of resilience relates to urban issues (Ibid.). Of all the five cases, only in the study of the city of Salisbury has the 'for whom' question included marginalised community groups and poorer household.

5.5 Discussion

Overall, the result of the comparative matrix analysis shows that approaches, measures and methods vary largely, even though some common denominators and themes have been found. As mentioned earlier in the global adaptation planning survey, this is partly due to regional and planning tradition differences. In the case of the five case study examples however, what really sets them apart is how the urban resilience concept, be it in an environmental or social perspective, have been used to deal with specific and local related impacts of change. This shows the importance of local context adaption.

The result also shows the benefits of following a global resilience program or guideline, since this enables a clear definition of the concept. Also, it helps in setting up explicit action and assessment targets. This can be seen in the two case studies of Keene and Karlstad, were both examples follow clear steps towards realising their goals in reaching further resilience. This also means however that such programs and guidelines are still only available when urban resilience is connected to environmental and climate change, and the methods and approaches in dealing with such changes are more developed than in the case of social urban change. To visualise this pattern, the five cases are divided between the two opposing aspects of resilience and/or environmental change efforts versus sustainability and/or social change efforts (Fig. 5.2).

The visual division line above shows that in between resilience/environmental change and sustainability/social change, the example of Birmingham stands in the middle. This is mainly due to its use of the WARm tool, which incorporates the concept of social urban change with a clear definition of resilience from a community perspective. Also, the tool uses a similar approach to that of traditional resilience measures, including vulnerability and assets assessment and prioritising of necessary planning strategies and actions. If overcoming the risk of simplifying or make logics of complex social dimensions, using community resilience tools and approaches similar to that of the WARm tool can enable further implementation of adaptation planning and dealing with the concept of resilience and urban change from social perspectives.

Fig. 5.2 Visual division between resilience and social change

Recent research such as Kerr and Menadue (2010) and Marcuse and van Kempen (2000a, b, c, p. 1) show that current social urban issues are related to social exclusion, segregation and poverty. By using social urban resilience as a mean to adapt to the impacts of such problematic changing patterns, new approaches of urban planning may be implemented were mitigation and social sustainability measures are lacking.

5.6 Conclusion

The findings of this chapter show that urban resilience is still dominated by its environmental and climate change aspects. This is especially true when examining global and national guidelines and directions, which defines resilience manly in regards to its connection to disaster and risk reduction measures.

In most cases, and especially so within the Swedish case studies, social urban resilience is not yet a commonly used phrase within contemporary urban planning. Instead, it has been more or less woven into the 'social sustainability' discursion, both in national directions and local practices. As the theoretical framework has shown, this is rather problematic, since although resilience can be viewed as being part of, or a method to reach, sustainability, the two concepts are still very different and one should not exclude the other. Sustainability is mostly built upon mitigation practices, such as limiting greenhouse emissions; resilience is built upon finding adaptive and flexible solutions to coping with change.

This is something that needs to be addressed further within present and future urban planning. Although recent practices show that it is heading in the right direction, it still has several opportunities in improving the social resiliency of cities. The result of the findings in this chapter shows that one possibility is to adapt some of the methods and approaches used within environmental urban resilience when planning for social changes within society and communities. This has been done in the example of Birmingham using the WARm tool, which uses resilience aspects to enhance deprived and socially excluded neighbourhoods.

The gap between urban resilience planning for environmental and social change can thus be bridged if the WARm tool, or similar approaches, can be further developed and implemented in other regions. As shown throughout this chapter, other means that are needed include implementing urban resilience aspects into mainstream and everyday planning; creating further commitment and involvement of stakeholders and community members; internal and external partnerships; a stronger volunteer sector; clearer definitions of the urban resilience concept; and finally, to balance and combine the planning approaches of adaptation and

mitigation efforts. If the gap can be successfully bridged, cities will be more resilient not only to the changes and threats posed by climate changes, but also be able to better identify, adapt to and improve the changing social patterns such as demographic changes and social exclusion.

The chapter contributes to further insights and understandings of contemporary urban planning aims and practices within urban resilience from a social perspective. As the conclusion shows, the area is still relatively new and not yet well represented within everyday urban planning policies and approaches. Also, since one of the main challenges with adaptation urban planning is to find adequate information and research, by examining and analysing previous experiences and case studies from various regions, examples of different methods and approaches has been further explored.

From an academic perspective, the findings of the study are relevant since it brings additional clarification to the theoretical discussion regarding the differences between environmental and social resilience from an urban planning perspective. Examples of this include incorporating the concept of social urban change, and comparatively analysing vital theoretical aspects of urban resilience.

Moreover, the study is relevant to urban planners and policy makers striving to increase the resiliency of cities and communities since it has reviewed international and local contemporary urban resilience and adaptation planning experiences. These studies have shown regional differences and similarities; current community difficulties and challenges in relation to change and which aspects that need further improvements and attention.

Suggestions for future studies within urban resilience and adaptation urban planning, especially so within a social perspective, are to further study the relation between urban planning and urban design and form of creating resilient cities. This includes examining the difference between planning practices and actual outcomes and to study the direct impacts of resilience spatial form has upon communities.

Also, as researchers such as Zolli (2012) argues, many important lessons can be learnt if the geographical study areas are shifted from westernized perspectives, since many developing countries are coping with various types of changes and have to deal with large disruptions on limiting budgets. Even though this chapter has incorporated current experiences from various regions, they have been targeting approaches and planning practises used in northern/western countries. Future study should thus further broaden the geographical and regional scope and seek alternative and experimental measures and solutions.

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6 Sustainable Disaster Resilience? Tensions Between Socio-economic Recovery and Built Environment Post-disaster Reconstruction in Abruzzo (Italy)

Grazia Di Giovanni and Lorenzo Chelleri

Abstract

Cities are the most resilient humans' artefact, and this is due to their socio-economic capacities to persist shock and stresses. However, sometimes cities do persist but at the cost of losing key functions and modifying their development trajectories. One of the challenges of disaster resilience is indeed to merge built environment reconstruction and socio-economic (re)development. This chapter aims to explore how to do that in the difficult circumstances of the territories which are losing populations, with ageing societies and economic stagnation. In order to do that, different municipalities of the Abruzzo region are taken as study cases. In 2009 the region was shocked by a severe earthquake, destroying L'Aquila city and surrounding 56 minor centres (44 of these been labelled from the Italian Government as "inner areas", definition that indicates towns that don't have a direct access to essential services such as secondary education or emergency care hospitals). The study analyses 18 post-earthquake

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reconstruction plans in the light of the legislative framework and the status quo 6 years after the disaster. Results emphasise a set of paradoxes and challenges in the application of the normative framework, which aims at the broadest, integrated, long-term socio-economic recovery, but at the same time limiting the space for innovation and actions beyond the built environment reconstruction. However, the out-of-ordinary opportunity offered from the reconstruction funds hides the still potential for building new patterns of development, that need to be tackled by addressing the tensions highlighted in this chapter.

6.1 Post-disaster Sustainable Reconstruction: Bouncing Back or Forward?

Disaster occurs because risk reduction thinking and measures have not been taken into account in the business as usual city management. However, once a disaster has occurred, there is one more challenge than building preventive adaptation or risk mitigation during the recovery phase: set a re-development strategy able to meet sustainable future scenarios. Simplistically speaking, three phases (mutually inclusive and multidimensional) of disaster management correspond to temporal and logical stages of the hazard: mitigation and preparedness (pre-crisis), response (during the crisis, emergency) and recovery (post-crisis) (Lettieri et al. 2009). Recovery consists, after having ensured shelter, medical care, rescue and property protection, of those actions that bring the damaged areas back to previous, or improved conditions. Post-disaster recovery plays a crucial role by linking (potentially) emerging technologies and learning processes, enabling more prepared people and built environments to future shocks, through the recovery process (MacAskill and Guthrie 2014; Yi and Yang 2014). However, from the literature on disaster resilience emerges that much of the work has been done on emergency planning, and less attention has been paid on Post-Disaster Reconstruction (PDR) (Lettieri et al. 2009), which indeed is a relatively new field which received increasing attention during the last decade, as indicated by Yi and Yang (2014). Research in PDR has mainly focused on identifying issues, understanding implications, evaluating impacts and performances rather than spending time on theoretical framing: "As researchers gain a better understanding and establish principles of PDR, they venture into more exploratory quantitative research and have produced some theoretical models (Gotham and Campanella 2011; Haigh and Sutton 2012) and decision-making frameworks (Pyles and Harding 2011)" (Yi & Yang 2014, p. 26). From these, 3 emerging clusters of research topics emerge, which are: (i) stakeholder analysis, (ii) reconstruction approaches and (iii) sustainable reconstruction. This last one is

emphasizing a deeper understanding of how integrated (re)development, sustainable (re)construction and embodied resilience (Yi and Yang 2014) are to be framed within PDR. When the metaphor of resilience is applied in real world practices, usually its meaning is referred to recovery (speed), adaptive or transformative capacities (Folke et al. 2010) with still not clear understanding of the huge difference which those very different perspectives imply, something which has been recently emphasized from different scholars (Chelleri et al. 2015; Elmqvist 2014; Matyas and Pelling 2015). The main difference indeed is expressed through the tension between the perspective calling for resistance (to change) and transformation (for change, hopefully toward sustainability paths). In disasters studies, resilience is indeed considered as a pattern, rather than a normative goal or series of activities (Haigh and Amaratunga 2010; Lengnick-Hall and Beck 2005; Longstaff 2005). Within this pattern, policies, plans and actions have to be framed accordingly two major conceptual approaches reflecting the above mentioned perspectives: (i) maximizing the speed for returning to pre-disaster conditions, or (ii) attaining the counterfactual state (Cheng et al. 2015). The first (bouncing-back) approach is based on a localised and isolated view of recovery intended as restoring the previous status quo, still alive in the memories of the people and with little consideration for alternative planning scenarios. Within this approach, speedy recovery aims to diminish and minimize interruptions to business operations, restore damages, and housing recovery is considered to be the priority (Bruneau et al. 2003; Rathfon et al. 2013). It implies reactive stance (rather than proactive) and a tension between the speed and the quality of recovery, and public participation could be compromised for the sake of speed (Cheng et al. 2015). By contrast, the counterfactual state approach uses the hypothetical counterfactual state (from regional science) in which a comparable location that resembles the affected context, but without disasters happened, set the stage of comparison.

> The first plan is that of the pre-existing city. This is the plan in people's minds, and the pieces are probably still in place: people, maps and human and economic networks. Everyone knows that this plan can work, but only if it is put back quickly while all the pieces are still close at hand. The second plan is the plan for the future. This might be a previous plan or a new recovery plan. It is the conflict between these two plans that must be resolved, and in a short time, so as not to lose the functional capabilities of the first plan and the mitigation and improvement possibilities of the future plan (Olshansky and Chang 2009, p. 207).

It is however worth mentioning that the difference among these approaches is smoothed by the fact that bouncing back is always a jump forward to a "new normal" after the disaster, giving the illusion of having bounced back to something which won't never be the same reality again (Alesch et al. 2009; Chang 2010;

Rubin Claire 2009). Because of this, the pragmatic difference between the above mentioned approaches regards the introduction of innovation and new development trajectories within the PDR processes. This implies reconstruction to bear in mind possible demolitions, new infrastructures and connections, alternative spatial and organizational patterns while setting the (normative) stage for the recovery process. The paper main research question is therefore "how can socio-economic post-disaster recovery and built environment reconstruction be integrated within a synergistic strategy of re-development, in a context characterized by been an "inner area"? In territories in which population is shrinking and economies stagnating, how to set up a sustainable (transformative oriented) post-disaster reconstruction? In many cases, disaster resilience is still framed as a metaphor for bouncing back to a new normal. Which are the barriers to frame resilience within a transformative pattern of development toward a socio-economic sustainable region, and how to overcome them?

As introduced in the next section, in order to address these research questions, we present a case study from Abruzzo region (Italy) which is currently under a huge reconstruction process after the earthquake of 2009.

6.2 The Abruzzo Region and the 2009 Earthquake

The Abruzzo region, even if geographically located in Central Italy, is considered belonging to the economically (under-performance) Southern Italy macro-region.[1] It is indeed one of the least populated Italian regions, counting with 1,307,309 inhabitants, equal to the 2.2% of Italian population (Data from Istat 2011 national population census). From another point of view, Abruzzo is also one of the richest Italian regions in term of natural landscapes (see Fig. 6.1 for a geographical location of the area). The western part is mainly mountainous, shaped by the Apennine chain's highest peaks (hosting the perennial glacial of Gran Sasso massif), while the eastern part is hilly, engraved by numerous riverbeds declining towards the Adriatic Sea.

The collision between the African and Eurasian plates, that shaped Italy's morphology, is the genesis of Abruzzo's frequent and strong seismic activity, documented since the XIV century. In this period of time, the region capital city of

[1]OECD defines Southern Italy as "a macro region whose economic under-performance has been since the Italian re-unification at centre stage in the political agenda and whose per capita GDP is still nowadays around 68% of the Italian one (that of Abruzzo is around 85%)" (OECD 2013, p.30).

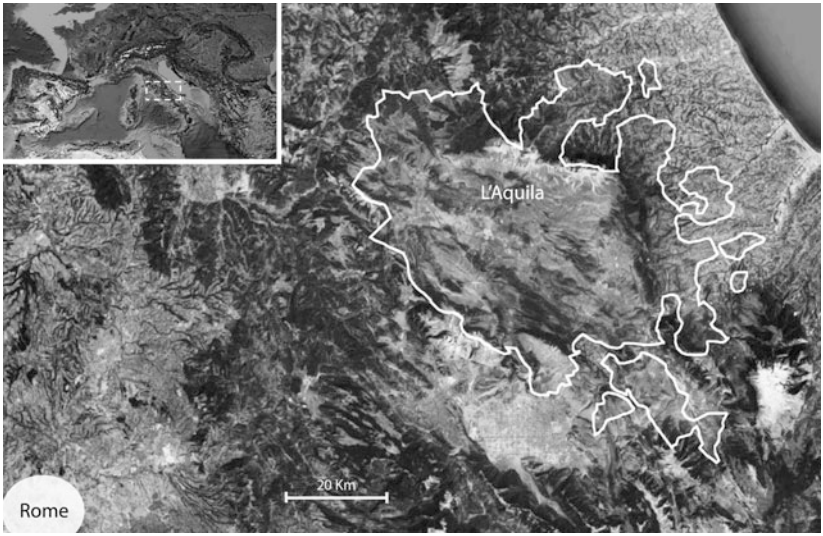

Fig. 6.1 Area highly affected by the 2009 earthquake, called "Seismic Crater" (*Source* elaborated by authors from Google Earth)

L'Aquila has been severely damaged at least 6 times (Bazzurro et al. 2009; Decanini et al. 2013a). The last dramatic earthquake happened on April the 6th 2009 (magnitude 5.9 Richter), hitting 57 municipalities in western and central Abruzzo and leaving 309 dead and 1600 injured people. The territory stricken has been defined as the "Seismic Crater"[2] (see Fig. 6.1). In 2008, just before the earthquake, around 144,000 inhabitants (half of which in L'Aquila) lived in this scattered and polycentric area. After the earthquake, and according to the last census (2011), the population counted for 138,000 inhabitants (still half living in L'Aquila municipality). Damage evaluations (as reported by the Civil Protection one year after the earthquake) revealed that, out of 73,000 damaged buildings inspected, 32.1% of private buildings, 21% of public buildings and 53% of cultural

[2]The seismic crater is constituted by municipalities affected by a MCS intensity equal to or higher than the VI degree, according to macro-seismic surveys carried out by the Department of Civil Protection with the National Institute for Geophysics and Volcanology (Decrees of the Designated Commissioner for Reconstruction no. 3 of 16th April 2009 and no. 11 of 17th July 2009).

heritage were classified as completely inhabitable.[3] Limiting the analysis to the city of L'Aquila, its reconstruction plan declared around 6000 completely inhabitable buildings, equal to the 30% of the damaged buildings of the city (Comune di L'Aquila 2011, p. 110). Data referred only to minor municipalities within the seismic crater (excluding the city of L'Aquila) enlightened the scattered effects of the earthquake, since more than 11,000 buildings have been damaged becoming completely inhabitable. However, in order to get a better understanding of the key socio-economic features behind the earthquake implications and the reconstruction process, it is also important to remark that only the 35% of the destroyed building dispersed along the seismic crater were principal homes, while the 65% of these were second/holidays homes. Also taking the last census of the province of L'Aquila, only the 55% of residential buildings were first homes, being almost the half of the residential building stock used as second houses or for tourism-related purposes. This tendency is descriptive in characterizing Abruzzo's population and economic dynamics, which have always been depending on Rome which represents a very considerable flow catalyst for a wide part of the seismic crater (OECD 2013). Indeed, looking to L'Aquila economic base, its employment is distributed around the industrial sector (31.2%, mainly micro-firms), tertiary sector (public and private services, 65%) and only a minor role played by agriculture (3.8%) (Calafati 2012; OECD 2013). This led to consider the city of L'Aquila as an "administrative city" (OECD 2013, p. 57), surrounded by natural parks and a scattered touristic local system specialized in high mountain and winter sports. After 20 years of constant declines in population (from 1951 to 1971), Abruzzo region slowly recovered, but it's worth noticing that regional differences exist, and the province of L'Aquila was the least populated, since the main population growth has been registered in the region coastal area. Its ageing society within these economic features should be taken in mind as pre-conditions characterizing the region before the earthquake happened, and highly influencing the recovery and rebuilding strategy.

[3]For further data: http://www.protezionecivile.gov.it/jcms/en/emergenza_abruzzo_unanno.wp?request_locale=en.

6.3 Setting the Stage for the Reconstruction: The Legislative and Institutional Framework

The emergency phase started the day of the earthquake, setting the ground for extraordinary procedures and exceptions to laws, and speeding up every administrative process. The Law no. 77/2009[4] and the Decree of the Commissioner for Reconstruction[5] no. 3/2010 set the bases for the normative framework of both the reconstruction process and the simultaneous "temporary housing" emergency programs (hosting part of the almost 49,000 people displaced after the earthquake while the reconstruction was taking place). Due to the extraordinary circumstances, the governance framework built for enabling an effective and coordinated management of emergency and reconstruction phases followed a structure that we have summarized in Fig. 6.2. This introduced new different offices with the aim of coordinating the extraordinary flows of resources involved within the two phases, bridging local administrations and national ones. This was a necessary step since the monetary flows exceed hundreds of times the usual yearly budget that the local administrations were able to manage. As shown in Fig. 6.2, during the emergency phase the Technical Mission Structure (Struttura Tecnica di Missione), which was established on December 2009, was the temporary emergency institution depending directly on the Presidency of the Council of Ministers and coordinating the works and plans of the 56 municipalities of the seismic crater and the city of L'Aquila. When the emergency phase was declared closed, on 31st August 2012, the return to the ordinary public administration saw the Technical Mission Structure been replaced at the local scale by two Special offices for the Reconstruction (one for the city of L'Aquila and another coordinating all the minor municipalities of the crater). These special offices provide technical assistance for public and private reconstruction and maintain the financial monitoring and implementation of interventions, on behalf of the central institutions.

Behind this administrative legal framework, during the emergency phase, while people were rescued and hosted in makeshift shelters and camps, the Executive Decree (O.P.C.M.) no. 3790/2009 of the President of the Council of Ministers (Art. 7) introduced the M.A.P. project (Moduli Abitativi Temporanei, standing for "housing temporary models"), consisting of small wooden buildings for temporary staying (to be built and then demolished). Across L'Aquila municipality 1250 of those units were built, while other 2200 sprawled through the minor municipalities

[4]Earlier Decree-Law no. 39 of 28th April 2009.

[5]The Commissioner for Reconstruction was the President of Abruzzo Region from 1st February 2010 (O.P.C.M. no. 3790/2009) to 31st August 2012 (Law no. 134/2012).

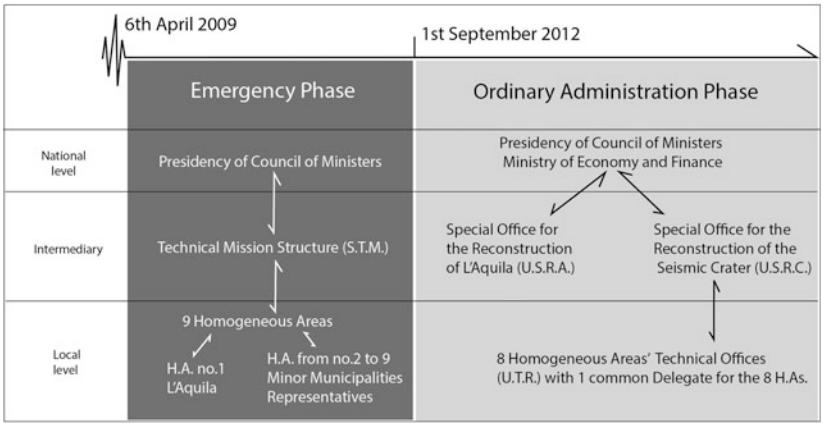

Fig. 6.2 Governance Framework for the emergency and reconstruction phases (*Source* by authors)

of the seismic crater. At the same time, the Law no. 77/2009 (Art 2) introduced a more ambitious project, named C.A.S.E. (Sustainable and Ecology-compatible Anti-seismic Complex). This program was conceived to provide longer term accommodations thanks to 185 new buildings, distributed through 19 sites hosting from 1000 to 1500 persons each, and spread only in the municipality of L'Aquila. These mini-settlements, full-equipped with proper infrastructures and used for temporary housing during the emergency phase, were declared to be re-usable for other scopes in the future, as a buffer for innovation and services for the municipality. In just a year, on June 2010, around 49,000 people were assisted in their accommodation needs, through the different temporary housing programs (18,600 people) or through benefitting a public subsidy to find an alternative housing solution autonomously (26,000 inhabitants chose this option).[6]

Simultaneously to that, the same Law 77 also defined the Reconstruction Plans, conceived as extra-ordinary planning instruments for guiding the reconstruction process for all the Crater's centres and towns damaged by the earthquake. The strategic guidelines for the post-disaster reconstruction were (Art. 14, 5-bis):

[6]On April 2014 data showed 23,000 people still assisted for their accommodation needs: 18,000 in L'Aquila and 5000 in the other municipalities. Data retrieved from: http://www.commissarioperlaricostruzione.it/content/download/1983/21073/file/Report%20popolazione%20post-sisma%2014_12.pdf; http://www.usra.it/wp-content/uploads/2014/05/SituazioneAlloggiativaAprile2014.pdf.

1. To ensure social and economic recovery
2. To promote urban redevelopment
3. To facilitate the return of inhabitants into their houses.

These aims were reinforced by the Decree of the Commissioner for Reconstruction no. 3/2010 (considered the legislative backbone of the reconstruction), which Art. 1 states: "general criteria for the reconstruction process support coordination and integration of initiatives fostering a territorial and inter-municipal vision" taking into account "functions and relations that are appropriate to establish, strengthen or modify between the capital city (L'Aquila) and other settlements of the surrounding area". This in order to "ensure the social and economic recovery, housing redevelopment and harmonic reconstruction of urban settlements and productive facilities in the areas affected by the earthquake", More pragmatically, in order to meet such integrated and strategic visions for the post-disaster reconstruction, it framed "the reinforcement of local territorial systems, identifying homogeneous areas in terms of strategic sectors of intervention" and highlighted the key role played by an "improvement of the environmental, historical and cultural networks; the rationalization of regional and urban mobility; capillarity and efficiency of infrastructure networks and services".

As illustrated in Fig. 6.3, "Homogeneous Areas" have been framed as optimal territorial and administrative entities to coordinate and synergistically address inter-municipalities reconstruction plans. The 56 municipalities of the seismic crater were organized in 8 homogenous areas through negotiations and agreements among the mayors. The administrative boundaries of the municipalities weren't affected by this re-organization, since homogenous areas represented a form of "temporary clustering" of municipalities with no normative authority as institutional bodies. Each of the 8 homogeneous areas has a leader municipality that represents the area and a dedicated technical office (U.T.R., as showed in Fig. 6.2). These new entities represented a significant innovation in the model of governance established to foster inter-municipality and regional coherence to the post-disaster reconstruction. Also, this was a chance to better coordinate the urban system regeneration at the regional scale, by linking the reconstruction of L'Aquila (which municipality has been assigned to represent 1 homogeneous area per se, apart from the other 8) and the minor municipalities of the seismic crater.

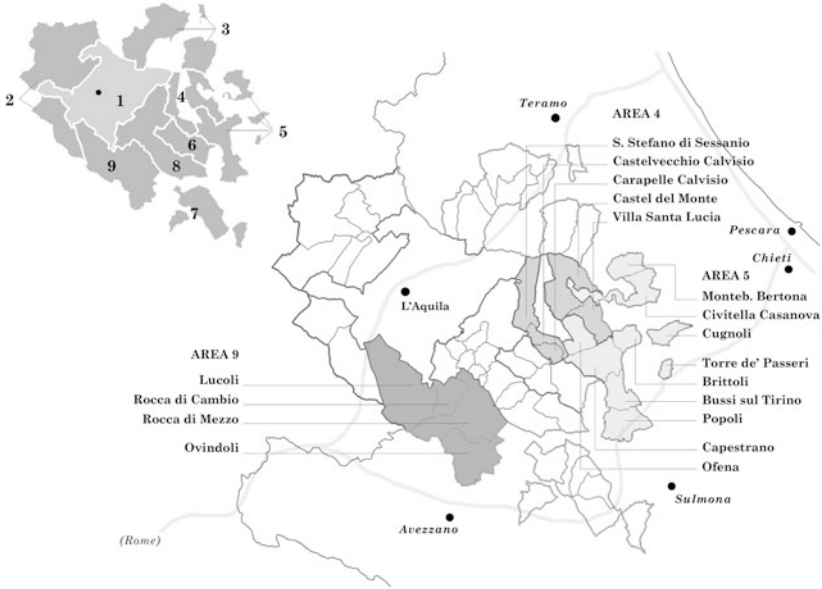

Fig. 6.3 Framing of the "Homogeneous Areas". On the *left*, the homogeneous areas and on the *right*, the municipalities belonging to areas 4, 5 and 9 (focus of this study) (*Source* by authors)

6.4 The Post-disaster Reconstruction Plans: Integrated Strategies, Ambitions and Guidelines from Different Areas of the Seismic Crater

6.4.1 Where to Plan?

The goals and aims of the Reconstruction Plans were established by the legislative framework, accordingly to the laws mentioned in the previous section. Looking to the pragmatic and practical side of the operationalization of those laws, it is key to notice where and how the reconstruction processes took place, after the seismic crater has been reassembled administratively through homogeneous areas. Indeed, notwithstanding the seismic crater identifies the most damaged municipalities, the reconstruction plans have to be designed within areas identified by specific "perimeters" (defined perimetrazioni), according to the Art. 1 of the Decree no.

3/2010. These perimeters were designed from the civil protection corps after a critical assessment of the post-earthquake built environment conditions (then revised and approved by every Mayor and the Presidents of Province and Region), and circumscribed the parts of the towns with particular historical, artistic and environmental values, and severely damaged by the earthquake. Most of the times, these areas were equivalent to the historical centres. The purpose of such delimitation of the plans was to guarantee a consistent planning process while recovering of the most valuable parts of the settlements, prioritizing investments. Outside these boundaries, so in the peripheral areas of the towns, the reconstruction process followed different and autonomous regulations. No plan was requested, and the reconstruction was fostered intervening on every built aggregate (or on every single independent building), according to technological, architectural and economic criteria assigned depending on the level of damage. Many criticisms against the necessity of putting in places the reconstruction plans (giving them a formal planning value) have been raised both from the city of L'Aquila and the minor towns. These plans were not recognised as necessary planning tools, and indicted of slowing down the speed of the reconstruction process. Indeed, six years after the earthquake, 9 out of 55 reconstruction plans have still not been approved by the city Councils (11 approved in 2012; 10 approved in 2013; 17 approved in 2014; 8 approved in 2015).

Because of such peculiar framework for the reconstruction plans, we selected 3 Homogeneous Areas (namely Areas 4, 5 and 9) because these have been the only areas that commissioned the design of the plans for the entire homogenous area to the same external consultor agency (or university).[7] This selection should help us in guaranteeing the analysis of coherent territorial strategies, designed for different municipalities belonging to the same area. On the contrary, in other areas all the municipalities' plans have been commissioned to different consultants, generating a less organic thinking in shaping recovery strategies at the mid-scale level.

[7]The groups to whom the plans have been commissioned are: Area 4 to a consortium made from the University of Padua and National Council of Research, with the collaboration of Polytechnic University of Milan and Sapienza University of Rome for Area 4 (exception: the town of Carapelle Calvisio designated a group of professionals); University of Chieti-Pescara for Area 5 (exception: the town of Capestrano designated a group of professionals); Sapienza University of Rome for Area 9.

6.5 Understanding Previous Conditions: Socio-economic Features Behind the Physical Damages

It seems relevant for the purpose of this chapter, to outline the socio-economic features characterizing the selected areas in order to better understand the implication of the reconstruction processes on the development trajectories of these territories. The 3 selected areas are not neighbouring (as shown in Fig. 6.3). While Areas 4 and 5 are on the east side of L'Aquila, foothills between the mountains Gran Sasso and Majella, Area 9 is south of L'Aquila and it is mainly a mountain area. The villages of Area 4 lie below the Gran Sasso Mountain (set between 850 m of elevation above sea level and 1300), while Area 5 is composed of five hilly villages and only two valley settlements. Southern L'Aquila, the villages of Area 9 are split within two plateaus (at 1400 m of elevation) and a valley, only recently connected with a tunnel in order to foster further development and better connection among difference municipalities. In general, the most of the municipalities of the seismic crater are characterized by an already small population (see Table 6.1), which declined strongly after the Second World War. The municipalities of Area 5 are the most populated (4 of the 7 municipalities have more than 1500 inhabitants) also due to their connections with the coastal urban systems. As reported in Table 6.1, the population data make sense also of the ageing Index (which we calculated dividing people >60 years and young people <18): we highlighted the obvious decrease in population and increase in its ageing before and after the earthquake, with the exception of some municipalities hosting special services which contributed to maintain or to increase the population after the disaster.

The presence of two National Parks contributed to contain villages development around the historical centres, and to encourage touristic activities. Differences are minimal among the 3 selected homogenous areas, been the most of the villages characterized by small centres living on (winter) tourism, sheep breeding (production of wool, cheese and meat) and the cultivation of some geographically protected origin crop (small and medium size enterprises dedicated to olive oil, wheat, lentils or wine). Among these, Santo Stefano di Sessanio (Area 4) is one of the very few cases in which several foreign investments have supported the restoration of the village's historical centre in order to increase tourism in connection with sustainable agriculture practices. On the contrary, only a few municipalities belonging to the Area 5 present a more urban nature, thanks to the presence of manufacturing activities near to the main mobility infrastructures. In

Table 6.1 Population and ageing index for Homogeneous Areas 4, 5 and 9

	Before the earthquake 2001		After the earthquake 2011	
	Population	Ageing Index	Population	Ageing Index
Homogeneous Area 4				
Carapelle Calvisio (now Area 6)	95	171%	85	236%
Castelvecchio Calvisio (now Area 6)	198	500%	159	300%
Castel del Monte	527	498%	447	670%
Santo Stefano di Sessanio	118	540%	111	500%
Villa Santa Lucia degli Abruzzi	206	1389%	141	1517%
Homogeneous Area 5				
Brittoli	415	381%	335	345%
Bussi sul Tirino	2977	188%	2636	261%
Civitella Casanova	2057	214%	1875	231%
Cugnoli	1669	135%	1590	180%
Montebello di Bertona	1120	214%	1023	268%
Popoli	5566	163%	5450	183%
Torre de' Passeri	3161	136%	3174	148%
Capestrano	960	420%	895	399%
Ofena	611	409%	527	465%
Homogeneous Area 9				
Lucoli	944	296%	1019	206%
Ovindoli	1200	166%	1190	246%
Rocca di Cambio	447	310%	504	348%
Rocca di Mezzo	1426	301%	1468	295%
Reference value for **Abruzzo** Region				158%
Reference value for **Italy**				144%

Source Elaborated by the authors using ISTAT data from the two national population Census (2001 and 2011).

fact, only in Bussi sul Tirino and Montebello di Bertona (Area 5) the secondary sector is the pillar of the economic base due to the presence of a proper industrial pole. Many villages of Area 9 are characterized by well-maintained historical centres as well as by diffused hotels and holiday homes in the surroundings. This kind of urban development was mainly due to winter tourism and sports, diffused in the area since the second half of the last century.

Looking to the damages suffered by these municipalities, in order to think about which implications and consequences could have had the earthquake on the local economies, the effects are very diversified. In some cases, only a few extreme damages occurred, concentrated in particularly vulnerable built aggregates or urban fabrics. In Castel del Monte or Santo Stefano di Sessanio the earthquake damaged mainly worship places and towers, symbols of the city.[8] In the historical centres of Brittoli, Bussi sul Tirino and Civitella Casanova the damages were severe but concentrated in areas with pre-existing hydrogeological criticality. In Ovindoli and Rocca di Mezzo the percentage of extremely damaged buildings is less than 25% of all the built heritage involved in the plans. On the contrary, in other centres, the damages were spread, like in Rocca di Cambio, Lucoli or Castelvecchio Calvisio, with more than 40% of buildings seriously damaged. Other heavily damaged villages are Cugnoli, Montebello di Bertona, Ofena, Popoli. However, the damages to underground infrastructures and pipeline networks (mainly water and drainage systems) have been dramatically contributing to the need of re-thinking how the built environment was supported by obsolete infrastructures and services.

6.5.1 The Reconstruction Plans: What and How

We have analysed the 15 plans of the municipalities belonging to the 3 homogeneous areas. Notwithstanding specific features of the plans, common themes structuring the reconstruction process and re-development trajectories are outlined in this section. Such common aspects can be due to numerous commonalities that these territories share, or because of the institutional and legislative framework put in place after the earthquake, as well as due to forms of policy mobility or because all the plans were designed by consortiums of university research groups.

All the plans propose a multidisciplinary and multiscale approach, notwithstanding been normative only within the before mentioned perimeters ("perimetrazioni") within

[8]It is believed that the collapse of the Medicea Tower of Santo Stefano di Sessanio was due to 20th century renovations on the tower's observation platform: the original wooden deck was replaced by a structure made of reinforced concrete.

the town centres. Responding to the requests of the legislative frameworks and of the Technical Mission Structure, the core elements of the plans are groups of prescriptive documents (technical reports and maps) indicating categories of interventions on building units, open spaces and infrastructures, regulatory standard for implementation, budget estimates. In addition to the prescriptive documents, the plans contain pilot projects or proposal of regenerations generally dedicated to the entire town, as well as strategic visions elaborated for the entire homogeneous area (or wide parts of it) interpreted as a unitary territorial system.

However, one of the main goals of the plans is to answer the third aim of the reconstruction process according to Law no. 77/2009, which is "the recovery of built heritage according to the most adequate anti-seismic standards[9] and the reduction of overall urban risk". The restoration of damaged historical urban fabrics is associated with the definition of a system of safe routes and areas ("lifelines") to improve the performance of urban and territorial systems in case of emergency (Decanini et al. 2013b; Di Venosa 2012). All the plans indeed refuse an approach oriented only to the restoration of pre-existing conditions: the reconstruction process should represent a moment of both conservation and recovery of local peculiarities, both as moment to meet the necessities of contemporary living introducing transformations and enhancement in technological and ecological terms (Caravaggi 2013; Clementi 2012; Università degli Studi di Padova et al. 2012b). Coherently, all the plans propose an enhancement of technological networks, both to repair damages and improve their functionality, both to foster a necessary overall technological reorganization and upgrade, because infrastructural fallacies augment social and economic marginality.

The will of exploiting the intervention on buildings, networks and open spaces as occasion to promote general urban redevelopment (second principle of Law 77) is openly affirmed in all the plans. This goal has lead mainly to shift from the restoration of the most valuable built heritage to the restoration of broad urban morphologies of these ancient centres, together with projects of revitalization and re-design of public spaces, often tiny and abandoned (Imbroglini 2013). The projects aim at recovering spaces and objects together with the introduction of new uses, in a difficult balance between conservation of the historical centres and transformation to make these places more comfortable and accessible for all. For instance, areas planned as emergency management sites are open urban green

[9]To coordinate the improvement of safety measures and energy efficiency of building units with the restoration of listed buildings reinterpreting local building traditions has been a challenge for the reconstruction in the entire crater.

spaces or places for social gathering "in times of peace", so to guarantee their maintenance and ordinary liveability.

The themes related to the first principle of Law 77 ("ensure social and economic recovery") have been translated mainly as general realm of interventions: promoting naturalistic tourism, improving the relations between settlements and surrounding landscape encouraging agriculture. All the plans advocate the necessity for structural policies to reach such a broad goal, starting from a deeper inter-municipal coordination to re-balance the fragilities of single municipalities, up to a reflection about the general relations among L'Aquila area, Rome and Pescara. The inadequate level of services offered to companies and citizens make these places less and less attractive for investors and future inhabitants. For improving the quality of life, especially of current elderly population, different plans propose a reinforcement of local welfare to be accomplished by integrated systems of services at over-municipal scale. Tourism and sustainable agriculture are stated as interconnected key sectors addressed by the plans in terms of relaunching the economic base of these places, based on the idea of sustaining "a territory of high quality" embedding the reconstruction also of "cultural values" (Caravaggi 2014; Università degli Studi di Padova et al. 2012a). The richness of these landscapes makes these places particularly suited to naturalistic tourism, as it already exists in these areas. In all the plans, the relation among these little and isolate towns and their landscape plays a basilar role in characterizing the reconstruction processes (Angrilli 2012; Imbroglini 2014). The plans suggest to strengthen and develop tourism and decrease the existing seasonality of it by proposing more contemporary models of tourism. This is particularly evident in the plans for Area 9: in this area winter tourism and skiing activities are still core elements of the local economic base, but the necessity of offering a wider touristic offer is strongly affirmed. The plans of these three homogenous areas suggest exploiting the reconstruction phase to improve accommodation facilities and local marketing, for instance through specific projects of conservation and recovery of the historical heritage, stressing the local specificities of these medieval settlements. To enhance landscape fruition and accessibility to parks exploiting the strategic location of the towns is a common goal of the projects. On the other hand, sustainable agriculture oriented to strengthen local traditional products seems to represent an opportunity to reduce hydrogeological instabilities, maintaining biodiversity and landscapes. Proposals of promoting forestry and farming don't have a relevant role in these strategies, except for some example in Area 9 dedicated to specific activities of this kind, while the crater has a huge availability of woods and grazing lands (Commissario delegato per la ricostruzione Presidente della Regione Abruzzo—Struttura Tecnica di Missione 2010, pp. 28–30, 36). Only Area 5

proposes stronger actions on manufacturing sectors, due to former and existing activities in Bussi sul Tirino and Popoli areas and the presence of important mobility infrastructures helping connections with coastal areas.

6.6 Discussion: Paradoxes and Challenges Within the Post-disaster Reconstruction Process

As up-packed in the introduction, disaster resilience deals with different complementary facets (Folke et al. 2010), in which short-term priorities should be merged with longer term recovery goals, aiming at local and regional sustainability (Matyas and Pelling 2015). This tension between conservative versus transformative resilience approaches (Chelleri et al. 2015; Elmqvist 2014) highlights the challenge in operationalizing disaster resilience through regional sustainability, rather than the mere recovery of the damages within the physical reconstruction processes. The need of addressing this issue is emerging also from the scientific literature, which demonstrates that within the phases of disasters management (preparedness/mitigation, response and recovery), post-disaster reconstruction (in which the transformative pattern could take place) only recently received the deserved attention (Yi and Yang 2014). Learning processes, for instance, are essential elements for a long-term sustainable recovery (as illustrated by MacAskill and Guthrie 2014; Oliver-Smith 1991; Smith and Wenger 2007), but are the most neglected aspects within disasters management studies (Lettieri et al. 2009). In this chapter, we emphasize the opportunities for learning, reviewing and adjustment respect to the reconstruction process in order to meet a sustainable recovery path. From the results of the analyses of different reconstruction plans different tensions emerge, and are discussed in this section.

The legislation issued after the earthquake entrusted the reconstruction process of broad purposes, both short-term and long-term goals. Despite the broad scopes, namely "strengthening local and regional systems, improving environmental, historical and cultural networks; rationalizing regional and urban mobility; enhancing capillarity and efficiency of infrastructure networks and services" (Decree 3/2010), the same legislation limited the reconstruction plans to specific areas ("perimetrazioni"), classified as "areas A", which corresponds to the historical centres according to the Italian planning legislation (Fioritto 2013). Consequently, the reconstruction plans are binding only inside these boundaries, notwithstanding the ambitions of presenting multi-scale and inter-municipal strategies of re-development (as guideline for future development). The long-term integrated and transformative purposes of the plans have been strongly influenced

not only by these perimeters, but also by the need of containing the public expenditure and the cost of reconstruction. Indeed, the budget estimation for the reconstruction was guided mainly by the damage levels and consequent standardized costs for the respective restorations, and by the absolute priority of reconstructing private houses. This normative mainstream rule of "causality nexus"[10] between damages and compensations sets the ground for what (and where) the reconstruction budget could be employed. Few case-by-case exceptions have broken this causality nexus role, mainly for underground and street infrastructures. The need of strategically combining reconstruction funds with other funds-programs or public-private partnership for long-term transition has been generally stated also by the plans' designers (Caravaggi 2013; Clementi 2012). However, here we find the main challenges of post-disaster sustainable reconstruction in depressed areas: how should we operate within inner areas (losing population, with a dramatic ageing index and without the potential and capacities to attract investors and coordinating international or European funding) with a reconstruction budget strictly related to defined perimeters and framed within a causality nexus? How could longer term and integrated redevelopment strategies boosting socio-economic recovery be put in place?

The inter-municipality cooperation established with the introduction of homogeneous areas represents the opportunity for innovative governance processes and for reducing planning fragmentation. The "obligation (and right) to take joint decisions, and provide lists of priorities" (Caravaggi 2013, p. 29) have been an element enhancing inter-municipal long-term cooperation in the light of the principle of a socio-economic recovery (Commissario delegato per la ricostruzione Presidente della Regione Abruzzo—Struttura Tecnica di Missione 2010, p. 79; OECD 2013, p. 12). This kind of institutional cooperation has a very weak tradition in Italy: the organization in homogeneous areas was controversial, in practice, as demonstrated by areas in which every municipality assigned the designing of its own plan to different professionals or researchers.[11] Furthermore, since homogenous areas have no normative authority as institutional bodies but are only unions of different municipalities joined for temporary necessities, the development projects proposed for large territorial scales have to be considered only scenarios and guidelines without any mandatory role.

Although all these challenges in applying what the legislative framework defined as "ensuring socioeconomic recovery", the laws' more detailed

[10]See Law no. 77/2009, Art. 1.

[11]Caravaggi defines the homogeneous areas as "an apparatus capable of bringing out possible alliances and unavoidable contrasts" (Caravaggi 2013, p. 29).

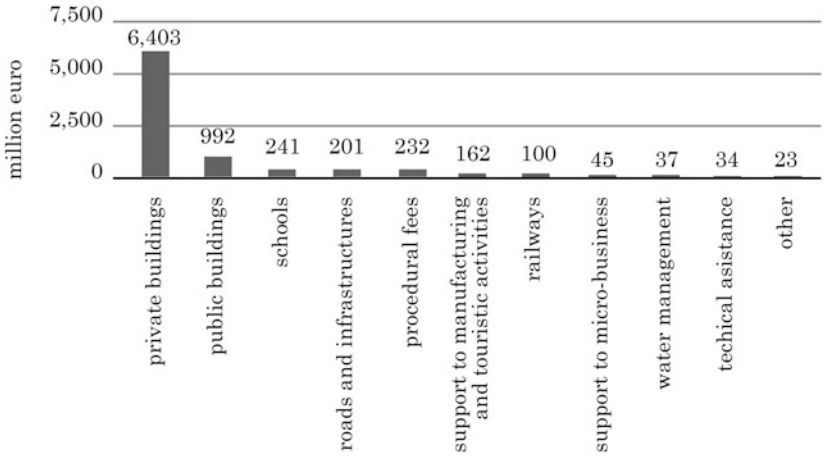

Fig. 6.4 Reconstruction funds divided for intervention sector between April 2009 and December 2015 (*Source* elaborated by the authors from the Assignments of the Inter-ministerial Committee for Economic Planning for Post-earthquake Reconstruction in Abruzzo. http://www.programmazioneeconomica.gov.it/2015/12/30/ricostruire-labruzzo-3/)

specifications about "returning home and enhancing urban quality" have been more easily integrated and developed into the plans, by addressing the microscale risk reduction in ordinary planning through safer urbanistic codes and design measures (Di Venosa 2012; Fioritto 2013). The priority given to these objectives can be easily deduced out from the funding scheme for the reconstruction (summarized in Fig. 6.4): from April 2009 to December 2015 the Italian government allocated more than 8.4 billion euros for the reconstruction, of which 76% were allocated for the reconstruction of private buildings and 12% for public buildings. Only a remaining 12% has been allocated among school building, streets and infrastructures, sustain to industry and research, railways and technical supports.

On the other hand, the lack of specific policy guidelines, economic planning tools and strategic visions dedicated to the overall system of the seismic crater has affected even more the potential role of the reconstruction plans of each homogeneous area. Even when the local plans have sustained institutional, technical and scientific ambitions to promote transformative projects and the introduction of new urban functions (refusing the logic that the reconstruction could be just the sum of interventions), the actual possibilities of implementing long-term transformative visions were weakened by these paradoxes (causality nexus—narrow perimeters of intervention—lack of shared overall projects).

Notwithstanding these challenges, the reconstruction plans here analysed have tried to reinforce local existing resources and ongoing tendencies proposing more sustainable or efficient development paths. In their sections dedicated to economic recovery, the plans focus mainly on sustainable agriculture and natural-based tourism. However, the foundations and sustainability of those engines for development presents rooted weaknesses, since historically agriculture didn't find very suitable conditions in these mountain areas (not adequate soil, adverse climatic conditions) and tourism is part of the economic base of only some villages, which cases suffer from a very seasonal and therefore unsustainable revenues.

6.7 Conclusion

This chapter introduced the challenges in operationalizing a sustainable post-disaster resilience approach. Taking a sample of 15 municipalities' reconstruction plans out of the 56 minor municipalities affected by the dramatic 2009 earthquake in Abruzzo the study outlines the limits, on the ground, of the reconstruction strategies in meeting a socio-economic relaunch of the area.

As mentioned in the introduction, resilience in its metaphorical meaning does not guide its application in the real world practices, which are biased from different (sometime conflicting) approaches, oriented toward conservation or transformation. Disaster resilience literature contains indeed two major conceptual approaches to measuring recovery, reflecting this existing tension between conservation and transformation: (i) returning to pre-disaster conditions; and (ii) attaining the counterfactual state (Cheng et al. 2015). The first approach aims at rebuilding the pre-existing city as in people memories. The second approach outlines a plan for the future, which could embrace different degrees of change. As Olshansky and Chang remark, "it is the conflict between these two plans that must be resolved, and in a short time, so as not to lose the functional capabilities of the first plan and the mitigation and improvement possibilities of the future plan" (Olshansky and Chang 2009, p. 207). The tensions between the first and the second approaches are but the ones between the concepts of reconstruction (re-building actions) versus re-development (catalysing higher returns to investment in innovation, technology transfer, better practices and institutional strengthening for long-term sustainability). Also, from Olshansky and Chang's quote, the key issue of timing emerges. After the earthquake, people and institutions shared willingness to plan for a better future asking to act "promptly but rightfully" (as noticed in many other post-disaster cases through the literature, see Clementi 2012). However, if such timing is delayed by postponing the design and implementation of the plans (as

happened in several municipalities of the crater) new stresses and lack of energy, interest and trust in the institutions are the natural consequences, negatively influencing the possibility of merging development and rebuilding.

In this chapter cases the diverging trajectories of the development potential and the physical rebuilding have to be justified through a series of challenges, and paradoxes, once the legislative framework for the reconstruction was put in practice on the ground. As discussed in the previous section, one inconsistency could be seen within the delimitation of the areas where the plans have normative power (and budget) versus the broadness of the goal of the Law no. 77/2009 and Decree no. 3/2010, mentioning to ensure socio-economic recovery. In line with this, the causality nexus, between the damage suffered because of the earthquake effect and the budget for reconstruction, did not facilitate to set a re-development strategy. Finally, there has been a lack of an overall strategy (for the whole seismic crater) driving and integrating the homogeneous areas' plans. That said, even if addressing such paradoxes and challenges, the most still unresolved issue is how to better merge re-development and reconstruction in a shrinking territory. In this case study indeed, the municipalities present an ageing index up to 10 times the Italian and regional score, and unfortunately demonstrated an insufficient entrepreneurial spirit and institutional capacities to deal with complex issues. If from one side indeed, it has been critical the role played from the analyzed plans, in providing longer term and integrated development strategies and guidelines (notwithstanding the causality nexus and delimitation of the areas), from the other side the need of complementing the reconstruction funds with other resources, to be found outside the system, requires a set of capacities which these territories lack. Finally, a high risk is represented from mismatching the economic recovery (economic performance) due to the "recycling" of activities and labor forces into the construction sector, that is currently the wealthiest economy due to the reconstruction process itself and that will last for a decade. This chapter has contributed with a descriptive and qualitative approach to explore the "on the ground" causes which inhibit longer term sustainable reconstruction processes. However, much more work has to be done in order to understand which strategies, tools and regulation could assist shrinking territories in setting up sounding and sustainable re-development post-disaster trajectories.

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Dealing with Surprise in Urban Regions—Some Ideas and Examples for Planners

7

Gérard Hutter

Abstract

Planners are concerned about the future, the future of cities and regions in particular. However, the future is full of surprise—at least this is what complexity science and concepts like resilience suggest. Unfortunately, planning research has not yet developed a genuine approach to surprise. The paper follows a modest ambition to further planning research with regard to surprise. It proposes a definition of "surprise", interprets dealing with surprise as component of a commitment to resilience, and presents some ideas how to perform foresight and surprise preparation by actors that are involved in urban development. The paper then presents examples from empirical research to illustrate these ideas. The outline of a research agenda concludes the paper.

7.1 Introduction

The experience of surprise is an experience of high equivocality. Some voices may argue to downplay surprise as a transient phenomenon that disappears after practicing more comprehensive and effective procedures of information gathering, knowledge development, and rational planning. Others may state in retrospect that they knew it all along, but did not pay attention before and during the surprising event. Some may neglect small deviations between expectations and the "real

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world" until crisis and even disasters facilitate insight into the significance of these deviations in retrospect.

In contrast, other voices may praise people that interpret surprises as opportunities for self-questioning and investigation into the "failures" of expectation building as well as for acquiring new knowledge to expand the range of what is believed and seen as possible in the "real world". This paper is clearly biased towards the interpretation of surprise as opportunity for self-questioning, learning, and renewal. Dealing with surprise is seen as an important component of a "commitment to resilience" (Weick and Sutcliffe 2001, 2007). However, the paper also acknowledges that dealing with surprise may be challenging and out of practical reach when it comes to surprise preparation by organizations in general, public bureaucracies that are involved in the development of urban regions in particular.

Unfortunately, the planning literature on dealing with surprise in urban regions is sparse. Surprise, especially preparing for future surprise, is clearly outside mainstream research and often more implicitly included in discussions about strategy development, governance, communicative planning, and resilience, to name only a few (e.g. Wiechmann 2008; Goldstein 2009; Davoudi et al. 2013). Therefore, the paper follows a modest ambition: It seeks to present some ideas and concepts from organizational and management research on surprise (e.g. Weick and Sutcliffe 2007; Cunha et al. 2012) and shows how these ideas and concepts can be applied to topics that are important for urban regions (e.g., dealing with floods in highly urbanized areas, building strategy for demographic change). The paper argues for more conceptual and empirical research on surprise in the context of planning efforts in urban regions. Therefore, it concludes with the outline of a research agenda.

7.2 Conceptual Framework

Obviously, the title of this paper refers to the notion of planning. Therefore, Sect. 7.2.1 clarifies this term to some extent; full clarification and theorization is out of the scope of the paper (see, for instance, Selle 2005; Allmendinger 2009; Healey 2007, 2009; Albrechts and Balducci 2013; Wiechmann 2008). Then, the Sects. 7.2.2 and 7.2.3 deepen our understanding of "surprise" and "surprise preparation".

7.2.1 Human Agency and Planning

Based on the philosophy of pragmatism, Emirbayer and Mische define human agency in a comprehensive and time-oriented way as "the temporally constructed engagement by actors of different structural environments—the temporal-relational contexts of action—which, through the interplay of habit, imagination, and judgment, both reproduces and transforms those structures in interactive response to the problems posed by changing historical situations." (1998, p. 970, italics in the original). Emirbayer and Mische (1998) elaborate in their seminal article in some detail on (1) *iteration* (routines, habits, and so forth, that are based on past accomplishments), (2) *projectivity* (imagination, experimentation with regard to "the future" or "futures"), and *practical evaluation* (judgement and making decisions given present circumstances). This understanding of human agency highlights that future-oriented activities like projectivity, foresight, forecasting, planning, and strategy making are related in complex ways to the past and present of human beings in general, decision makers in organizations in particular (Weick 1995).

Furthermore, the paper distinguishes between (1) agency in daily life and (2) agency in planning as institutionalized action (e.g., Scott 2014). Some time ago, Luhman (1966) has argued that it is fruitless to define "planning" in a general way through referring to "the future" and daily anticipatory activity of human beings. He understands planning as process of deciding in the present about decision premises of future decisions ("reflexive mechanism"). Planning decisions are often documented to some extent in plans and further types of documents (e.g., "strategic study"). Planning is this understanding qualifies as a manifestation of agency that reproduces or transforms institutionalized patterns of social action in response to the problems posed by changing historical situations (see Healey 2007, 2009).

Against this conceptual background, who then is "a planer"? To repeat, the paper addresses questions of agency with regard to institutionalized social action in urban regions. In this context, future-oriented efforts of actors related to iteration and practical evaluation are of interest as long as the institutional conditions of these efforts in urban regions can be specified. A planner in this understanding is every individual person that is concerned about "the future" in the context of formal as well as informal institutions of urban development. This understanding comprises the "typical" city and regional planner. This understanding also comprises actors that do political and professional "work" in specific policy fields and sectoral areas of urban regions.

For instance, the paper provides some empirical evidence about the human agency of public officials as members of the "Office for environmental protection" within the local administration of the City of Dresden based on case study research (Yin 2014; Hutter and Schinke 2016). These public officials are involved in flood risk management based on formal and informal institutions (e.g., officials should and actually do consider the formal institution of the Floods Directive of the EU in managing flood risk in urban regions).

In what follows, Sect. 7.2.2 defines surprise and Sect. 7.2.3 seeks to outline some possible activities of surprise preparation in urban regions. Thereby, highlighting human agency in this paper does not necessarily imply that it is easy for actors to care about surprise and to develop effective solutions for surprise preparation.

7.2.2 Who Expects Surprise and Why Do They Care?

Increasingly, planning research for cities and regions addresses questions of preparing for shocks, crisis, and even catastrophes. In this context, scholars often refer to the concept of resilience (e.g., Birkmann 2008; Albers and Deppisch 2013; Davoudi et al. 2013). The experience of surprise and attempts to prepare for future surprise also play important roles, but largely remain implicit in this research (see Goldstein 2009 for an exception). Planning scholars have not yet developed a genuine research approach to surprise and surprise preparation. Such approaches can be found, for instance, in psychology, safety studies and research on global change as well as organizational, management and strategy research (e.g., Wildavsky 1988; Schneider et al. 1998; Weick and Sutcliffe 2007; Bazerman and Watkins 2008; Kahneman 2011; Cunha et al. 2012; Kuhlicke 2015; Hutter 2016). This paper seeks to make a modest contribution to further planning research with regard to the unexpected and surprise preparation.

Research efforts have led to a variety of definitions, arguments, research designs, methods, and recommendations to practitioners. A first crucial decision of this paper is to place the extensive psychological literature on rare events and surprise in the background of investigation. The paper focuses on *social action* to interpret collective experience and to prepare for future surprising events. Obviously, in modern societies, social action implies actors like individual persons and collective actors that show agency for themselves and for others (Meyer and Jepperson 2000). Collective actors may be teams, organizations and under specific conditions also networks of persons and organizations. This paper focuses on

action that is accomplished by *organizations* in broader societal context (e.g., the "Office for environmental protection" within the local administration of the City of Dresden that includes diverse organizational units). Organizations may display coherence in expectations of individual persons and this is important for the definition of "surprise" that is adopted here.

A surprise may be defined as the *disappointed expectation of an actor that is experienced in combination with a certain puzzlement due to the disappointment* (Cunha et al. 2006, 2012). This definition highlights relations between expectations, disappointments, and puzzlements:

1. Surprises are based on strong expectations. Actors assume before the surprise (more or less explicitly) that an expectation will come "true" ("strong" means high confidence in the expectation). This may refer to both the expectation that an event will happen and alternatively to the expectation that an event will *not* happen (Weick and Sutcliffe 2007).
2. Disappointment means that an actor recognizes a significant difference between a strong expectation on the one hand and the "real world" on the other (e.g., falsification of an expectation through an occurrence in the "real world"). Disappointment does not necessarily imply "real world" conditions and consequences that are consistently evaluated by the actor as negative (e.g., a disappointment may lead an actor to an innovation in product development within a business organization, Cunha et al. 2012). Disappointment simply means that an actor recognizes that the "real world" does not develop as expected.
3. Puzzlement refers to the feature of surprise that an actor is startled at least for some time in the face of the (actual or virtual) experience of difference between an expectation and the "real world" (see Winship 2006 on "Policy analysis as puzzle-solving"). Organizational research shows that actors may seek to minimize the experience of puzzlement (e.g., to sustain reputation in the face of important peers, superiors, and stakeholders in terms of perceived competence to plan, organize, and implement, Weick and Sutcliffe 2007).

Hence, surprise is a sub-category of the more general term "the unexpected" (as explained by Weick and Sutcliffe in "Managing the unexpected" 2007). This surprise definition requires that strong and nevertheless disappointed expectations of actors are identified to investigate (actual or virtual/simulated) surprise experiences and social action for surprise preparation.

In line with this understanding, Cunha et al. (2006) argue that it is helpful to distinguish between types of surprises in the context of management efforts in organizations. For instance, surprising new issues of strategy development based

on established social processes require different management efforts than "radical surprises" that are characterized by a complete "loss of collective sense" in terms of contents and processes of social action ("Management as facilitating learning", in contrast to "Managing as sensemaking", Cunha et al. 2006, p. 322; see Kuhlicke 2015 on "radical surprise").

Some organizations may care about surprise preparation, others do not (Cunha et al. 2012). The latter may be more interested in demonstrating high competence in implementing planned intentions and in downplaying surprise. Furthermore, Weick and Sutcliffe (2007) argue that subtle differences between expectations and the "real world" may go unnoticed or are "normalized" in retrospect. In contrast, planners that are concerned about an, at least partly, unknowable future will also seek to learn from surprising experiences, to recognize the emergence of surprise at an early stage of development, and to find ways for dealing with the unexpected. For instance, Volberda (1998) argues that managers in business organizations who notice and analyze growing change and turbulence in external conditions will enhance social processes of organizing for surprise instead of "traditional" planning capacities (e.g., linear and formal approaches to strategic planning). They seek to develop robust or flexible solutions, for instance, through activities that refer to foresight and surprise preparation instead of forecasting and surprise suppression.

Planners that display agency with regard to future surprise can be seen as planners that show a "commitment to resilience" (Weick and Sutcliffe 2001, 2007). The word 'resilience' has many different meanings (e.g. Brand and Jax 2007; Hutter et al. 2013). This paper follows Wildavsky (1988) as well as Weick and Sutcliffe (2001, 2007) who base resilience on the "assumption that unexpected trouble is ubiquitous and unpredictable; and thus accurate advance information on how to get out of it is in short supply. To learn from error (as opposed to avoiding error altogether) and to implement that learning through fast negative feedback, which dampens oscillations, are at the forefront of operating resiliently." (Wildavsky 1988, p. 120). An agency-oriented perspective highlights that resilience can be generally understood as "[i]mprovement in overall capability, i.e., the generalized capacity to investigate, to learn, and to act, without knowing in advance what one will be called to act upon, is a vital protection against unexpected hazards" (Wildavsky 1988, p. 70).

Of course, planners that show capabilities in line with this understanding of resilience are able to do more than dealing with surprise in urban regions. However, this paper argues that surprise preparation is a "critical" management challenge to establish a well-developed commitment to resilience. In this context it is important to consider that managers in private business organizations think and act under qualitatively different context conditions than planners in the public realm

(e.g., different institutional conditions like legal regulations, normative expectations). Therefore, Sect. 7.2.3 elaborates on how foresight and surprise preparation may be performed by planners that are involved in developing urban regions.

7.2.3 Foresight of and Preparation for Surprise in Urban Regions

Hanssen et al. (2009) identify five key elements of regional foresight: (1) structured anticipation and projection of long-term developments and needs, for instance, specific societal and technological developments; (2) interaction and participation of diverse public, private, and intermediary actors to enhance collective analysis and debate; and (3) forging new social networks as well as (4) vision building and developing a shared sense of commitment and (5) recognizing the implications of visions and commitments for present-day decisions and actions.

This understanding of foresight underlines the importance of human agency in terms of "projectivity" and "practical evaluation" (see Sect. 7.2.1). Furthermore, it seeks to embed foresight in *networks* that connect individual persons and organizations in diverse societal realms ("network level of regional foresight"). In contrast, this paper adopts an *organizational* perspective on foresight (e.g., Tsoukas and Shepherd 2004). The paper focuses on relations between foresight activities and surprise preparation, whereas Hanssen and colleagues place more macro-oriented questions of governance and democratic legitimacy in the foreground of investigation. The paper distinguishes between

- Organizations that *fail* to adopt foresight and surprise preparation to contribute to urban development in cities and regions, and
- Organizations that *succeed* to adopt foresight and surprise preparation through methods of scenario planning, formal surprise management, and "managing the unexpected".

Organizations that fail to adopt foresight and surprise preparation in urban regions: case studies on flood risk management in urban regions show (see below) that public officials see public organizations in general, administrative organizational units in particular, as "bureaucracies" that favor the regular, the expected, problem solving and success demonstration through planning and control, whereas dealing with the irregular, the unexpected, problem solving through bricolage and improvisation are avoided, neglected, or placed in the background of organized attention. Cunha et al. (2012) explain that the preference for the regular, expected,

planned and controlled is, among further "factors", deeply rooted in assumptions of organizational members in modern societies about rationality, identity, causality, and success (see also March 1994, 2010; Weick 2001). Surprise preparation as a specific and resourceful organizational activity would questions these assumptions and, therefore, is dismissed. It seems reasonable to expect that this pessimistic perspective on the prospects of surprise preparation in urban regions may hold with regard to some public organizations and in some context conditions (Cunha et al. 2012).

Organizations that succeed to adopt foresight and surprise preparation in urban regions: In contrast to "failing organizations", others may be able to adopt resource-intensive activities of foresight and surprise preparation. For instance, the literature shows the following three approaches:

1. Scenario planning is relevant for both private and public organizations in urban regions (e.g., Tsoukas and Shepherd 2004; Neumann 2005). The method of constructing "wild cards" focuses in particular on dealing with surprise and the unexpected in scenario planning (Cunha et al. 2012 based on Mendonça et al. 2009). Wild cards represent the occurrence of "*singular* (idiosyncratic, historically original), *sudden* (abrupt, fast), *surprising* (unexpected, startling) and *shattering* (serious, severe) events." (Cunha et al. 2012, p. 307, italics in the original). It is important to think about "wild cards" in the context of *less wild* expectations based on trend analysis and further methods of scenario planning.
2. Farazmand (2009) argues in the context of public management debates that applying methods for dealing with surprise as "stand-alone solutions" is not sufficient for effective surprise management. Organizational structures in public organizations, resource allocation mechanisms and leadership practices need to change too. He favors "surprise management" as a new formal and comprehensive management approach to deliver public goods in urban regions in an age of high uncertainty and complexity as well as globalization.
3. Weick and Sutcliffe (2007) propose a more cultural-cognitive approach to managing the unexpected. Based on empirical research about "High-Reliability Organizations (HRO)" (e.g., some nuclear power stations, fire brigades), they argue that high potential for harm need not result in actual crisis and disasters, if organizations are able to focus on failure in expectation building and operative organizational decision making as well as resilience in reaction to the unexpected based on expertise and not on formal authority and rank.

To sum up, foresight of and preparation for surprise in urban regions are challenging for planners. Planners need to have "good reasons" to commit to the

purpose of surprise preparation. Section 7.3 shows some reasons for commitment, but also conditions of "failure".

7.3 Examples for the Purpose of Illustration

Up to now, issues of surprise preparation are often issues of secondary importance or implicit in planning research on, for instance, resilience, adaptation, and strategy development (see above, Sect. 7.2). It is no surprise, then, to have difficulties in finding examples of dealing with surprise in cities and regions. In contrast, it is easier to find examples of how individual persons, business organizations, and "High-Reliability Organizations (HRO)" prepare for surprise (e.g., Kahneman 2011; Cunha et al. 2006, 2012; Weick and Sutcliffe 2007). However, the following seeks to provide some illustration of the ideas and arguments presented above through reinterpretation of *existing* empirical findings about topics that are of some relevance for actors in urban regions.

Firstly, case study research on the "flood catastrophe" (Müller 2013) in the urban region of Dresden/Germany in August 2002 shows that "surprise" was an important characteristic of this collective experience (see LHD 2012, especially with regard to the river Weisseritz, see below). State actors and local actors within the City of Dresden are busy now for some time to develop more robust strategies for flood risk management which *may* give us some illustration in Sect. 7.3.1 how foresight of and preparation for surprise are performed by public officials in practice. Then, secondly, Sect. 7.3.2 looks at city planners in the City of Dresden to develop a strategy for demographic change (Siedentop and Wiechmann 2007; Wiechmann and Pallagst 2012). Foresight and surprise preparation *may* also be important here. Section 7.3.3 provides a brief comparison of the two examples.

7.3.1 Dealing with Surprise in the Context of Natural Hazards—How Local Officials Consider Surprise in the Context of Floods of the River Weisseritz in Dresden

It is now widely acknowledged in research and practice that the flood events in Germany in August 2002 triggered significant policy change and public investments in new measures for "more safety" (for an overview see, for instance, Müller 2013; Vulturius 2013; DKKV 2015). With regard to the concept of "surprise"

outlined above, the collective experience of the rare flood event of the river Weisseritz is especially salient (Hutter 2007, 2016).

The river Weisseritz is a tributary of the river Elbe in the Dresden region witch a medium-sized catchment. It is a typical mountainous river with significant potential for flood events that are characterized by fast onset, high velocity, high potential for debris, blockage of bridges, and potentially high physical impact on the urbanized areas in Dresden and further localities within the catchment. Case studies conducted after the rare flood event of the river Weisseritz in August 2002 show that the collective effort of learning lessons from this event displayed a development pattern in which (1) a broad discussion about new options for dealing with floods of the river shortly after the event was rather quickly followed by (2) focused decision making of state actors and local politicians supported by local officials on providing "more safety", especially through engineering works directly related to the river in the urbanized areas within the territory of the City of Dresden.

The following focuses on *local officials* that are members of the "Office for environmental protection" within the local administration of the City of Dresden. It elaborates what "foresight" and "surprise preparation" may mean in the context of providing new safety solutions through "traditional policy" that is based primarily on public investments in improvements of technical infrastructures.

Based on expert interviews with members of the "Office for environmental protection", this office may be seen as *a coherent actor* within the overall context of local administration in the City of Dresden. Coherence implies similar as well as cognitive overlapping (more or less implicit) decision premises of individual persons partly based on experience, value premises, classifications, and expectations (e.g., Weick 1995; Scott 2014). Document analysis and expert interviews indicate (e.g., Hutter 2007; Hutter and Schinke 2016) that office members explicitly use the word "surprise" only *infrequently* (e.g., LHD 2012, p. 8, with regard to the river Elbe). However, officials stress that the river Weisseritz is the "most dangerous flood" in the City of Dresden due to, for instance, the possibility of highly dynamic floods and potentially catastrophic consequences for the city center (LHD 2012, p. 6).

Furthermore, in August 2002, the majority of state actors, local politicians and officials as well as citizens in the flood-prone areas were taken by surprise because of the rare flood event of the river Weisseritz and its consequences in terms of inundated areas and assets (Hutter 2007). Before the event, actors implicitly assumed that the river Weisseritz plays only a marginal role in the process of revitalizing this area, especially those parts that are rather close to the city center. This implicit assumption was significantly disappointed through the flood event

and the inundation of flood-prone areas as well as through the consequences of flooding (e.g., flooding of the main station in Dresden). This may hold also for the "Office for environmental protection" during the event in August 2002. After the event, office members were continuously and intensively involved in discussions and decisions on aims and measures of FRM, but also in discussions about the aims and measures of revitalizing the Weisseritz area in line with the overall goals for city development.

Against this background, this paper proposes that the Weisseritz river flood experience in August 2002 is an important antecedent for the significant and continuous concern of the "Office for environmental protection" about *rare* as well as *extreme* floods. This also indicates that office members display concern about *surprising* events related to flash floods of rivers, but also floods that are due to spatially limited intensive rain fall *within* the territory of the City of Dresden (LHD 2012, 2014). Office members even use the term "inner drive" to express high motivation for dealing with rare floods and surprises in the future (Hutter and Schinke 2016). This confirms somehow the research expectation that salient experiences of rare events and surprises increase the motivation of actors to deal with such events and surprises in the future (March et al. 1991; Lampel et al. 2009). However, this does *not* necessarily imply that actors *overestimate* the relevance of experience for collective decision making (Hutter and Schinke 2016).

Experiences of rare floods and surprises as well as intensive and continuous involvement of local officials in FRM do not necessarily lead to high levels of foresight activities and surprise preparation. Furthermore, to my knowledge, *specific empirical* studies on surprise preparation in the urban region of Dresden have not yet been conducted.[1] Also the following is rather silent about scenario planning and wild cards, formal surprise management, and managing the unexpected as specific activities of office members. Therefore, based on the existing empirical findings it is difficult to assess what activities of foresight and surprise preparation are actually ongoing and how they are performed by office members in the highly institutionalized context of FRM. Because of this research situation, the

[1]In May of the year 2011, external experts conducted an audit of FRM in the City of Dresden: "Hochwasser—wie gut sind wir vorbereitet" developed by the "DWA—German Association for Water, Wastewater and Waste". The audit concludes that the strategy of the city of Dresden shows some specific shortcomings, for instance, with regard to dealing with extreme flood events. However, the audit is constructed as a kind of "check list" without systematic consideration of surprise and without distinguishing between floods of different probability, frequency and in relation to surprise as an actual or "virtual/simulated" experience of actors. Hence, the audit is only of limited value for suggestions about foresight and surprise preparation in the City of Dresden.

following should be read as *very tentative suggestions* on foresight and surprise preparation in the "Office for environmental protection" of the City of Dresden.

It is reasonable to expect that office members prepare for surprise in a similar way to how they deal with rare events (Hutter and Schinke 2016): They assume that institutionalized and routinized processes in local administration are often *in tension* with the consideration of rare events and surprises. They interpret surprise preparation as a "balancing act" in local administration in general and the "Office for environmental protection" in particular (balance between neglecting and considering surprise, Cunha et al. 2012).

For instance, office members pointed, on the one hand, to the difficulty of "openly" considering the limits (e.g., "residual risk") of engineering solutions that imply large public investments and significant resources of the budget of the City of Dresden. The Free State of Saxony and the City of Dresden have agreed to jointly finance engineering work (or "structural measures") related to the river Weisseritz to increase the safety standard up to the "500 year flood event" which corresponds approximately to the discharge of the flood event in Dresden in August 2002 and which is also high above the average safety standard of the "100 year flood event" in Germany. This paper proposes that these public investments in technical infrastructure for flood protection are somehow collectively interpreted in Dresden as "safety promise" addressed at local politicians and citizens that will hold over a broad range of possible flood events and their consequences.

On the other, local officials also argued that the consideration of floods of low probability and of rare, extreme and surprising events has been eased through the implementation of the Floods Directive of the EU (Hutter and Schinke 2016, especially with regard to the consideration of floods of medium and low probability as well as extreme floods, see Art. 6(3) of the Directive). Furthermore, continuous experience with and involvement in FRM in the urban region of Dresden also eases communication with private actors and business organizations based on event-based and target-group oriented communication.[2]

To sum up, difficulties to find well-documented specific activities that indicate foresight of and systematic preparation for surprise in the context of floods in Dresden may be due to both (1) the lack of such activities in "reality" and (2) the

[2]For instance, communication shaped as a pragmatic procedure that emphasizes a step-by-step approach to dealing with uncertainty, complexity and surprise in the sense of "First, think and talk about events of high and medium probability; then, second, begin the consideration of low-probability, rare, and even extreme flood events" (see Hutter and Schinke 2016).

lack of appropriate research to detect, analyze and interpret such activities in reality. Given the concern of members of the "Office for environmental protection" in the City of Dresden with regard to rare, extreme, and (presumably) also surprising flood events, it seems worthwhile conducting specific case studies on surprise preparation in the urban region of Dresden in the future.

7.3.2 Dealing with Surprise in the Context of Demographic Uncertainty—Do City Planners in Dresden Consider Surprise?

Demographic change is a complex phenomenon with significant uncertainty. Complexity and uncertainty are important conditions for dynamic processes of change. Surprises flourish under such conditions (McDaniel et al. 2003). Hence, to consider examples of surprise in urban regions, it may be worthwhile to look at strategies for demographic change in cities like Dresden. The example of building strategy for demographic change in Dresden is interesting because it shows discrepancies between the expectations of city planners responsible for strategic planning and actual population development due to economic conditions and interregional migration processes (for more details see Siedentop and Wiechmann 2007; Wiechmann and Pallagst 2012):

- After the reunification, the city development strategy of Dresden was based on optimistic assumptions about future socioeconomic development. For instance, zoning and infrastructure plans assumed a target figure of 520,000 residents. The actual development path of Dresden in the 1990s did not meet this optimistic expectation. The economy in Dresden, like elsewhere in East Germany, underwent a "shock" followed by escalating unemployment rates as well as dynamic out-migration to West Germany and a dramatic drop in birth rates. At the end of the decade, the housing market in Dresden showed significant oversupply with a vacancy rate of more than 20%.
- In the second half of the 1990s and because of the population loss of the past, the city changed its strategy. The new zoning plan in 1996 assumed only 430,000 residents in 2005. A further turning point was the year 2000. The "Integrated City Development Concept", formulated in 2001, was no longer growth-oriented and emphasized the "Leitbild" of the compact "European city". However, since the turn of the millennium, Dresden experienced an increasing population for the first time since the early 1980s due to rising birth

rates and a positive migration balance. Since then, Dresden has become one of the few growing cities in East Germany.

Hence, in the past, city planners in Dresden experienced significant discrepancies between expectations based on prognoses and actual socioeconomic development: The city forecasted a population increase in times of population loss. "In a period of stabilization, local planners and politicians assumed continuous shrinkage. And as substantial growth set in, the prognoses were based on a premise of stable population development." (Wiechmann and Pallagst 2012, p. 270). However, it is an open question whether city planners experienced and interpreted these discrepancies as surprises.

In current planning processes, city planners consider future changes in city development concepts and plans in the face of planning horizons up to the year 2025 and beyond. Changes in concepts and plans are anticipated because of expected changes in climatic, demographic, and economic conditions. However, no specific evidence is available that shows how planners draw conclusions from past discrepancies specifically with regard to surprise and concern for future surprise. This may be due to the tendency of planners in bureaucratic organizations of local administration to downplay surprise and demonstrate rational planning abilities. This may also be due to a lack in specific empirical studies about surprise experience and efforts to prepare for the unexpected in the office for city planning in Dresden.

7.3.3 Comparison of the Examples

It comes with no surprise that the two examples show similarities and differences (see Table 7.1): Both examples indicate that surprise is potentially a relevant experience for public officials in the local administration of the City of Dresden. Officials involved in environmental protection experienced the surprise of a rare flood event related to a tributary of the river Elbe in Dresden. City planners experienced discrepancies between expectations about population development based on prognoses and the actual development pattern over time. This confirms the introductory statement that planners may be concerned about a "real world" that is characterized by a significant potential to "produce" disappointments of strong expectations and puzzled actors.

The examples also show some differences to what extent officials do care about surprise preparation. Officials responsible for managing flood risk show significant explicit concern about rare, extreme and surprising events, whereas city planners

Table 7.1 Comparison of the two examples

Example	Question	
	Who expects surprise and why do they care?	What are the activities of foresight and surprise preparation and how are they performed?
Example no. 1: Natural hazards like the flood of the river Weisseritz in August 2002	Members of the "Office for environmental protection" within the City of Dresden expect to be surprised by future rare and extreme flood events. Office members express an "inner drive" to be concerned with surprising floods based on experience with the rare Weisseritz river flood event in August 2002 (among other flood events in Dresden)	Office members interpret dealing with rare and surprising flood events as continuous "balancing act" between the preference of bureaucracies for the regular, expected, planned and controlled on the one hand and dealing with irregular, rare, and surprising events on the other. However, there is a lack of empirical evidence on foresight activities and surprise preparation in terms of methods, and so forth
Example no. 2: Demographic uncertainty relevant for the City of Dresden	Members of the "Office for city planning" within the City of Dresden experienced discrepancies between the actual population development in Dresden since the German reunification and expectations about this development based on prognoses. Therefore, office members "should" have experienced surprise. However, there is a lack of empirical evidence on actual surprise experience and concern about future surprise	Given a planning horizon up to the year 2025 and beyond, office members expect changes and amendments in non-statutory as well as statutory city planning due to processes of demographic and climatic change as well as globalization, However, evidence on surprise-oriented foresight efforts is difficult to find due to either lack of such efforts or limitations of empirical research to detect, analyze and interpret such efforts

Source Based on expert interviews with office members (Hutter 2007; Hutter and Schinke 2016) and the analysis of documents from practice (e.g. LHD 2012, 2014) and from research (e.g. Wiechmann and Pallagst 2012)

seem to be more interested in future plan amendments that cover a range of different types of changes. However, such differences may also be due to differences in empirical investigation. Furthermore, both examples confirm the research expectation that too little is known about dealing with surprise in urban regions based on theoretically justified concepts and empirical planning research.

In sum, surprise experiences and ideas for caring about future surprise are (with some limitations) relatively "visible" in the two examples, whereas agency of public officials in terms of specific efforts of surprise-oriented foresight activities *is not*. This raises the question how to improve this research situation.

7.4 Conclusion

Is there a gap between the importance of foresight and surprise preparation in planning research on the one hand and actual achievements in research and practice on the other? This paper argues to answer this question with "yes". The gap may be not dramatic, but significant enough to justify consideration about surprise preparation as topic of future planning research. In a rather simplified way, one could think of three steps that would improve planning research on dealing with surprise in urban regions and that would lead to a contribution to a genuine planning approach to this topic:

- *Step 1 "Conceptual development"*: As mentioned above, psychology and safety research as well as research on strategy, management and organizations produced a variety of definitions, concepts, arguments, research strategies and recommendations. In a first step, planning scholars could assess these findings to develop conceptual results that are of relevance for planning theory, empirical research and, perhaps, planning practitioners alike (e.g., elaborating on the definition of "surprise"; discussing relations between surprise and different planning theories, see Allmendinger 2009; specifying "dealing with surprise" as component of a commitment to resilience, Weick and Sutcliffe 2001, 2007, in the context of urban development).
- *Step 2 "Empirical planning research"*: There are diverse traditions of empirical research followed by planning scholars (e.g., the qualitative and quantitative research traditions, see Silva et al. 2015). This paper argues that comparative case studies (Yin 2014) in line with principles of qualitative research (e.g., "Grounded Theory Building (GTB)") are especially useful to elaborate on the experience of surprise by actors that are deeply involved in urban development and the contents, processes and context conditions of surprise preparation as

one possible manifestation of human agency. Thereby, different types of organizations facing diverse institutional conditions could be of interest for research.

- *Step 3 "Synthesis of conceptual and empirical research"*: Karl Weick often asserts that conception without perception is "empty" and perception without conception is "blind". This should hold also in case of planning research on dealing with surprise in urban regions. Consequently, based on convincing findings from conceptual development and empirical investigation, options for synthesis enter the foreground of research attention (e.g., creating a new typology, crafting arguments why and how planners could consider surprise preparation more intensively than before).

The topic of dealing with surprise in urban regions may provide a useful focus to further conceptual development, empirical research, and synthesizing approaches in planning research. Practitioners could gain through such research improvements too. However, given that experimental designs like in psychological research on surprise are only of very limited relevance in planning, the highly equivocal "nature" of surprise and surprise preparation may also diminish the likelihood of significant research achievements. Hence, surprise research may also face a surprising future.

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8 Resilience Thinking as Leitmotif in Urban and Regional Planning Dealing with Climate Change Impacts

Sonja Deppisch

Abstract

Resilience thinking is related to spatial planning within the context of strategies to deal with climate change impacts in coastal urban regions and the consequent challenges posed to planning. The notion of resilience thinking is based on an emphasis on complexity and learning to live with change, adopting a perspective of social and ecological interdependencies and questioning paths already taken and taking into account potential transformations. This widened understanding is considered useful for tackling the challenges future climate change impacts pose on current decisions on land use. Potential gains as well as trade-offs that could occur by applying this perspective as a leitmotif within spatial planning are discussed and related to the challenges climate change places on to planning. The conceptual reflections are illustrated with empirical examples in Europe and the United States.

8.1 Urban Regions and Climate Change

Urban regions are complex agglomerations that are subject to manifold change processes. With respect to their future urban and regional land use development, several change processes in the social, economic, political, ecological and technological realm are of relevance, such as demographic or economic change on

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different scales. This chapter focuses on climate change as its potential future impacts are thought to be highly relevant for the spatial development in urban regions (for spatial impacts of climate change see: Revi et al. 2014). Additionally, climate change adds a new quality of uncertainty, posing new challenges for urban and regional planning (Hallegatte 2009).

Climate change can be expected to have various effects on urban regions, such as due to increased temperatures or extreme weather events. Climate change scenarios are accompanied by uncertainties, and the specific local consequences of climate change are difficult to predict as they depend on local assets such as the specific land use structure or the geomorphologic situation as well as on the vulnerability of society and of ecological assets, their institutional and socio-economic structure and infrastructure, and the urban region's capacity to adapt to potential impacts (Revi et al. 2014). Urban regions in coastal zones are thought to be more at threat due to their exposure through sea-level rise and storm surges. For various reasons, urban regions are considered highly vulnerable to the potential effects of climate change, due to their concentration of humans and infrastructure or their role as economic, socio-cultural or political-institutional cores (Birkmann et al. 2010). In addition, cities have specific local climates (Souch and Grimmond 2006) that could further intensify the effects of temperature rise. Furthermore, coastal urban regions are experiencing strong pressure to spatially develop due to their economic activities and functions, their role as transport nodes or their attractiveness for tourism and housing. Climate change can have manifold impacts on urban regions, for example on

- developed areas, with damage being caused to infrastructure and its services, buildings or large settlement structures,
- undeveloped areas, natural resources and ecosystem services, causing severe problems involving the supply of drinking water or wastewater disposal,
- human health and well-being and
- socio-economic structures, affecting all kinds of sectors and land uses.

Here, the question is tackled whether resilience thinking can act as a leitmotif for spatial planning faced with the challenges of climate change. It is discussed which lessons may be learnt from applying this way of thinking to urban and regional planning and which potential trade-offs could occur if this leitmotif is pursued.

Since this field of research is of a more conceptual nature, an attempt is made to discuss these questions using specific cases dealt with in one explorative study and two case studies. However, in these cases, resilience is not used as the leitmotif in

practical planning (with the exception of one case, in part). The findings are based on conceptual thoughts, underlined by case studies from two European coastal urban regions on the Baltic Sea, namely Stockholm (Sweden) and Rostock (Germany), and one explorative study at the Pacific, namely the San Francisco Bay area (USA, California). All case studies were performed between 2009 and 2012.

In the next subchapter, a brief illustration is given of the challenges spatial planning faces from climate change impacts. The subsequent section gives an explanation of social-ecological resilience thinking, its potential meaning for practical urban and regional planning, and the potentially fruitful inputs resilience thinking could have if used as a leitmotif in planning. Then the two case studies and the explorative study are described before potential gains and trade-offs are discussed of applying resilience thinking as a leitmotif in spatial planning.

8.2 Challenges for Spatial Planning

Owing to manifold area-related climate change impacts (Revi et al. 2014) and different land use interests within urban regions, spatial planning is very relevant when tackling climate change impacts (Blanco and Alberti 2009; Davoudi et al. 2009). Climate change impacts and associated adaptation measures could considerably influence existing land use forms and structures. As a consequence, they could cause new conflicts of land use interests (Davoudi et al. 2009). But this is not the only identified challenge, as six main challenges for spatial planning are identified:

- *Dealing with climate change impacts is not the only task*
  Following a general view, spatial planning and regional and urban planning in particular provide a unique venue for integrated, cross-sectional and anticipatory approaches with regard to spatially relevant climate change impacts and adaptation measures. However, initiatives and measures taken by spatial planning in performing its main tasks (to organise the different interests on land and on its use) may also cause additional vulnerabilities, risks and damage in interrelation with future and unforeseen climate change impacts. For example, this could occur due to the interaction of increased land consumption and soil sealing with heavy rain fall, leading to severe flooding. Additionally, measures to adapt to climate change impacts can also have side effects (Hallegatte 2009).
- *Tackling a twofold complexity*
  Urban and regional planning has to deal with a twofold complexity. At the one hand climate change is complex, epistemological distant (Carolan 2004) as well

as of a hybrid biophysical-sociocultural nature (Forsyth 2003). At the other hand urban regions are complex, too and provide many interdependencies with further scales. Due to the inherent complexities and uncertainties within the climate change scenarios and due to very specific local climate change impacts, there is no exact predictability on impacts in urban regions. Specific local impacts are difficult to predict and depend on local circumstances such as built structures and their density in relation to open and green spaces (Smith and Levermore 2008). Other uncertain or unknown future developments and change processes that are important for urban and regional development or that interact with climate change impacts also affect scenarios of future urban and regional land-use development. Tackling situations characterised by uncertainty is not considered a new situation in spatial planning, but within the context of climate change, reference is increasingly made to the new quality of uncertainty and complexity, which lead to further doubts whether it is useful to apply planning tools that assume predictability. The challenge is to develop land-use strategies that recognise the potential wide array of future trajectories and that are flexible in the event of unexpected developments (Ruth and Coelho 2007).

- *Tackling given stocks and structures*
  Urban regions are highly vulnerable due to their concentration of humans and infrastructure, their diverse, interdependent functions, and the continued high pressure placed on them concerning land-use. How can the given high vulnerable structures and assets be tackled and who will pay for protection measures in the long run? The principle of grandfathering reduces strongly the planning options to influence given structures and assets and also, such processes require a large amount of time (Birkmann et al. 2010; Smith and Levermore 2008). This points out to challenges beyond planning that need to take into account important regulations in general legislation and specifically in planning law.
- *Tackling multiple time scales*
  The long-term horizon of climate change scenarios does not coincide with planning horizons which are usually up to fifteen or twenty years. At the same time, current (and legally binding) planning decisions have potential long-term consequences such as buildings, land-use structures or infrastructure. Therefore, uncertain and co-emergent future change processes and situations must be taken into account which might challenge these structures. The additional question arises how new scientific knowledge can be integrated into legally binding plans that have already been adopted. Furthermore, the processual nature of climate change with different impacts on buildings and land use

structures at different times must be tackled, too (Hallegatte 2009). Openness and flexibility seem to be necessary but challenging for regional and especially urban planning. With respect to time scales, it also is difficult to justify current costly adaptation strategies and measures which will be of use in an uncertain future.

- *Tackling new land use conflicts*
  Assuming that climate change impacts lead to new land use conflicts, above all in vulnerable urban regions, regulatory planning instruments will be challenged; particularly if adaptation measures oppose other land use interests (Wheeler et al. 2009). Not only concurrence to other land use interests, but also the aforementioned side effects of adaptation measures must be taken into account. Urban and regional planning is embedded in a context of multiple social constructions, with different problems causing different concerns. Due to the wide range of uncertainties, different perceptions of situations and different interests, citizens, stakeholders, as well as political and administrative decision-makers in regions are likely to assess and judge the need for action very differently (Hirsch Hadorn et al. 2008).
- *Potential and valid assessment frameworks and leitmotifs*
  The complexity and particularly the aspect of uncertainty and of potential states of not knowing make spatial planning as a not-only technocratic, but a more political undertaking and challenge more explicit. Resulting challenges could include the (re)definition of planning paradigms and the visions and normative backgrounds of how to deal with land as a collective resource (Birkmann et al. 2010). Several conceptual approaches and their implications are discussed with reference to the question of how to deal with climate change impacts. Such approaches include different assessment approaches or different orientation frameworks such as resilience, adaptation and vulnerability (Eakin et al. 2009). Although the discussion of so-called leitmotifs is not new to planning, each leitmotif provides orientation towards decisions on how to confront the challenges mentioned above. Since the uncertainty, potential states of not knowing and unforeseen co-emergent processes leave leeway open, the challenge is to find a suitable leitmotif and to consider it also in planning law to provide greater orientation for the final planning decision. A leitmotif on how to tackle potential climate change impacts, potential states of not knowing and further change processes relevant to land use could determine what must be considered in final decision processes, which analyses should be performed, and so on.

8.3 Resilience Thinking as a Potential Leitmotif

In the debate on how to tackle change and complexity in cities and regions, the concept of resilience appears increasingly as a reference framework, also in the planning and regional development discussion and in association with climate change adaptation (e.g. Beatley 2009; Pendall et al. 2010; Wardekker et al. 2009). Resilience thinking occurs as a suitable leitmotif which emphasises complexity, including characteristic uncertainty, co-emergence and potential states of not knowing, as well as learning to live with change and to adopting a perspective of social and ecological interdependencies. Wilkinson (2012) presented a specific, distinct elaboration of the useful insights generated by the social-ecological resilience concept for planning theory and shared notions.

Since the idea of social-ecological resilience has been discussed in several contexts, there is a vast array of definitions (Brand and Jax 2007). Apart from the differences, many approaches refer to aspects of uncertainty and complexity and the ability to deal with ongoing changes, unpredictable and sudden events or disturbances in social-ecological systems through incorporating and living with change (Berkes et al. 2003; Folke et al. 2002).

Here, resilience is understood as the capacity of an urban region to absorb climatic stimuli and their effects and to reorganise itself in order to maintain, manage and deliberately advance or even transform essential social and ecological functional and structural properties whilst undergoing change (Carpenter et al. 2005; Walker and Salt 2006; Berkes et al. 2003). This understanding of resilience in the given context of climate change is not identical with the main definitions used in social-ecological resilience thinking, but adds the notion of further advancing or even transforming essential functional and structural properties. Walker et al. (2004), however, would classify this understanding to their concepts of adaptability or transformation (Walker and Salt 2006). It might be necessary to transform social structural properties as, for example, institutions might have been developed by taking certain paths that are unsuitable for tackling complex change processes. These change processes may already have resulted in trapped situations in various realms due to institutional failures or other wrong paths taken. Since the resilience thinking approach is then also applied to spatial planning, the notion of deliberation and transformation furthermore takes urban and regional planning into account as human-intended action. And it includes the possibility to overcome path dependencies in urban and regional development, as well as linear thinking rooted in planning institutions. A broader understanding of social-ecological resilience, including adaptive or transformative aspects, can be found in Goldstein's

understanding of "collaborative resilience" (2012) or within Davoudi's notion of "evolutionary resilience" (2012).

What might a leitmotif of social-ecological resilience thinking mean to practical spatial planning? What input could be gained from an orientation towards this leitmotif? Answers to these questions are given in Fig. 8.1 and explained in the text below.

Strengths of resilience thinking	Inputs for practical spatial planning dealing with climate change impacts in urban regions
A) Uncertainty, surprise, potential states of not knowing	Acknowledge and deal systematically with uncertainty and potential states of not knowing as well as sudden surprising events => multiple plausible trajectories, enhance diversity, redundancy
B) Dynamic change, regime shifts	Solve gaps: between short planning horizons and current planning decisions with long-term consequences; between "old" legally binding plans and new knowledge, take into account the possibility of regime shifts and analyse thresholds of slow variables
C) Complexity, questions dominant assumptions, coupled social-ecological systems	Rethink methods and procedures applied that reduce complexity and start from linear understandings – try to overcome too simplistic approaches and allow complex and innovative thinking, integrate ecosystem services approach, learn from past developments (and their paths)
D) Different forms of knowledge, social learning, self-organisation	Strengthen collaborative planning processes and the role of their outcomes. Combine expert knowledge with stakeholder knowledge, review planning processes and especially laws on integration of different knowledge forms, define realms for self-organisation (not to flee from state responsibilities)
E) Cross-scale dynamics and interdependencies (panarchy)	Think along the lines of multi-scale plans oriented towards problems rather than jurisdictions, flexible planning, multi- and cross-scale planning processes

Fig. 8.1 How resilience thinking can impact practical spatial planning (*Source* by author)

(A) Uncertainty, surprise, potential states of not knowing

Does urban and regional planning deal consciously with uncertainty, sudden surprising events and potential states of not knowing? An orientation on resilience thinking could influence planning to deal more systematically with these and to rethink the so far used methods and information, which seem to be oriented on (seemingly) predictable trends or probabilities. The difficult—and not yet sufficiently answered—question remains in this context, how the resilience thinking approach could be operationalised for applying within planning. Existing literature on urban and regional resilience (e.g. Fleischhauer 2008) tends to incorporate resilience principles originating from urban hazard research. These are mainly redundancy, diversity, efficiency, autonomy, strength, interdependence, adaptability and collaboration (Godschalk 2003; Fleischhauer 2008). Some authors, who rely more on the social-ecological understanding of resilience, conceptualize resilience broader and emphasize the integration of different types of knowledge, self-organization, diversity and learn to live with change and surprise (Wilkinson et al. 2010; Folke et al. 2002); whereas others follow the same conceptual thinking but add multiple feedback loops, high flux, flexibility, modularity, buffering and redundancy (Wardekker et al. 2009; Kumagai et al. 2010).

Even though there are these manifold criteria and aspects of resilience to be found, some principles are highlighted as pivotal elements for urban resilience, emerging in different case studies and contexts (Godschalk 2003; Wardekker et al. 2009). These are mainly

- redundancy in the meaning of if one system component fails, other functional similar components can take over,
- diversity or diversification in the meaning of several functional different and independent approaches and components, which can stay functional if another fails,
- flexibility and learn to live with change as well as,
- self-organisation.

An orientation on resilience thinking in urban and regional planning would then imply not only to consider systematically different plausible future trajectories and surprising events (what would be of help to overcome the first challenge already), but also to enhance diversity and redundancy in land-use structures as well as to promote a flexible and learning approach and to foster self-organisation.

(B) Dynamic change and regime shifts

With the emphasis on ongoing change in social-ecological systems, resilience thinking puts the attention directly on gaps, which seem to be not yet solved within practical urban and regional planning, as system-immanent and non-linear change seems to be neglected within urban and regional planning. An orientation on resilience thinking as leitmotif would then also imply to solve the gaps between the limited planning horizons ranging from one to two decades and the long-term consequences of planning decisions going far beyond these horizons and between adopting legally binding land-use plans and simultaneously remaining flexible enough to cope with ongoing change processes such as different climate change impacts over time (see the discussion on strategic planning). Third, also more light would be shed on slow variables and their thresholds, which could strengthen the capacity of urban and regional planning to analyse or try not to contribute to undesired regime shifts (Scheffer et al. 2001; Wilkinson 2012).

(C) Complexity, questions dominant assumptions, coupled social-ecological systems

Social-ecological resilience thinking draws on complexity theory, which is especially crucial to understand cities and urban regions. Existing urban research is hardly in a position to do so, due to its reduction of complexity (Allen et al. 2008). Also, planning in urban regions is used to methods and procedures, which reduce complexity and start from linear understandings. Social-ecological resilience thinking gives here some major inputs for urban and regional planning as it

(1) questions dominant linear assumptions such as impact regulations, command and control approaches, partial worldviews and therewith puts into question methods and procedures in planning that reduce complexity instead of acknowledging its presence; and
(2) draws especially on social-ecological systems, conceptualized as inseparable systems and entities in their own right due to interaction dependencies and feedback between the social and ecological spheres. Stress, shocks and surprises influence both the ecosystem and the social system at the same time, and disturbances influence the specific social-ecological interplays and feedback within the specific system (Folke 2006). An orientation on resilience thinking would then imply to highlight the social-ecological interdependencies within urban regions and to put also more emphasis on ecosystem services, also in integrative planning at the urban and regional scale (Elmqvist et al. 2004; De

Groot et al. 2010). Nevertheless, this approach alone would not be sufficient, as there are other aspects of complexity and social-ecological interdependencies of importance to be tackled in practical planning, too, which also point out the problem of fit between the administrative planning boundaries and the existing social-ecological interdependencies.

An orientation on social-ecological resilience thinking might lead to very different foci in practical implementation and also in scientific analysis and conceptual work: It questions the dominant assumptions of separate systems of nature and society, of linear and stable ecosystems and their development under human control, as well as the norms and habits that might have put the urban regions on a certain restricted path (Pendall et al. 2010). Also it puts into question, if it is adequate to integrate data produced, analysed and judged by the different sectors and departments (such as concerning agriculture, economic development or transport) within urban and regional planning. An alternative could be to follow an integrative analytical approach with a social-ecological lens already from the very beginning of the planning process.

(D) Different forms of knowledge, social learning, self-organisation

Resilience thinking conceptualizes coupled social and ecological systems interacting in complex feedback as one system. This requires the integration of natural and social sciences perspectives or even the transgression of their different disciplinary paradigms. Urban and regional planning has already a cross-sectoral approach and has to integrate different interests and perspectives on land-use. Nevertheless, as resilience thinking emphasizes also the role of social learning to comply with complexity, the question arises as how far spatial planning itself follows a learning approach. Applying resilience thinking as leitmotif would then also imply to integrate not only various disciplinary generated knowledge or even interdisciplinary integrated knowledge, but also to transgress borders of scientifically generated knowledge as such and to integrate stakeholder and their experience-based knowledge. This would also entail not only to strengthen collaborative and communicative planning processes (Goldstein 2009), but also to integrate consciously stakeholder and experience-based not scientifically generated data and knowledge (Innes and Booher 2010). This would also (depending on the given planning system and the respective national laws) imply to review established planning processes and laws on the real integration of different forms of knowledge and ways to integrate relevant so far tacit knowledge into planning, too.

But as information, data and knowledge (as well as perspectives) in administration in industrialized countries usually is organised in different sectors, the important task of land-use planning is to integrate these. How might a real integration be possible while planning is reliant on the sectoral interpretation of data and information and sectoral methods and while real (and at the same time for practitioners essential: easy applicable) methods to integrate scientific data from different realms such as social or natural sciences are just developing.

The emphasis on self-organisation in this respect not only points out to the capacity to operate on an urban-regional scale independently of outside control, but also to have the respective competencies to do so (Wardekker et al. 2009).

(E) Multiple scales, cross-scale interdependencies

Furthermore, the systems perspective within resilience thinking can be considered to be of good value especially to understand complex, coupled ecological and social systems and to perform analyses across multiple scales oriented on practical problems. The latter are not occurring according to jurisdictional borders but to social-ecological interdependencies across different scales.

The scale-mismatch with reference to spatial scales is not really new to spatial planning, but the general problem that planning is undertaken in the most cases only according to administrative boundaries is still not solved yet. Instead of having plans according to jurisdictions and not coercible to problems, it could be thought of flexible plans and planning processes crossing scales, depending on the problems at hand. Otherwise these scale mismatches between ecological processes and management practices might cause new problems or leave some problems unsolved (Borgström et al. 2006). Additionally, urban and regional planning has to take into account other scale mismatches than only the spatial scale mismatch, as already mentioned above with reference to the time scale.

8.4 In Practice: San Francisco Bay Area, Stockholm and Rostock Region

In this context, urban and regional development strategies as well as planning approaches towards climate change impacts were explored with the question if resilience thinking does play any role so far, and, more broadly, how it is dealt with the challenges cited above. The findings are based on explorative empirical studies using an analysis of documents (urban or regional adaptation strategies as well as regional or local spatial plans) and qualitative semi-structured interviews

conducted with representatives of planning or environmental administrations from the respective urban regions.

Three single explorative case studies (Yin 1989) were performed in different contexts, albeit all of them in industrialised countries. In Europe, these were Stockholm (Sweden), as a coastal urban region that already deals with climate change impacts (Deppisch et al. 2011; Albers and Deppisch 2012), and the Rostock region (Germany), also located at the Baltic Sea coast, that started developing a strategy to adapt to climate change impacts recently. The urban region of San Francisco (USA) was chosen as a case outside of Europe. This is also a coastal urban region, but differs from the European cases due to its experience with severe threats and dynamic change due to earthquakes (Coaffee et al. 2009) and through severe problems in ecosystem services, such as water supply and management (Innes et al. 2009). What San Francisco has in common with the other cases is its raised awareness of a rising sea-level and other climate change impacts, being particularly exposed and characterised as a coastal urban region. The strong role played by local community planning is a common characteristic in all three cases. However, the formal and informal planning approaches differ.

In the Californian **San Francisco Bay Area** case, a climate action plan was developed in 2004 by the city of San Francisco (SF 2004), emphasising the need for mitigation by showing future climate change impacts such as on human well-being, ecosystems and ecosystem services or infrastructure (SF 2004). A vulnerability assessment focussing on sea-level rise for the Bay followed in 2008 and a more informal, voluntary think-tank based assessment, taking into account different climate change impacts, followed in 2011 (SPUR 2011). As the most relevant impacts for the Bay Area, the latter identified rising temperature and heat waves, water uncertainty with drought and sea-level rise, which meet the specific vulnerable conditions within the Bay, threatening transport, energy infrastructure and settlements (SPUR 2011).

In terms of dealing with climate change impacts, the 2009 California Climate Adaptation Strategy exists at subnational level, which has an advisory mandate only; and the San Francisco Bay Conservation and Development Commission (SFBCDC) amended the Bay Plan, a programme to assist and advise local governments (SFBCDC 2011) with an emphasis on sea-level rise. The different scientific scenarios produced ranges for the Bay area at different times, using two scenarios for explicit vulnerability mapping. This document is mainly of an advisory nature for land use planning, as the Commission has a mandated authority for the water body only. Although, SFBCDC's recommendations impact developers in their choice of development sites as they tend to adopt a long-term perspective and refrain from building in areas threatened by sea-level rise.

General public's awareness of the concrete need to tackle future climate change impacts appeared to be low. This even seemed to be the case in some of the most vulnerable communities at the south of the Bay, which are already now below sea level and are threatened by flooding. Climate change plays virtually no or only a small role in local land use planning. Following the economic crisis and recession, the priority of local planning is to promote economic growth and create jobs. Climate change and its impacts only seem to be a topic relevant to a minority of local communities in the Bay Area, such as Berkeley, which is by no means the most threatened area.

SFBCDC pursues resilience thinking to a certain extent, such as crossing administrative boundaries, seeking strategic, regional and local allies to raise awareness on slow variables for change, tackling uncertainties or emphasising social-ecological interdependencies. According to interviewees, the organisation cannot pursue this thinking in a manner it considers useful because (a) some of the resulting strategies would violate existing legislation, issued before climate change became an issue and (b) as the existing laws and rules tend to encapsulate certainty. SFBCDC therefore made a regional attempt to cross the boundaries of its responsibility and to join forces with other regional agencies to raise awareness and to discuss jointly how to tackle the inherent uncertainties of climate change and the impacts it could cause.

Turning to Europe, the Swedish capital **Stockholm** expects climate change impacts due to temperature rise, an increase in rainfall and rapid snow melting leading to severe flooding due to a limited capacity of the urban drainage and sewage water system (Ekelund 2007). Sea-level rise is expected to have low impacts on infrastructure in Stockholm over the next decades due to isostatic uplift of northern Baltic regions, but more severe impacts at the end of the century (Graham et al. 2006; Viehhauser et al. 2006). Nevertheless, flooding and sea-level rise are already a topic of public awareness as Stockholm's drinking water reservoir is threatened by saltwater intrusion and deteriorating water quality and as there are already problems occurring due to limited water run-off and severe flooding.

Adaptation to climate change impacts has already been an issue for both the city and the urban region for several years, even though there is not yet any explicit national, regional or local adaptation strategy. The first report on adaptation was published by the city of Stockholm in 2007 (Ekelund 2007), which focussed on potential impacts and elaborated the next steps to be taken. Two studies exist at the regional level. One focuses on impacts, the other on the need to adapt and on factors that might influence adaptation (Nilsson and Gerger Swartling 2009). Local experts emphasise that the issue of tackling climate change impacts is considered in

urban and regional planning projects and that it has already been mentioned in planning documents.

Spatial planning at the municipal level, with detailed development plans and building permits, is legally binding; the comprehensive plan at municipal level is of a strategic nature and has an advisory mandate for these more detailed plans. The planning horizon is up to twenty years. The recent urban comprehensive zoning plan (2010) for the city of Stockholm already points out climate change impacts for the city. It also states adaptation as a goal and lists climate change impacts as one risk that has to be considered in all further planning processes. Since this plan is open to new insights and is considered to be an ongoing or "rolling" planning process, the specific local impacts of climate change on Stockholm and concrete needs for action are further analysed by urban planners. There are also other ongoing change processes, to be integrated later in the same comprehensive plan, which is open to further clarification and add-ons. In addition, the recent regional zoning plan (2010) includes adaptation to climate change impacts as an explicit goal, as is the case with several other local communities of the urban region in their zoning plans. They may also plan to revise their planning documents to include adaptation to climate change. Planners and administrative actors emphasise the need for flexibility within planning, for multiple uses of buildings and for diverse green spaces due to climate change impacts. The explicit contents of urban and regional plans with reference to climate change were extensively discussed by the public. On the one hand, the regional plan's proposal to avoid further settlements or buildings in the coastal zone due to sea-level rise and further climate change impacts was hotly debated and considered too strict. On the other hand, the risks to the drinking water reservoir caused by climate change were judged by some to be too positive or too ignorant of the risks involved.

Besides direct references to climate change and the flexibility of the planning process, the plans also pursue further resilience aspects. The diversity principle can be found with regard to transport, energy supply and green spaces. The redundancy principle was followed with reference to a polycentric settlement and flood protection works with flexible ranges according to new knowledge, also with reference to climate change (Albers and Deppisch 2012).

Temperature rise, sea-level rise and altered precipitation patterns are the main climate change impacts expected to affect the urban region of **Rostock** at the German Baltic Sea coast. Drinking water supply by the main river is threatened, and flooding threatens old and new planned settlements. Although a national adaptation strategy exists in Germany since 2008, no explicit measures were initiated in the urban region. Until 2009, the majority of key local and regional actors failed to recognise a need for action, although the city of Rostock is very active in

the movement to mitigate climate change and in the field of renewable energy. Especially in view of Rostock's weak financial and economic situation the region and city have more urgent problems to tackle. Apart from a few local media reports, there was no broad public awareness of climate change impacts in the region.

Spatial planning at the municipal level of the preparatory land use plan for the whole city is mainly binding for public planning authorities, which have to adapt their planning according to its content. This is especially important for the finally binding and more detailed binding land use plans for smaller parts of the local territory. The regional plan crosses the boundaries of several municipalities and usually has binding advice for the preparatory land use plans. The planning horizons of these plans usually range from ten to fifteen years. They are fixed plans once adopted; changes require a new formal procedure. Although urban and regional planning usually integrates cross-sectional information, this information and knowledge is usually compiled in plans or information developed by sector. The recent regional plan adopted in 2011 mentions climate change, but does not highlight adaptation as a goal or explicit need for action. The 2009 urban preparatory land use plan does not explicitly tackle climate change impacts. Instead, the waterfront development foresees new building projects in flood-prone areas.

The initiative to tackle climate change impacts was created by two research projects, especially one which focuses on future spatial development under climate change impacts. This process (Deppisch et al. 2014) lasted from 2010 to 2012 and involved key urban and regional planning actors and other important stakeholders from business, politics, civil society and administrations who are relevant to spatial development. The initial conceptual background was social-ecological resilience-thinking, brought in by scientists and posing a challenge to practitioners. The method used was scenario planning, involving the development of different scenarios of future land-use development with climate change impacts and other main drivers of spatial development (see Hagemeier-Klose et al. 2013). Recognising and including all of the identified main drivers for land-use development and two to four different potential paths how they could develop in the future, complexity was acknowledged and the uncertainty and ranges of different plausible futures were highlighted. This process raised awareness of potential climate change impacts and of the need to act, as well as of opportunities for action at the urban and regional planning level. In addition, previously existing short-term solutions to land-use problems were placed in a longer-term perspective, and the exacerbation of the problems due to climate change was acknowledged. A political process was started, too, causing adaptation to be mentioned in the "Guidelines for

the urban development of Rostock" (2010) and in a political framework concept on adaptation of the city of Rostock (2013). The draft development concept for the peri-urban region of Rostock of 2010 also includes adaptation to climate change impacts as a common field of action for the city and its surrounding region, and refers to the aforementioned research process (Deppisch et al. 2014).

The diversity principle has already been implemented in the plans, referring to transport, energy, economic development and green spaces. Also here, the redundancy principle with reference to a polycentric settlement structure has been implemented (Albers and Deppisch 2012).

8.5 Discussion: Applying Resilience Thinking as a Leitmotif—Potential Gains Versus Potential Trade-Offs

As evident in the characterisation of the cases above, in each case aspects of resilience thinking had or still have an effect, whether consciously intended or not. None of the cases explicitly show social-ecological resilience thinking as a leitmotif for urban and regional planning practice. Nevertheless, a number of driving factors for tackling climate change impacts were guided by this kind of thinking, such as the regional Commission for the Bay in the Californian case or the transdisciplinary research process attempting to implement the general aspects of this thinking The Swedish planning system already seems to provide possibilities for implementation because it offers planning instruments open to new knowledge and further amendment.

In the other two cases, the impulses for local and regional planning to tackle climate change and its potential impacts and to deal with uncertainty and ranges of potential future developments had to come from outside. In the Californian case, this was a regional environmental administration that took the initiative by crossing the boundaries of its own authority and a non-governmental non-profit organisation that aimed to promote good planning in the Bay Area. In the German case, the impetus came from academia.

In the German case, confronting practitioners with resilience thinking and emphasising uncertainty, change and non-linear dynamics as well as potential surprising events in the future was rather challenging for some practitioners and their thinking in political-administrative structures and routines. This was especially the case when practitioners related their thinking to the desired outcome of planning such as a legally binding plan, which must be generated using the available knowledge such that the plan would hold even if taken to court.

Social-ecological resilience thinking was more easily absorbed by cross-sectional and environmental planners. Most participants were used to working with specific predicted numbers rather than with margins or broad ranges of potential future developments and tended to think and discuss only the most probable future. It was highly challenging for all of the participants to leave traditional thinking routines, above all in their respective field of expertise. As a consequence, resilience thinking required translation, further clarification and application. During the process, resilience thinking was useful as a metaphor to frame change and uncertainty. Nevertheless, it was merely possible to think, discuss or develop scenarios that considered the disappearance of a huge or important given stock such as the harbour in town.

Despite being of a speculative nature, we must also ask what gains and trade-offs resilience thinking as an explicit leitmotif could achieve, taking into account the information on the cases. First, we turn to the gains that can be achieved for the planning process and its implementation.

As the Stockholm case shows, it is possible to integrate a flexible approach in spatial planning. This shows that the strengths of resilience thinking—emphasising ongoing change and remaining flexible—can be implemented also in such a formal and structured process as spatial planning. This is achieved in Stockholm by a still open adopted planning document into which new knowledge is integrated and by the regular review of the plan. This approach could also prevent planning from contributing to vulnerabilities, as explained above. This appears to be particularly possible with a comprehensive plan that is not legally binding and is of a strategic, advisory nature.

In all three cases, awareness of complexity and its characteristics of interdependencies and uncertainties are shown in part. The Stockholm city plan refers to the special challenges posed by these complex interdependencies; the San Francisco Bay plan draws on social-ecological interdependencies. The Rostock case shows that it is possible to tackle an urban region as a social-ecological system, as well as specific characteristics such as dynamic and co-emergent change processes and uncertainty. However, this process involved an extensive workload, triggered from outside of the practical planning processes, and was mainly financed by external funding. Although implementation must be observed in a couple of years, it seems that the outcomes of this process were sound and innovative as the strategies and measures developed to tackle climate change impacts crossed scales of mandated authority and of time. It was also possible to develop strategies and measures that are resilient to very different land use development scenarios and that adopt a long-term perspective beyond customary planning horizons.

Experience-based and stakeholder knowledge was also specifically integrated (Stockholm, Rostock) as well as were new cross-scales (across administrative levels, across sectors, across logics of action, etc.) ties bound in a new informal network (Rostock).

As far as the content of land use development is concerned, it is possible to take into account social-ecological interdependencies (Rostock scenario planning process, San Francisco Bay Area) and to raise awareness of uncertainty, change and surprise (Stockholm, Rostock). However, it remains to be seen if or how this thinking can be implemented when it comes to final political decisions on specific measures and on legally binding plans.

But new trade-offs could also occur due to an orientation towards resilience thinking as a leitmotif in spatial planning. The focus on the long-term functioning of the social-ecological system could trade off vulnerabilities of specific social groups and neglect immediate damage (Eakin et al. 2009). For instance, strictly following a resilience approach with its orientation on the long-term functioning of the social-ecological system in the SF Bay Area would mean having to leave the low-lying settlement areas and resettling inhabitants further away in the hills. Within the Bay Area, it is mainly weak and poor social groups who live in low-lying areas and are at most risk from sea-level rise. However, these groups are considered to be the least well prepared for costly and flexible adaptation.

With an emphasis on social-ecological interdependencies, there can be both gains and trade-offs in the practical political process of taking decisions on future urban and regional development. While it strengthens the perspective on the importance of ecological and natural assets, it could also cause problems in real implementation due to its roots in ecological system thinking, as it could be seen as being biased. As the Rostock case showed, for example, there was little awareness of social problems and specific vulnerable groups at the leading political level. As thinking stands at the moment, it could be instrumentalised to push certain political interests or to reject this thinking in the first place. Whether the concept of social-ecological resilience thinking supports given power structures due to its blind spots concerning power, has already been discussed elsewhere, as well as supposed normative undertones (Wilkinson 2012; Swanstrom 2008). Taking social-ecological resilience thinking as it stands as a leitmotif in practical planning would require clarification here, also taking into account the notion of Adger (2008) that resilience does not distinguish between desired or undesired states of social-ecological systems, but preserves both. The social-ecological resilience thinking bears an open, flexible framework that, whilst being applied, requires discussion within overarching and strategic planning processes and for every single

social-ecological system under consideration to define the norms and values at stake.

Also, it is necessary to discuss and define the essential local and regional structures and functions of the social-ecological system that should be preserved or that should be transformed further if wrong paths were taken before. The distribution of benefits and costs, impacts, vulnerabilities, adaptive capacities and power in the decision-making process on future land use as well as gains and trade-offs achieved by applying resilience thinking among different actor groups, generations, systems or scales has to be carefully observed (Eakin et al. 2009; Wheeler et al. 2009; Swanstrom 2008). In the process, we must identify who is affected, who pays, who benefits and when, (a) from climate change impacts and (b) from application of the leitmotif of resilience thinking in practical planning.

The question of responsibility must also be explored in this context. Local responsibility in the sense of being capable of operating independently of outside control and the existence of local formal competence are considered important (Wardekker et al. 2009). Davoudi (2012) sees this point with the emphasis on self-organisation critically and fears the risk of this idea being used in a neo-liberal way. This would imply that the state would shy away from its responsibilities, leaving the weak in need of support alone. Here, this notion is not shared completely. Instead, it is highlighted that local sense-making and decisions on filling normative and content-related gaps are necessary, which resilience and other leitmotifs leave unresolved. In contrast, as the Rostock case and, to a certain extent, the SF Bay study show, there is a need to collaborate across administrative scales and to support local processes to undertake the challenging process of applying resilience thinking and to take common decisions on future regional and local development.

The flexible approach can be used for strategic or preparatory land use plans (Stockholm), but was not shown for detailed legally binding land use plans. It seems that the implementation of flexibility in binding plans is fairly challenging and has to be integrated in the planning laws first, as the two examples of Rostock and Stockholm show. Innovations in the respective planning laws could then be to reduce grandfathering of new authorised buildings, stocks and land use structures and to re-evaluate and potentially revise use on a regular basis according to the changed or adapted strategic planning contents.

Social-ecological resilience thinking that draws on complexity and takes into account a wide array of potential future trajectories with ongoing and sudden, surprising change processes is already fairly challenging for planning practitioners and other stakeholders with an academic background, as the Rostock process showed. Adopting this thinking as a leitmotif in practical planning could possibly

exclude citizens or stakeholders who do not have such a background. To what extent a translation within urban contexts is possible must be explored in further research or practical processes.

8.6 Conclusions

An orientation towards resilience thinking in spatial planning that faces climate change would imply necessary changes in routine thinking, which are more or less new to existing practical planning, as the case studies show. Resilience thinking can indeed be introduced to practical planning. Adopting it as a leitmotif would provide both gains and potential trade-offs with reference to planning processes and planning outcomes. A number of important aspects such as the flexibility approach seem to be possible at a strategic but not legally binding planning level, even without losing the long-term perspective inherent in resilience thinking. At the more detailed and legally binding level, implementation in practical planning must probably wait for innovations in planning law and general civil law, as it touches the principle of grandfathering. Here it is a matter of principle how societies will deal with given and future property rights, as well as private versus public responsibility.

Finally, it is important to stress that regional and local specific normative decisions are still necessary if resilience thinking is to be used as a leitmotif in planning. Using resilience as a leitmotif can then be seen as a strong indication that local sense-making and the determination of desired outcomes and essential structural and functional properties is very important, especially within this open framework and its specific holistic perspective. At the same time, it is also important to discuss their actual state and if they need to be transformed because wrong paths may have been taken. Thinking in change processes and in potential wide arrays of future trajectories is not a replacement for the necessary, place-specific processes of discussion and negotiation on commonly shared goals and common welfare. But orientation towards a leitmotif of resilience thinking within spatial planning, especially at strategic levels, could enrich these processes and the planning outcomes. This would be achieved by pursuing a holistic perspective emphasising social-ecological interdependencies, co-emerging processes, slow variables and their role for potentially undesired regime shifts in ecosystems (Scheffer et al. 2001). It would also strengthen concerns regarding ecological assets, as well as the concern of future generations. This way, it sheds light on potentially underrepresented or neglected issues (see also Wilkinson 2012). As a leitmotif for practical planning, this would not only have implications on goal

orientation, but would also serve as an orientation framework for further planning decisions, such as problem definition and analysis.

However, it should also be dealt with as an open leitmotif so as not to exclude other perspectives from the planning process. Even though resilience thinking and the resilience concept are gaining an increasing amount of attention within planning sciences (Davoudi 2012; Wilkinson 2012; Albers and Deppisch 2012), this concept is still at the early stage. Exploring resilience building and ethical challenges in spatial planning is a potential future research endeavour that does not seem to have been undertaken yet.

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9 Developing Resilient Urban Waterfronts: Integrating Adaptation into Urban Development and Management

Peter C. van Veelen

Abstract

There is a growing attention for integrating climate change adaptation into policies, strategies and decision-making processes (e.g. mainstreaming). This paper explores to what extent climate adaptation can be integrated into processes of urban development and change, based on case study research in Rotterdam waterfront area (Feijenoord). In this research "adaptation opportunities" are identified, by mapping all planned spatial investments in brownfield development, urban renovation, and maintenance projects of public and private infrastructures and assets. These adaptation opportunities are seen as momentum for enhancing resilience at relatively low costs. The Feijenoord case shows that intervention opportunities, based on an assessment of life cycles and investment projects is not effective due to a lack of strategic asset management and because processes of urban development are becoming increasingly fragmented and uncertain. The paper concludes that it is more effective to focus on "intervention opportunities" that are based on an understanding of the economic and organisational processes of urban development and change.

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9.1 Incorporating Coastal Adaptation in Urban Development and Change

In climate adaptation research, much attention has been given to analyse the impacts of climate change, and the development and assessment of strategies that adapt to those effects. However, there is a lack of research that focuses on processes of urban development, management and change as an important precondition for a successful implementation of climate adaptation strategies. Several resources (Pahl-Wostl et al. 2007; Huq et al. 2003; Klein et al. 2005; Bouwer and Aerts 2006; Zevenbergen et al. 2008; Uittenbroek et al. 2012) stress the importance of incorporating adaptation to climate change adaptation in other policies, strategies and decision-making processes. In climate change literature this process of making adaptation part of 'the routine' is known as mainstreaming. The concept of mainstreaming originates from development planning (Huq et al. 2003) and has increasingly been used in processes related to resource management, community development, livelihood enhancements, coastal zone management, sustainable development, and risk management (Smit and Wandel 2006). Also, at the level of practitioners is a growing awareness of the opportunities of mainstreaming adaptation. One of the front-runners in this respect is the city of Rotterdam. Mainstreaming is one of the leading principles in the Rotterdam Climate Adaptation strategy; it is referred to as 'linking in [adaptation measures] with area development, network maintenance or the transformation of real estate' (Rotterdam 2013, p. 26). Also the Dutch Delta Program stresses the synergetic advantages and has explicitly adopted mainstreaming as a core strategy, referring to it as 'coupling of mutual goals' (Delta program 2012).

Despite the inconsistent terminology—sometimes it is referred to as "mainstreaming with", "incorporating in", "coupling" or "marry" with, the underlying premise behind incorporating climate adaptation into processes of urban planning and decision-making is that it is more straightforward and cost-effective. Cost savings are expected from opportunities to "piggy-back" adaptation upon other activities or from increasing benefits for local and regional stakeholders on the short term. But also to avoid maladaptation in the long run, which may result in increasing costs and poorly integrated solutions. Uittenbroek et al. (2012) argues that mainstreaming increases the opportunities for innovations and improves the effectiveness and efficiency of policy making. Other sources claim that mainstreaming speeds up the process of adaptation (Mees and Driessen 2011), reduces costs (Klein et al. 2005) and yields synergetic benefits (van de Ven et al. 2011). In the context of climate change adaptation, adaptation options that are beneficial, or

yield benefits in the short term, and add to reduce long-term effects of climate change are referred to as no-regret options (Hallegatte et al. 2012). Despite the positive qualities that has been attributed to mainstreaming, Smit and Wandel (2006) observe that research that focuses on the implementation processes for adaptation is still not common, although they acknowledge that in other fields of research 'a vast body of scholarship is developed that deals with actual practices and processes of adaptation' (*idem* p. 285). In practice, adaptation still appears to be proceeding slowly and is faced with many institutional or financial barriers.

Although these barriers are equally important, a more profound criticism is that mainstreaming remains limited to a strategic or tactical level and that it ignores the operational level of urban planning and development. However, processes of urban change, renewal and transition may well be the strongest determinants of success of climate change adaptation, and, more importantly, potentially create opportunities that open new ways for adaptation that are not yet identified. Arguably, urban dynamics and change may be leading drivers in adapting urban environments rather than adaptation urgency being the main driver steering urban planning and development.

This chapter focuses on the question: 'how can we use urban change and development as moments of change for enhancing resilience?' To answer this question, it is necessary to explore what urban change or dynamics can be used as a catalyst for enhancing resilience in waterfront communities and how these moments of change may be used effectively to steer urban areas towards more resilient futures. To get to that point, first an introduction of earlier tested methods based on identifying life cycles of buildings and urban assets and windows of opportunity in urban development processes is provided. Based on this overview, a new urban dynamics based method is introduced and tested in two case studies of urban coastal waterfronts in Rotterdam and New York. Based on the case study research conclusions will be drawn on the applicability of incorporating flood risk adaptation into incremental and planned processes of urbanisation, and finally, findings on the uniform application of the proposed method are shared.

9.2 Growing into Resilience: Life-Cycle Based Adaptation Planning

Recently, researchers (Veerbeek et al. 2010; Zevenbergen et al. 2008; van de Ven et al. 2011; Gersonius 2012) have drawn attention to incorporating adaptation into urban renewal, regeneration and development cycles. The assumption is that actual moments of change in processes of urban renewal and development and life cycles

of buildings and assets offer significant 'windows of opportunity' that allow for integrating adaptation measures at relatively low costs. Identifying these adaptation opportunities allow for a more 'opportunistic' adaptation strategy, in which urban dynamics set the pace and nature of adaptation responses of urban areas 'growing into resilience'. van de Ven et al. (2011) identify two major opportunities for neighbourhood life cycle based adaptation. Firstly, the development of greenfields and the transformation of brownfields provide opportunities to include adaptation into the design of buildings, infrastructure and networks. Secondly, the planned renovation of buildings and urban assets offers opportunities to retrofit adaptation measures. When these adaptation opportunities are missed, retrofitting adaptation measures usually becomes more expensive, time-consuming and leads to weakly integrated spatial solutions.

Gersonius (2012) introduces a method based on the identification of Mainstreaming Adaptation Opportunities (AMOs). AMOs are defined as 'windows of opportunity' derived from cycles of maintenance, modification and renewal of urban assets, infrastructures, buildings and public spaces. The method is based on (1) identifying all planned or expected spatial investments within a predefined study area, (2) determining the time windows when these investments may occur, (3) modify these investment projects to incorporate climate adaptation measures and (4) analyse if time windows of adaptation strategies and investment projects overlap or coincide. The AMO method has found to be effective when assessing the viability of adaptive strategies in well-managed systems, such as an urban sewer system and when limited to identify 'project-level adaptation mainstreaming' (Gersonius 2012, p. 78).

Although, both approaches initially aimed to assess the adaptive capacity of urban regions or urban systems in general, it may be doubted if evaluating life cycles or moments of change is an appropriate method to define adaptation opportunities at the project-level of urban development and change. Both methods assume a high level of continuity and predictability of urban development and maintenance. This may be true for cycles of planned maintenance of urban infrastructure, such as a sewer system, but the economic life span of buildings is only one of the myriad factors that influences urban dynamics. Other factors, such as ownership, position within the urban geometry, current market values and market conditions, and political incentives (van de Ven et al. 2011; Veerbeek et al. 2010) are equally important when understanding urban dynamics and identifying adaptation opportunities.

Secondly, both approaches limited their focus on identifying the moments of change that allow for incorporating adaptation, but ignored the fact that it needs more to turn these moments into actions. A common problem in adaptation is that

costs and benefits of adaptation are not distributed evenly among stakeholders (Adger et al. 2005). In addition, local governments lack legal instruments to regulate adaptation measures on building level (van Vliet 2012). Finally, both methods ignore that other interventions (e.g. changes in institutional landscape, policy changes or new financial instruments) at other levels of the system can sometimes generate new and unexpected moments of change and open up opportunities for adaptation at the local level. To conclude, it is necessary to develop a method that bridges the gap between adaptation opportunities based on actual moments of change in urban development and transitional changes in legal, institutional and financial structures that are needed to improve the willingness among stakeholders to invest in adaptation or that unlock the potential of new moments of change.

9.3 Towards Transitional or Transformative Pathways: Adaptation Options, Intervention Points and New Opportunities

The method proposed here is based on a distinction made by Pelling (2011). In his view, adaptation is a result of processes of incremental *resilience* actions, *transitional* adaptation and *transformational* adaptation. Resilience actions aim to improve the performance of a system without changing guiding assumptions or established routines, *transitional* adaptation actions aim to optimise and improve of current policies, rules and technics, and *transformational* adaptation actions aim to develop large-scale or radically new trajectories, approaches, techniques and policies. The IPCC (see for example Denton et al. 2014) follows this view and calls the kind of actions that changes the fundamental attributes of a system in response to change *transformational adaptation* as opposite to *incremental adaptation* that aims to 'maintain the essence and integrity of a system or process at a given scale' (Denton et al. 2014, p. 1121). Incremental responses are often referred to as business-as-usual approaches that focus on proximity causes (Kates et al. 2012; Denton et al. 2014; Wise et al. 2014), while transformational adaptation involves innovations that contribute to systemic changes (Denton et al. 2014). Incremental adaptation is sometimes also referred to as *restorative* resilience aiming to restore a previous situation, which contrasts with *adaptive* resilience aiming to improve and adapt (Zevenbergen et al. 2010). The point is to distinguish between incremental adaptation pathways (combinations of interventions that are part of the routine), transitional adaptation pathways that do require some improvement of the set of policies, rules and techniques, and transformative adaptation pathways that are

based on large-scale institutional and cultural changes and new partnerships that unlock the full potential of these new pathways.

Building on these definitions five aspects of adaptation can be distinguished: (1) *adaptation options*, defined by the IPCC (2014, p. 2) as 'the array of strategies and measures that are appropriate for addressing adaptation needs' (*idem* p. 838), (2) adaptation *opportunities*: 'factors that make it easier to plan and implement adaptation actions, […], or that provide ancillary co-benefits' (IPCC 2014, p. 2). In addition to these definitions, it is necessary to distinguish between (3) *adaptation intervention points*, which are defined as the actual moments of change that potentially may be used for adaptation, (4) *adaptation transitions* that are defined as changes in legal, institutional and financial structures that unlock the full potential of adaptation intervention points, and (5) *adaptation transformations* that are fundamental changes in urban form, policies, institutional arrangements and norms that could create new adaptation *opportunities*.

Rather than identifying all potential adaptation options and select the most optimal, the method introduced is based on assessing the effectiveness and long-term sustainability of the current policy framework. Building on the work of Haasnoot (2013) and Gersonius (2012) the method (as illustrated in Fig. 9.1) starts with the first steps of the Adaptation Pathway method: (1) defining the system, objectives and thresholds, followed by (2) a vulnerability assessment and (3) identifying moments of time when thresholds are reached. It then continues with an assessment of expected urban dynamics, relevant stakeholders, and an assessment of local agendas and ambitions for change in the area to analyse how incremental changes and transformative change affects the vulnerability of the system under review. As an example, an expected spatial change—be it an incremental process of gentrification or a more transformative development triggered by a rezoning—may both positively or negatively affect the vulnerability of the area and influence the position of critical thresholds. A conclusion at this stage of the adaptation planning process could be that adaptation is not (yet) needed, or that incremental urban change leads to a more resilient situation. However, when urban change is expected to increase vulnerability adaptation may be needed in the future. When adaptation is needed or expected, (5) adaptation *options* and *adaptation intervention opportunities* are identified that enhance the resilience of the area within the current policies and regulations frame. Based on this assessment, the effectiveness and long-term sustainability of the current policy framework is judged. A potential outcome of this stage is that the current policy is effective to enhance the resilience of the area, although (7) adjustments of the rules are needed that improve the effectiveness of the policy frame assessed. If so, after implementation of these policy adjustments the method continues with monitoring the

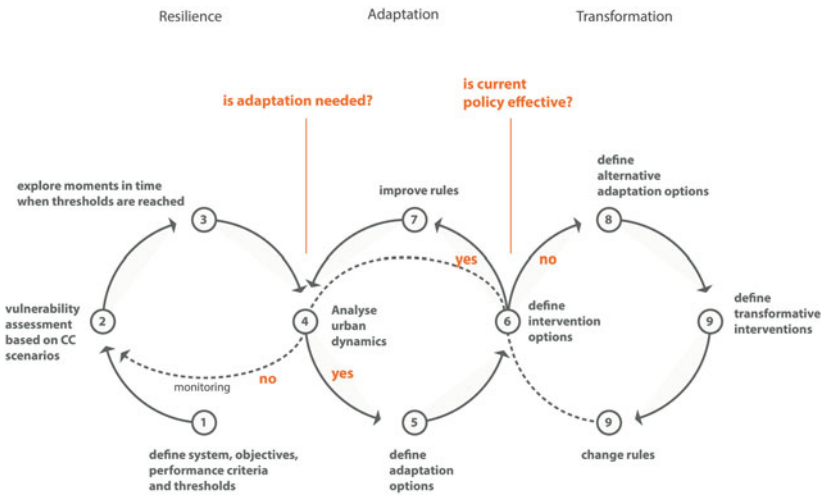


Fig. 9.1 Adaptation pathway method based on incremental adaptation and transformative adaptation pathways (*Source* by author)

timely implementation of adaptation options based on an assessment of urban change (4). Yet, if the improvements of the rules, over time, prove to be ineffective to deliver resilience in the long run (8) alternative *adaptation options* and (9) *intervention opportunities* are assessed and (10) *change of rules* that is needed to unlock the potential of the adaptation options and intervention opportunities identified. As a final step, based on this analysis, the transformative adaptation strategy can be implemented and again a phase of monitoring proceeds (4).

9.4 Research Approach

In the next session we will analyse potential adaptation options and opportunities in two flood prone waterfront areas in Rotterdam (Feijenoord) and New York City (Red Hook). To find potential adaptation options and intervention points, all planned public and private investments projects and expected long-term changes were identified. These changes were assessed on temporal cycle, the readiness among stakeholders to invest and likeliness of change. The analysis was based upon data provided by municipal agencies and information derived from interviews with municipal officials, key stakeholders in local development and

community representatives in both cases. In the Rotterdam case, data on planned housing projects was obtained by selecting projects from a municipal database that contained all real estate developments. This dataset, however, only registered new construction projects that are granted a building permit or to be realised within a time frame of 5–15 years. Renovation projects, long-term projects or not-yet defined projects were not included in the data set. To bridge this gap, semi-structured interviews were conducted with representatives of the district authority, city officials and key stakeholders in the area, such as the public housing association, or local community representatives. Data on planning of infrastructure projects and public assets, such as planned renovation of quay constructions and redesign of green areas in Rotterdam, was collected during a workshop with officials of the department of public works.

In New York City, data on planned real estate development is not centrally recorded and not available at district level. Based on literature research, reports of the NYU Furman Center (2014) and data provided by city authorities, the average rate of rebuilding and renovation of buildings and infrastructure could be estimated. These lifecycles were used to estimate future investments and calculate the time-scales of adaptation. As a timeframe for adaptation the year 2050 was taken. Interviews with key stakeholders provided information on uncertainties, strategic decisions and potential interrelationships between these investments. The results were mapped and recorded in a diagram as shown in Fig. 9.3 and a topographical map (Fig. 9.2) to identify intervention points both in time and space.

9.5 Casus Feijenoord

The urbanized area of Rijnmond-Drechtsteden has large unembanked alluvial areas that are almost entirely urbanized and not protected by the primary flood defence system. Approx. 60,000 people live in this area of some 200 ha, an area equivalent to that of a small provincial city, including the largest port-industrial cluster of Europe (Veerbeek 2013). The flood prone parts of the unembanked areas are already vulnerable for flooding and will have to deal with an increased flood risk due to rising sea levels in the river Meuse caused by sea level rise and increased river discharge. Although flooding of the unembanked areas happen more regularly, the floods are characterized by relatively low inundation depths and are relatively short-lived.

One of the flood prone areas is Feijenoord, which is a residential district located in the nineteen-century former port area. Feijenoord is a local basin with a relatively high flood probability. More than 90% of the housing stock in the area

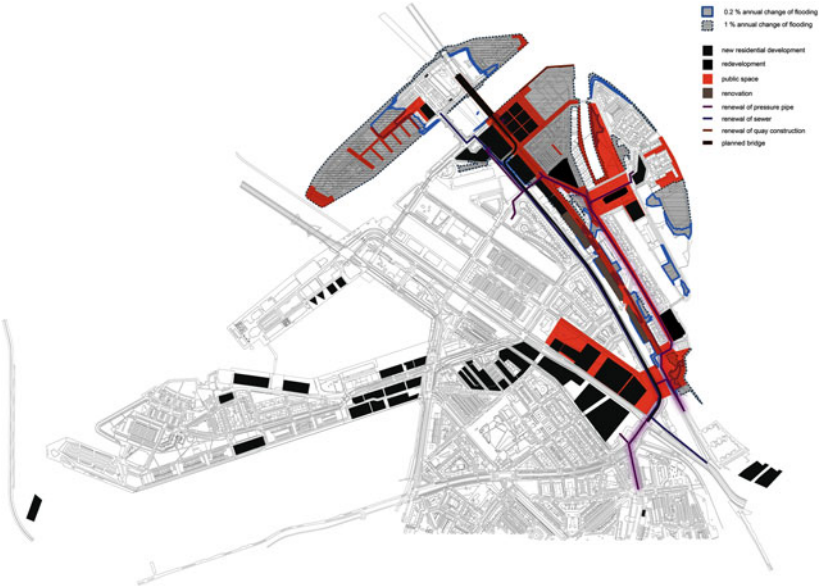


Fig. 9.2 Overview of all identified public and private investments in real estate development, infrastructure and planned maintenance projects of public assets and infrastructure (*Source* by author)

comprises social housing. The area also hosts several companies, including a factory of Unilever and an aluminium foundry. The area is struggling with several interacting problems. The overall condition of the social housing stock is in a poor shape. A large part of the buildings consists of poorly renovated nineteen-century apartment blocks and apartment blocks that have been developed during a previous phase of urban renewal in the late eighties. The low-costs social housing stock no longer meets current housing standards and needs complete renovation. Also, the area lacks public facilities and the quality of public space is poor. As a result, the area is populated by a low-income immigrant community and has one of the highest unemployment rates of Rotterdam. Despite the severe socio-economic problems, the position of de Kop van Feijenoord as a waterfront location close to the city centre and neighbouring the prestigious high-rise district of de Kop van Zuid makes the area highly attractive for redevelopment. In 2012 a new master plan (Rotterdam 2012) was developed to attract investors. This master plan includes a redevelopment of brownfield areas and a large-scale transformation of

the existing social housing stock. A new tramline and a bridge are planned to improve the accessibility of the area. Additionally, it is expected that a large amount of the existing social housing building stock will be renovated or redeveloped in the near future. However, due to the economic crisis and changes in national housing legislation restricting the high-risk commercial urban development projects of social housing corporations, many of the planned developments are currently on hold or being reconsidered.

9.5.1 Adaptation Options

9.5.1.1 Current Flood Risk Policy

At this moment, there is no comprehensive flood risk policy for flood protection of existing buildings in the flood prone areas. The current flood risk policy of the City of Rotterdam regulates new constructions to elevate the plot to the 1/10,000 storm surge flood level. The current storm surge flood level height is set to a level that fluctuates between 3.60 and 4.10 m above sea level, depending on certain local conditions and vulnerability of the land use. This policy implies that new buildings and assets need to be raised to approx. 1 m above average street level. For existing buildings there is no additional policy or regulation in effect to minimize the effects of a potential flood (van Veelen 2013). Homeowners are held responsible for possible damages caused by a flood and to take precautionary measures, although at this moment they are poorly informed about local flood risks. Community disaster management is currently limited to closing-off quay sections and public areas at high water levels. In addition, flood risk is not available in regular home insurance.

9.5.1.2 District-Wide Protection or Building-Level Resilience

Previous research (van Veelen 2013) has shown that there are two strategies to reduce flood risk. Two alternative strategies to reduce flood risk in the area are assessed. The first strategy is based on keeping water out of the area by gradually raising the low-lying quay shorelines to flood design level. Because a great deal of the quays and bulkheads already is elevated during previous urban renewal phases, preventing floodwater to enter the area can relatively easily be achieved by raising some of the quays and by constructing small flood walls. A second strategy is to improve the flood resilience of the urban area. This can be achieved by a combination of flood proofing new buildings and retrofit flood resilience into existing buildings, wet-proof utilities and infrastructures. Because of the considerable flood

depths and duration of the flood, dry-proofing existing buildings is, however not feasible, incorporating dry proofing in the architecture of new buildings is considered a viable option. Retrofitting wet-flood proofing to existing buildings is physically possible, but because wet-flood proofing requires substantial structural modifications it is assumed that only in case of new constructions or large-scale renovation projects wet-flood proofing is a low-cost and effective option.

9.5.2 Adaptation Intervention Points

9.5.2.1 Elevating Building Plots of New Developments

The area has a significant amount of vacant land owned by private developers and the City of Rotterdam that recently is rezoned to residential uses. Despite the slowing down of redevelopment of vacant land due to the financial crisis and weak real estate market, it is still very likely that these developments will take place in the short and mid-term. These developments offer opportunities for elevate the plot or creating flood-proof buildings. The inventory also revealed that many public investment decisions, such as renovation of the sewer system or redesign of the public realm and infrastructure, are tightly coupled with real estate development projects. Due to the weak real estate market, many developments in the area are currently on hold or under reconsideration, which also affects the timing of public investments. However, despite the uncertainty about the timing, it is likely that these plots will be developed in the mid-term, creating a predictable adaptation intervention point. Almost 842 new building units will be added to the existing building stock (Pohl et al. 2014), which will double the amount of units in the flood plain.

9.5.2.2 Retrofitting Flood Resilience Using Social Housing Renovation

As a result of more stringent national regulations and the financial crisis, investments in social housing have generally decreased. Despite the poor state of the social housing stock in the flood prone area, it is expected that only a small portion of the housing stock will be sold or rebuild on the short term. Based on information on the average building and renovation investment cycles derived from annual reports of the social housing corporations we estimated that in average 2–3% of the social housing stock in Rotterdam is large-scale renovated and 1% of the social housing building stock is rebuilt completely every year. Within a time frame of 35 years (2050) 35% of the social housing stock will probably be completely

rebuild and 70–100% will have undergo a large-scale renovation, thus providing an opportunity to wet-flood proof the building. Based on this inventory, it can be concluded that building level adaptation is effective, it is, however, an expensive and time consuming strategy. It is estimated that retrofitting wet-flood proofing require an investment of more than €50,000 per building (Rotterdam 2014), which can only partly be recovered because of the social renting prices. However, the social housing corporation has not yet decided on their long-term strategic port-folio management, making it highly uncertain whether they are going to pin their hopes on large scale renovation or selling-off individual houses on the private market or to private investors.

9.5.2.3 Planned Management of Infrastructure and Public Realm

Finally, it is expected that the city will invest in the public realm and infrastructure as part of a long-term regeneration program and will invest in planned maintenance of the sewer and heating system. Based on the information from city officials it proved that improvements of the urban infrastructure and networks provide only little opportunities for adaptation. For example, improvement works on the Combined Power and Heating infrastructure network and sewer system is mostly based on a replacement of existing infrastructure and is executed independently from other investment. An interesting opportunity to be considered, however, is the renovation of bulkheads and quays. Many of the bulkheads and historical quay structures are in poor conditions and large investments are foreseen in the next 15 years. Renewal of the bulkheads offers significant opportunities to elevate the waterfront or to create a floodwall at relative low costs.

All strategies provide opportunities to couple with urban development and public investments. Figure 9.2 presents an overview of all identified public and private investments in real estate development, infrastructure and planned maintenance projects of public assets and infrastructure. The inventory of timing of investments and life cycles (Fig. 9.3) shows that the development of new buildings and infrastructure and large-scale renovation projects offer a one-off opportunity to adapt, whereas the shorter redevelopment cycles of public realm and infrastructure offer multiple adaptation intervention opportunities in time. Flood proofing may also benefit from planned replacement and renovation of historical bulkheads and quays.

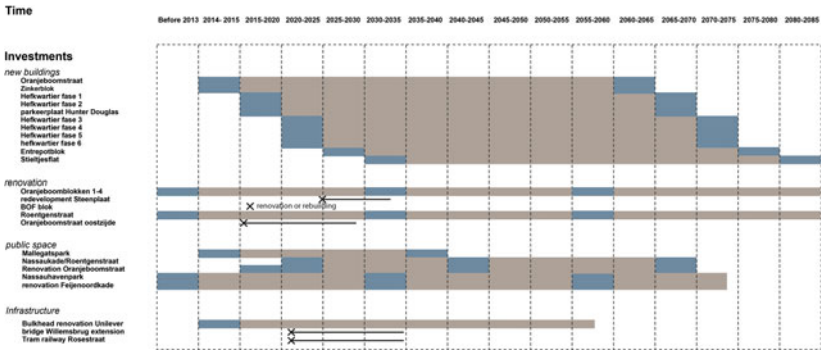


Fig. 9.3 Overview of the expected year of realization of planned public and private investments in the Feijenoord area (in *blue*) and estimation of the functional life, based on general lifespan of buildings, infrastructure and streets. The *black lines* indicate an expected investment decision of which the outcome is still uncertain, for example, to renovate or rebuild public housing buildings

9.5.3 From Intervention Options to Opportunities: Improving or Changing Rules

To capitalize on adaptation intervention points it will be necessary to develop direct incentives for stakeholders to invest in building level adaptation. One of the most effective instruments is to put a price on adaptation by levying charges or introducing compulsory flood insurance; combined with the development of flood resistant building codes that promotes adaptation. Flood insurance, however, is still not available in The Netherlands and there are no signs that a market will develop soon. Also, in The Netherlands, building codes are exclusively a matter of national responsibility and it is not expected that site-specific building regulations will be integrated in the buildings codes given the tendency to reduce regulations. Creating a flood wall, however, will requires some sort of coordination to assure the final realization but it also needs new financial arrangements to capture potential values and redistribute costs and benefits evenly among the stakeholders (van Buuren et al. 2014). In addition, a floodwall results in a rearranging of responsibilities between the city, water board and local stakeholders, that affects national policies.

Finally, a promising transition that creates new opportunities is the potential "sale and leaseback" of social housing, which would create a window to agree upon investments to enhance resilience. Social housing units being sold on the domestic market would create an opportunity to invest in property level adaptation,

as turning social housing apartment to private homes requires large-scale improvement and renovation. Although this transition is particularly promising the social housing corporation has not yet decided on their long-term strategic portfolio management, making it a highly speculative intervention point (Ballard et al. 2015).

The Feijenoord area may profit from large-scale redevelopment projects along the waterfront to create a district-wide protection. However, creating a publicly funded floodwall is not compatible with national regulations and requires a fundamental rearranging of responsibilities between the city, water board and local stakeholders.

Additionally, it requires new financial arrangements to capture potential values and redistribute costs and benefits fairly among the stakeholders (van Buuren et al. 2014). Several potential arrangements were analysed and discussed with stakeholders, of which an area fund or long-term area contract to pool resources and redistribute costs and benefits among stakeholders seemed to be the most appropriate (van Buuren et al. 2014). During a couple of workshops that were organised as part of the Stadslab Initiative[1] with the social housing corporation, urban planners and city representatives these concepts were translated into the concept of a *package deal* aiming to channel the value created by increased flood protection to support local community development. Within this agreement, all stakeholders who benefit from increased flood protection funded by public authorities (e.g. city and water board) are committed to invest equally to the value of benefits accruing from increased flood protection into socio-economic development. This allows for a more flexible and yet comprehensive approach, in which all stakeholders act within their modus operandi, while the local community benefits.

9.6 Casus Red Hook, New York City

9.6.1 Situation

Red Hook (Fig. 9.4) is a rapidly changing Brooklyn waterfront neighbourhood and home to approximately 12,400 people (NYRCRP 2014). As many New York City waterfront areas Red Hook was once a marshy wetland with some natural elevations that were reclaimed and filled to enable industry and business activities (NYCDCP 2014b) Still, the area has one of the few left working waterfront zones

[1] http://stadmakerscongres.nl.

Fig. 9.4 Water levels at the Red Hook waterfront at the current 100-year flood level and projected flood levels at the 10-percentile and 90-percentile NPCC 2050 scenario. The *dotted red line* indicates the maximum level reached during hurricane Sandy (*upper picture*) and residential buildings in the 100 year flood zone with the ground floor below the base flood level (BFE) (*lower picture*)

in New York and host significant amounts of industrial, manufacturing and commercial buildings. Given its peninsula-shaped position and the boundaries of the entrance of the Brooklyn-Battery tunnel and the Gowanus expressway, Red Hook is bounded by strong physical barriers and poorly connected to other areas of Brooklyn. The majority of the property in the area is privately owned. However, a significant amount of lots is city-owned or publicly owned by federal or state authorities, particularly along the waterfront area (NYCDCP 2014b). The area is home to one of the largest social housing projects, the Red Hook Houses. There is a significant number of vacant sites that remained undeveloped due in part of environmental contamination (NYCDCP 2014b) but potentially also because of speculation on future rezoning.

During Super storm Sandy, Red Hook suffered flooding from a storm surge coming directly off the Upper Bay and Buttermilk Channel and from surge water that was pushed into the Gowanus Creek (NYC 2013). The storm surge flooded almost the entire area reaching to inundation levels up to 1.85–3.0 m and causing inundations of basements and ground floors. Flooding of the sewer system led to sewer backing up in homes and businesses, resulting in local sanitation and environmental problems. The flooding led to long-lasting outages of power and block heating and in some cases running water, leaving many houses uninhabitable for many weeks and even months (NYC 2013; NYRCRP 2014). It is expected that the flood risks will increase in the future due to climate change. The recently updated flood maps showing the 100-year flood plain released in June 2013 by the Federal Emergency Management Authority (FEMA) show significant changes of urban areas that might suffer flooding (NYC 2013). Also sea level rise predictions show a significant increase in sea level rise ranging between 4 and 11 inches (0.10–0.28 m) in 2020 and 11–31 inches (0.10–0.79 m) in 2050 (NPCC 2013). Additionally, to coastal flooding, the area also suffers from pluvial flooding caused by poor drainage and sewer backup problems (NYRCRP 2014).

9.6.2 Adaptation Options

9.6.2.1 Retrofitting Flood Resilience

An essential part of the US flood management strategy is the federally operated National Flood Insurance Program (NFIP). This program enables property owners in flood prone areas to insure damage of flood risk, as long as they meet the basic requirements for constructions in flood prone areas. Buildings in flood zones are mandated to elevate above or flood proof below a certain flood elevation level, the

Base Flood Elevation (Ingargiola et al. 2012; NYCDCP 2013a). Only when buildings are completely brought up to the flood resistant construction standards they are eligible for a substantial reduced flood insurance premium (NYCDCP 2014a).

Elevating buildings to above the flood level is physically only feasible for typical low-rise urban typologies such as detached wood-framed structures (NYCDCP 2014a). Elevating attached or semi-detached masonry building in densely conditions is challenging because of structural integrity implications, limited on-site construction space and the need of collaboration with several neighbouring property-owners (NYC 2013). An alternative option is to wet-flood proof the building to reduce damages. Typical Brooklyn multi-family brick stone buildings use a cellar to locate the mechanical and electrical equipment (Findlan et al. 2014). In general, the cellar is located below a semi-below grade basement unit that is rented out as a small garden apartment (Fig. 9.5). Following the FEMA based NYC guidelines (NYCDCP 2014b) wet flood proofing requires filling of all below grade spaces and relocating the critical equipment to above to BFE, which typically means to a new mechanical room above the basement. This will require extensive modifications to reinforce the building structure and a considerable loss of useable space (NYCDCP 2014b), which, especially in small 2–4 family apartment buildings is probably not a feasible option as many of the home-owners rely on the rental income to offset mortgage costs (Stein and Nagy 2014). However, building owners may invest in flood damage reduction through flood proofing mechanical and electrical equipment, although it will only lead to an insignificant flood premium reduction. Finally, dry-flood proofing the basement and cellar by sealing off all openings is an option. However, under current Federal legislation, dry-flood proofing of residential premises in the 100-year flood plain is not allowed and will not result in reducing flood insurance premiums (Findlan et al. 2014). In addition, building resilience should be accompanied with investments in critical systems resilience, such as electrical utilities and sewer and communication systems to avoid a long-lasting recovery and rebuilding process after a flood.

9.6.2.2 Integrated Flood Protection System

The proposed strategy for Red Hook as mentioned in the report of the NYC Special Initiative for Rebuilding and Resilience (SIRR) aimed to prevent the area from flooding and improve the resiliency of buildings, infrastructures and vital functions in the area. One of the selected citywide solutions mentioned in the SIRR report (NYC 2013) is to 'install an integrated flood protection system in Red Hook and harden or modify shoreline parks to protect adjacent communities' (NYC 2013,

Fig. 9.5 Typical Red Hook building with semi below grade basement and ground floor apartment located below the base flood elevation (BFE) (*Sources*: *upper picture* Google street view, *lower picture* by author)

p. 254). The proposed integrated flood protection system is a combination of demountable floodwalls that consist of panelised structures that are put in places

during a storm or flood and fixed structures, integrated in the design of sidewalks and streets.

There are two major concerns regarding this option. Firstly, an integrated flood protection system requires many small adjustments of streets, sidewalks and private property and entryways, which make the development a contested and expensive process. Secondly, a floodwall consisting of demountable elements is not compliant with NFIP regulations unless the floodwall is permanent and accredited by FEMA (2014). This means that a flood protection system will not necessarily result in a full insurance premium reduction (Findlan et al. 2014). Another option identified, is to develop a permanent flood protection system consisting of elevated waterfront plots, hardened shorelines and floodgates at the Gowanus channel. A permanent flood protection system is highly effective in reducing flood risk and could result in a full reduction of flood insurance premium, once accredited by FEMA, it needs however large investments and considerable space.

9.6.3 Adaptation Intervention Points

9.6.3.1 Gentrification—Building Improvements and Renovations

After many years of degradation, Red Hook is on the rise again and benefits from the strong uplift of real estate value in New York and Brooklyn. Although the area's low-rise building typology is attractive, the area is not well connected to the subway network, which is one of the reasons why the area is not gentrifying in the way other better served parts of Brooklyn are experiencing (NYRCRP 2014). A second reason is that the area's most attractive assets along the waterfront are largely zoned for industrial, manufacturing and commercial uses (NYRCRP 2014). Despite this, buildings in the area are renovated and some of the former warehouses have recently been redeveloped into high-end condominiums and shops. Additionally, there are plans for transforming parts of the industrial waterfront areas into residential and mixed used, high-end waterfront development.

The gentrification process offers opportunities for building level adaptation but will only partly reduce the flood risk. New constructions or buildings that are substantially improved are required to comply with the flood resistant building codes of the NYC Building Code. All other building may voluntarily retrofit adaptation measures. The majority of the residential building stock consists of attached or semi-detached masonry constructions on a basement that is not suited

for structural elevation, as required by FEMA regulations. However, buildings that have a ground floor above the BFE will physically be able to bring the building up to the full FEMA standards to relatively low costs.

The amount of buildings that retrofits voluntarily depends on the speed of the gentrification process. A report on the state of the New York housing and neighbourhoods (NYU Furman Center 2014) show a 5-year average of 0.35% new units added to the current building stock for Brooklyn and less than a 0.2% units added to the total housing stock for Community District 6, which includes Red Hook. Based on data on issued Certificates of Occupancy, which serves as indicator for both new constructions and significant rehabilitated units (NYU Furman Center 2014; Keenan and Chakrabarti 2013) it may be conclude that the annual newly build and renovation rate is almost 2% of the total building stock of District 6, which is much more than the Brooklyn average (0.4%). Assuming an annual 2% renovation or rebuilding rate, it will take almost 50 years to retrofit the building stock of Red Hook. Considering the relative large increase in flood levels due to sea level rise, it is expected that climate change surpasses the speed of adaptation.

9.6.3.2 Improve Rules

Property owners of existing buildings are encouraged to adapt their buildings to comply with the new flood resistant building standards to lower their flood insurance premiums, but the NYC Department of City Planning acknowledges that 'in many instances, zoning regulations or conflicts between Building Code requirements would make it difficult, or in some cases impossible, for owners to build or retrofit to these standards[2]'. To stimulate homeowners to invest in flood resilience, the New York City Department of City Planning has recently updated the zoning ordinance and the City's building codes (NYCDCP 2013b). One of the adjustments made is an extension of the opportunities to recapture lost floor space due to wet-flood proofing actions, by adding an equivalent amount of floor area to the building as long it fits within the existing building envelope (Fig. 9.6). This adjustment allows property-owners to compensate for the loss of residential use of basement and cellar. To assess the effectiveness of this policy adjustment for the implementation of building level adaptation an analysis of building typology, first floor levels and potential for compensation was executed. Based on this assessment it was estimated that almost 30% of all residential buildings in the 100-year flood plain have their first floor elevated above the BFE and it is assumed that these buildings physically can be adapted to comply with NFIP/FEMA requirements.

[2]www1.nyc.gov/html/dcp/html/flood_resiliency/index.shtml.

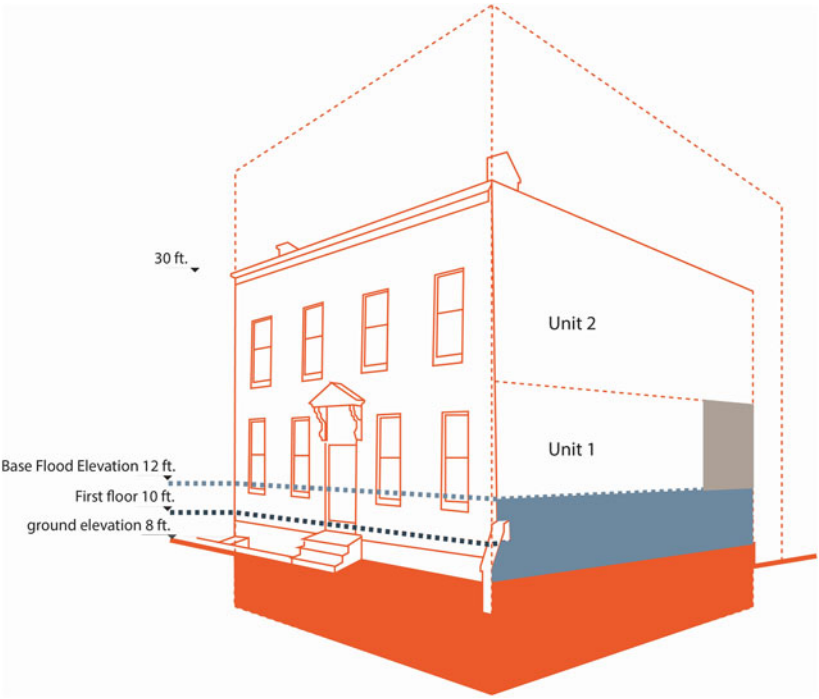


Fig. 9.6 To comply with FEMA regulations below grade spaces need to be filled (*red*) or wet-proofed (*blue*). Recently updated regulations allow property-owners to compensate for the loss of residential use of basement and cellar by adding an equivalent of space within the building envelope (*dashed line*)

More than 70% of all residential buildings in the flood plain have a first floor located below the BFE, which means that they are physically unable to comply with the FEMA requirements. However, it is often optional to wet-proof the below BFE floor area. Following the updated city's Building Codes, wet proofing leads to a substantial loss of space. The majority of these buildings (57%) have not yet reached the maximum allowable FAR and may compensate the loss of all below BFE uses by adding an extra floor or build out in the garden. However, to bring these buildings up to full compliance with FEMA's requirements requires a substantial investment. It is not likely to happen when buildings are completely renovated.

As summarized in Table 9.1, it may be concluded that of all residential buildings in Red Hook only 11% of the building stock can be brought up to full compliance relatively inexpensive. The majority of buildings (70%) have their first floor located below the BFE and may adapt by wet proofing the below BFE spaces. However, 48% of the Red Hook residential building stock is built to the maximum allowable floor area or reached the limits of the building envelope. It is expected that retrofitting these buildings will be physically and financially infeasible.

Despite earlier policy improvements, it is expected that the current policy is not effective to increase the resilience of the Red Hook community. A major step towards improving the cost-effectiveness of retrofitting buildings is to incorporate wider portfolio of adaptation options into the current FEMA requirements that better fits to the structural and spatial characteristics of high-density urban areas (NYCDCP 2013b). For example, dry proofing residential buildings is, under the current legislation not allowed, although, particularly for high density urban typologies and the relatively shallow flood conditions of most waterfront areas in New York, it is one of the most effective and beneficial adaptation options.

Table 9.1 Percentage of buildings that is able to adapt to the full FEMA requirements and NYC building codes or other adaptation options

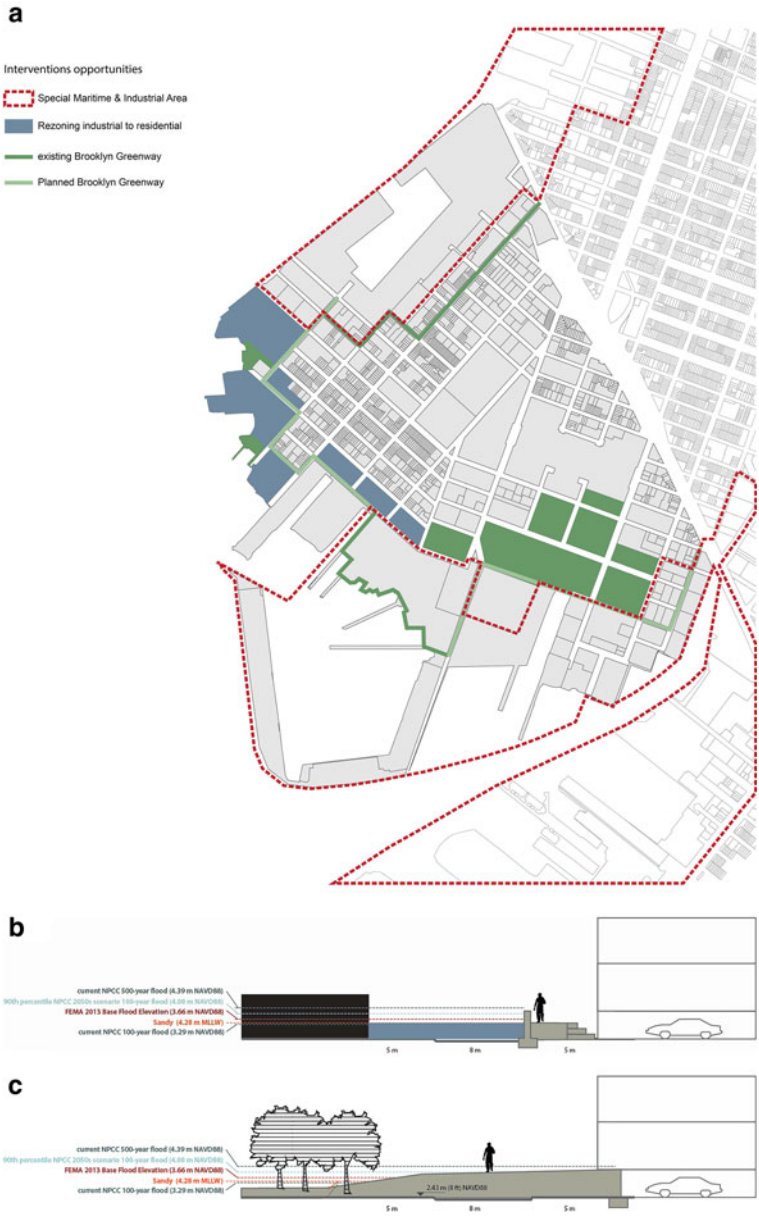
Building typology	Compensation possible	Adaptation options	NFIP premium reduced?	Percentage of building stock (%)
Wood frame detached		Elevate	Full reduction	1
Brick stone and first floor above BFE	Overbuilt or no room in building envelope	Wet proof all below BFE mechanical equipment	Partial reduction	18
	Room available in FAR and building envelope	Fill all below grade spaces and wet proof all below BFE uses	Full reduction	11
Brick stone and first floor above BFE	Overbuilt or no room in building envelope	Wet proof all below BFE mechanical equipment	Partial reduction	30
	Room available in FAR and building envelope	Fill all below grade spaces and wet proof all below BFE uses	Full reduction	40

Widening the portfolio of flood proofing alternatives, however, requires a Federal-level reform. The impact that these reforms may have on the willingness of stakeholders to invest in flood resilience is, however, unclear. Additionally, in some cases a rezoning is required to enlarge the building envelopes to allow for the construction of habitual spaces to compensate for the loss of space due to wet proofing. This rezoning is, although a time-consuming process, probably one of the most effective policy interventions that increase opportunities to adapt.

9.6.4 New Interventions and Changing Rules

9.6.4.1 Rezoning Red Hook's Waterfront

A large part of Red Hook waterfront is still zoned for manufacturing or industrial uses, which acts as a buffer between the industrial waterfront and the residential zoned areas. Rezoning this area to allow residential or mixed residential uses opens up opportunities to negotiate local amenities, such as affordable housing or public space in exchange for a higher density development (NYU Furman Center 2014). Rezoning to higher density uses unlocks significant value that could be captured to finance a district-wide flood protection. Additionally, rezoning may increase densities or height limits that triggers the redevelopment of resilient buildings or replacement of non-resilient buildings (NYCDPC 2013b). While rezoning has been successful in transforming large parts of the Brooklyn waterfront to improve public access and create a continuous bike and pathway, until now, district-wide flood protection infrastructure as a trade-off of a rezoning process is not common. Another major concern is that the Red Hook waterfront is granted special protection and is designated as one of six Significant Maritime and Industrial Area (SMIA) by the City of New York to protect and encourage concentrated working waterfront uses (NYCDCP 2011). This special indication means that the sites are protected to rezoning that would allow residential development (NYCDCP 2011). In addition, regarding potential conflicting interest of the local community, such as loss of affordable housing and local jobs, rezoning Red Hook will probably be a contested and long-lasting process. However, a combination of linking some existing elevated parks, rezoning of industrial sites to residential, and a bike path serving as flood protection could provide integrated flood protection for the area, as illustrated by Fig. 9.7.


a
Interventions opportunities
Special Maritime & Industrial Area
Rezoning industrial to residential
existing Brooklyn Greenway
Planned Brooklyn Greenway
b
current NPCC 500-year flood (4.39 m NAVD88)
90th percentile NPCC 2050s scenario 100-year flood (4.08 m NAVD88)
FEMA 2013 Base Flood Elevation (3.66 m NAVD88)
Sandy (4.28 m MLLW)
current NPCC 100-year flood (3.29 m NAVD88)
5 m
8 m
5 m
c
current NPCC 500-year flood (4.39 m NAVD88)
90th percentile NPCC 2050s scenario 100-year flood (4.08 m NAVD88)
FEMA 2013 Base Flood Elevation (3.66 m NAVD88)
Sandy (4.28 m MLLW)
current NPCC 100-year flood (3.29 m NAVD88)
2.43 m (8 ft) NAVD88
5 m
8 m
5 m

◀ **Fig. 9.7** *Upper picture* overview of intervention opportunities. A large part of the Red Hook waterfront is protected for rezoning by an indication designated as one of six Significant Maritime and Industrial Area. However, a chain of elevated parks (*green*), potential residential sites (*blue*) and a bike path (*green line*) could provide opportunities for creating an integrated flood protection for the area. *Lower picture*: multi purpose flood protection options by partly elevating of a sidewalk or complete waterfront zone

9.7 Discussion and Conclusions

9.7.1 Cases

One of the key finding is that there is little potential to build resilience from household redevelopment or renovation within an acceptable timeframe even when new complementary policies and regulative instruments that support building-level resilience would be developed. Because the speed of retrofitting adaptation depends on the speed of regular renovation and rebuilding rates, in both cases it was found that retrofitting would require at least a period of 30–50 year, which would hardly surpass the expected increase in future flood risks. The case of Red Hook has shown that retrofitting resilience of existing buildings is challenging from a technical and economical point of view and will require a considerable period of time. Additionally, these policies do not necessarily result in infrastructure vulnerability reduction (sewer and electrical systems outages). It is necessary to develop complementary policies and regulative instruments that support easy-to-implement or low-impact building-level resilience. In the Netherlands, developing a flood insurance policy that covers the costs of building flooding could cover the losses of low frequency flooding, although it is not an effective incentive to homeowners to invest in building level protection. In the US, widening the portfolio of building level adaptation that allows for a full insurance premium would increase the willingness among stakeholders to invest in building level adaptation and increases opportunities to harvest on incremental urban change.

A district-wide protection is effective in terms of flood reduction but requires large-scale transformations of the waterfront zone to seize opportunities for developing integrated protection at low costs. The Feijenoord case shows that the planned new developments and renovation projects of the bulkhead, new waterfront development and public realm offer a unique one-off opportunity to realize a district-wide embankment scheme at low costs, while keeping options open to adapt in the future. Both cases show that the development of a floodwall/multipurpose embankment offers new opportunities for creating a

greener and accessible waterfront, which affects housing prices and unleash new urban potentialities. This collective strategy, however, needs new financial arrangements to capture potential values and redistribute costs and benefits fairly among the stakeholders. Additionally, it requires large governance reforms, for example a widening of responsibilities of the water board. Also in the case of Red Hook, it was found that a district-wide solution, such as a floodwall or interconnected system of elevated waterfront plots might be effective. However, it not only requires a rezoning, more importantly, it requires a long-term coordinated approach that affects all waterfront development. This would not only require leadership at the local or city level, but also a culture of integral planning and development, which especially in the US context is probably a bridge too far.

9.7.2 Method

This chapter has explored to what extent climate adaptation can be incorporated into processes of urban development and change. It was argued that adaptation planning in its current definition mainly focuses on policy development processes at a strategic level and ignores the chaotic, fragmented and uncertain processes of urban development, renewal, management and incremental change. To adequately incorporate adaptation into urban dynamics, transitional actions need to be identified that unleash the potential of adaptation options, creating opportunities for adapting at relatively low costs or that yield additional benefits. Both case have shown that identifying intervention opportunities, based on an assessment of life cycles and investment projects and potential transitional interventions and "changes of rules" is helpful to assess options to realize adaptation measures at low costs. Moreover, it helps to identify key interventions—spatial, legal or financial arrangements—that are needed to unlock the potential of adaptation options. However, probably the true value of the proposed method is that it has proved to be effective to understand the complex relations between potential physical adaptation options, urban dynamics and intervention transitions. Thus, the method bridges a gap between flood risk management, urban development and governance. This opens opportunities for application to plan for long-term transitions that affect urban development.

Several remaining issues are identified. First, one of the challenges when working with the method is that it proved to be very complex to identify project-level adaptation points beyond a time frame of 5–10 years, with any objective certainty. This can be explained by a lack of strategic asset management, but also because decision-making processes of urban development and renewal are

by nature fragmented and uncertain. Data on the average rate of rebuilding and renovation of buildings and infrastructure provided a basis for assessing the long-term viability of the retrofitting process, but it still remained speculative. However, it may be interesting to use scenario-based analyses to understand the variety of future developments and opportunities for integrating adaptation and to assess the robustness of investments based an assessment of the sensitivity towards future trends.

Secondly, stakeholder engagement is crucial to understand the needs and agendas and to identify mechanisms of change that lead to adaptation opportunities. This is particularly true for adaptation planning for the mid- and long-term, because this requires to understand long-term ambitions, rather than to focus on project-based adaptation planning. Finally, it is arguable that both the urgency to adapt to increasing and more extreme flood events *and* the urban potentialities of waterfront development form a powerful combination to create added value. In a way, this is the case in Feijenoord and Red Hook where the development of a floodwall not only offers new opportunities for creating a greener and accessible waterfront, but also relies on a rezoning that affects housing prices and unlocks new urban potentialities.

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Making Infrastructure Climate Resilient: Bridging the Transformation Gap with "Living Labs"?

10

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Abstract

Infrastructure forms the backbone of any urban and regional economy. Energy, water, waste water, transportation and telecommunication facilities and networks shape the picture of cities and urban regions. Infrastructure makes an important contribution to the quality of life. The construction and the operation of infrastructures are responsible for a significant proportion of greenhouse gas emissions and for climate change. Cities and their infrastructures are, at the same time, affected by the impacts of climate change, resulting in the disruption of supply and severe economic damage. What is needed is a transformation towards low carbon, resilient structures that means the design of infrastructures is able to prevent or cope with the impacts of climate change or other attacks on the system. This paper explores, based on the concept of resilience, the question of how to initiate and to support the transformation of the infrastructure sectors. The Living Lab approach is such a transdisciplinary concept and provides the space for innovation. The paper gives an overview of the main features of this approach and points out some preliminary conclusions drawn from a regional case study.

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10.1 Introduction

Infrastructure is at the heart of economies. Infrastructure systems are critical to economic vitality, security, health, and environmental protection of cities, regions, and nations. Energy, water, sewage and waste systems provide the basic services to private households and to the business sector. Transportation and communication networks enable the market to function. More than 75% of the population of developed countries lives in cities and urban regions. The worldwide process of urbanization will progress further and will take place primarily in the emerging countries with high population growth but, also in Europe, the urbanization level is going to increase (United Nations 2014). Cities are therefore nodes of central infrastructure systems. Planning and design of urban infrastructures is, thus, considered one of the determining factors when dealing with climate change: The built infrastructure in cities and regions has a significant impact on how we move, how we communicate and how we satisfy our basic needs. Cities are therefore one of the main sources of greenhouse gases and the redesigning of settlement urban structures and infrastructure systems has great potential for reducing emissions.

On the other hand, due to the spatial concentration of infrastructure systems and their interdependencies, cities are particularly vulnerable to climate change. Climate adaptation is therefore crucial for the sustainable development of cities and urban regions (Pandit et al. 2015).

Against this background, the future development and the performance of infrastructure systems in modern industrial societies rank high on the political agenda. This debate involves a variety of problems and challenges. The issue of financing infrastructure and high investment requirements for the transition towards a low carbon economy, privatization and regulation of the network infrastructures, new organizational structures and the implications of demographic change, changing customer preferences and new demands for greater involvement of civil society in the planning procedure are the most important facets of the current debate in most of the developed countries.

More frequently, the debate also shifts towards the vulnerability of infrastructure and the consequences of possible failures. A recent study estimates the cost of a complete power failure in Germany during the winter months to be €750 million per hour (Growitsch et al. 2015). The flood in the early summer of 2013 in the south-east and the east of Germany, but also in the south of England caused damage worth billions of dollars to the infrastructure (de Moel et al. 2015; Jongman et al. 2015; O'Brien et al. 2015). Jongman et al. (2014) demonstrate that extreme flood losses in Europe could more than double in frequency by 2050 as a

consequence of future climate change and socio-economic development. A study by Forzieri et al. (2015) concludes that climate hazard impacts on critical infrastructures and EU regional investments may strongly rise in Europe; also damage could triple by the 2020s, multiply six-fold by mid-century, and eventually increase by a factor of ten.

Besides the obvious increase in the number of extreme weather events, there are also gradual, continuous changes in the climatic conditions placing new demand on the design as well as on the operation of infrastructure (Whitehead 2015). Future climatic changes have to be allowed for in today's investment decisions, because the infrastructure planned and built today will have an impact on future generations for many years.

These decisions are very complex and must be taken in a context characterized by growing uncertainties in the social, ecological, economic, and technical environment of the infrastructures systems. The initial conditions are considerably different from those in the past, when infrastructures were developed alongside relatively stable framework conditions (technology, finance, demand for infrastructure services, etc.). The current infrastructure system has evolved incrementally and the existing infrastructure stock is not really the result of coordinated development planning (Martinsa et al. 2013; Madani 2015; Furlong et al. 2016).

The current state of the infrastructure system also determines the future development of the system. This applies in particular to capital-intensive infrastructure systems with a long asset life of over 40 years. Lock-in effects and path dependencies are characteristics of these systems, which will hamper their capacity to adapt to changing conditions.

The plea is, therefore, to increase the resilience of infrastructure, i.e. its adaptability to new conditions against an uncertain background: "A better approach would include radically different ways of conceptualizing, planning and designing (…), constructing, maintaining, managing, adapting and valuing the physical infrastructure to make it resilient no matter which threats are manifested or how the future develops, for which symbiosis between infrastructure, management systems and end users must be nurtured" (Rogers et al. 2012).

There are a number of studies and research programs dealing with the characteristics of a resilient infrastructure system (Alderson et al. 2015; Hart 2015; McDaniels et al. 2015; Pandit and Crittenden 2015; Sage et al. 2015; McKibbin 2015). The statements, however, remain rather vague, particularly with regard to questions on how such a transformation process can take place and on how innovation processes can be initiated (Bulkeley et al. 2014; Sitzenfrei et al. 2013; McCormick et al. 2014; Quezada et al. 2015).

These questions are at the center of the following sections.

Section 10.2 deals in more detail with infrastructure planning challenges arising from uncertainty and sheds light on the barriers that hinder transformation. Section 10.3 describes the "living labs" concept as an innovative approach to overcome these barriers and to foster the development of resilient infrastructures. Section 10.4 provides the description of a real and complex problem of regional planning which could be used as a test field for the living lab approach. The last section contains a brief summary.

10.2 Challenges for Infrastructure Innovation Within the Context of Climate Change

10.2.1 Climate Change and Uncertainties

There is growing evidence that the international community will be unable to limit global warming to 2° and that climate change—a rise of the global temperatures, changes in rainfall patterns, an increasing number of extreme weather events—will have a significant impact on all social and natural systems. In addition, the climate may develop more dynamically in the future than it has been the case in the past.

The transformation of the infrastructure sectors has to take into account these changes, but there still is a large degree of uncertainty with regard to the extent of climate change and of its spatial and temporal consequences (Drouet et al. 2015; Gillingham et al. 2015; McMahon et al. 2015). Climate projections are still subject to uncertainty resulting from incomplete knowledge of the physical and biogeochemical processes, missing data on the development of greenhouse gas emissions and limitations of the implementation of existing knowledge, yet the ongoing uncertainty also results from the internal variability of the climate (Dessai and van der Sluijs 2007; Yip et al. 2011; Birkmann et al. 2012). Stern (2016) pointed out that current economic models are also grossly misleading, because they tend to seriously underestimate the potential impacts of dangerous climate change as well as the wider benefits of a transition to low-carbon growth.

There are also further sources of uncertainty which will have an impact on the future performance of infrastructure systems: demographic development, energy and resource efficiency savings; the deployment of new—smart—technologies, changes in consumer behavior, new forms of environmental and economic regulation etc.

Infrastructure systems are particularly vulnerable to the consequences of climate change and play a prominent role in climate mitigation and climate adaptation. The

construction and operation of infrastructure are important sources of greenhouse gas emissions. Müller et al. (2013) analyze the carbon footprint of the existing infrastructure capital stock and mention the dimensions of the problem: If the infrastructure model of western industrial countries will prevail, so this would claim up to 60% of the global carbon budgets available, in order to stabilize the climate below 2 °C above pre-industrial level. "A promising but poorly explored mitigation option is to build new settlements using less emissions intensive materials, for example by urban design however, this strategy is constrained by a lack of bottom-up data on material stocks in infrastructures" (Müller et al. 2013, p. 11739).

In the meantime, a lot of measures and concepts have been developed to reduce the greenhouse gas emission of constructing and operating infrastructure systems (Lechtenböhmer et al. 2010; Foxon et al. 2015; Stokes et al. 2014; Rasul and Sharma 2015; Furfari 2016; Ferroukhi et al. 2015; Hendrickson et al. 2015). Simultaneously, to achieve a low carbon and climate resilient economy, there will be a large demand for investments in new infrastructure land in the upgrade of existing infrastructures (Kennedy and Corfee-Morlot 2013; Global Commission on the Economy and Climate 2014; Imperial College and Element Energy 2014).

At the same time, infrastructure systems are also a central subject of climate adaptation research which deals with measures to increase the adaptability of the systems to changing climate conditions and to make them more resilient. These strategies rely on more or less detailed vulnerability analyses and include technical measures, but also organizational and institutional measures (Hughes et al. 2010; Hallegatte et al. 2011; The Royal Academy of Engineering 2011; Chappin and van der Lei 2014; Stewart et al. 2014; Tavasszy et al. 2016; Watkiss 2015).

Creating infrastructures which are both low-carbon and climate-resilient will be challenging. During periods characterized by climate stability, it is sufficient for planning decisions to be based on the status quo. This does not apply if climate conditions change, since planning instruments and management approaches can no longer rely on climate data and development paths from the past. In infrastructure planning, therefore, the potential consequences of a dynamically changing environment are taken into account. However, there are knowledge gaps concerning vulnerabilities, risks and the resilience of infrastructure systems (Guikema et al. 2015). Therefore, the question arises as to whether climate change adaptation measures can be based solely on forecast-oriented "top-down" approaches in order to justify the decisions taken. Given the scale of uncertainties and the regionally different conditions, there seems to be a lot of restrictions on the application of this "top-down" approach. Many authors, therefore, argue for the mutual complement of "top-down" and "bottom-up" approaches. A "top-down" approach should help

to identify the need for action and to create favorable conditions for the implementation of adaptation measures. Considering the vulnerability of the infrastructure systems, the assessment of the weaknesses and strengths of the current development paths, as well as the specification of adaptation strategies should take place at regional or local level (bottom up) (Dessai and Hulme 2003; Dessai and van der Sluijs 2007; Oberdörfer et al. 2014). Figure 10.1 points out the interaction between "top-down" and "bottom-up" approaches.

Adaptation strategies are to be evaluated against the background of the level of technology, the ecological conditions, the available economic resources, the regional economic development perspectives and the institutional and socio-cultural conditions. While in the short-term the technical components may be

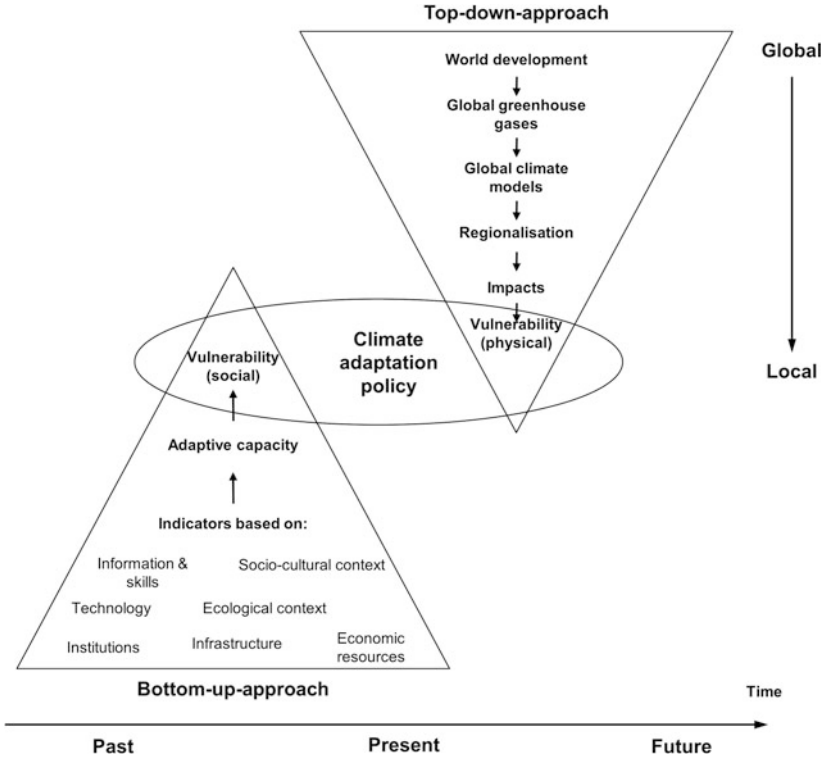

Fig. 10.1 Top-down and bottom approaches used to inform adaptation to climate change (*Source* Dessai and Van der Sluijs 2007)

more relevant, in the medium and long-term the framework conditions should be set in a way that adaptation can be achieved by adjustment of the socio-cultural and institutional framework (Arcari et al. 2012).

There is a number of analytical tools which accommodate uncertainty, multi-actor objectives and trade-offs in infrastructure planning (Watkiss et al. 2014; Madani 2015; Watkiss 2015); but it is questionable as to whether methods like "game theory" or the "real option" approach could be transferred into practical policy measures at the local or regional level.

To summarize the previous arguments: Infrastructure planning and the innovation process have to deal with a large degree of uncertainty and take into account and to balance short and long-term developments and the interests of stakeholder while considering the relevant technological, social or institutional frameworks.

10.2.2 Resilience and Its Implications

While the previous section dealt with climate change as the specific context of infrastructure development, now the question about the objective of the innovation process is addressed.

Against the background of the need for setting the right incentives to reduce the climate impact of infrastructure systems on the one hand, and the demand for adaptation strategies which consider path dependencies and the low flexibility of the systems on the other hand, now one focus of the scientific literature is on transformation of infrastructures according to the principles of resilience (Fichter et al. 2010; Libbe 2013).

Resilience may on the one hand be described as the resistance and responsiveness of a system towards disturbance events (such as extreme weather events) (Bruneau et al. 2003; Bruneau and Reinhorn 2007; McDaniels et al. 2008). On the other hand, resilience covers the system's ability to adapt and transform (e.g. long-term changes in the climate system) (Walker et al. 2004; Walker and Salt 2006).

Climate resilient systems are those which, following a kind of a "no matter what comes" principle, are always able to provide their services under very different conditions (Dessai 2011; Walker and Salt 2006). The principle of resilience not only implies mitigation and climate adaptation in the conventional sense, but also opens up options for a transformation of the system (Walker et al. 2004). Based on the definition of von Gleich and Gößling-Reisemann (2015) resilience can be defined as follows:

> Resilience describes the ability of a society to maintain the services necessary for its needs under stress and tumultuous environments even against the background of long-term changes.

However, the assessment of resilience is not without challenges. Infrastructure systems are always in interaction with their respective environment. The resilience of a system therefore depends not only on the technical factors and the internal organization of the sector, but is also affected by the economic, socio-cultural and institutional framework (Boone 2014).

To assess the resilience of an infrastructure system requires a profound knowledge of the way the different segments of the value chain function. The relevance of the different factors for the evaluation of the resilience also depends on the time horizon considered and, thus, the degree of uncertainty (Arcari et al. 2012). As a rule, the non-technical factors and conditions will contribute to spatially different manifestations of the resilience of an infrastructure system and will require a systemic and cross-disciplinary planning and decision-making process (Beratan 2007; Kaufmann 2012).

10.2.3 Infrastructure, Lock in and Path Dependencies

Infrastructure will be particularly affected by climate change. The potential impacts vary considerably depending on the infrastructure sector and climate change will affect the supply as well as the demand side. The relevant vulnerability literature focuses on the energy, the water and the transport sectors. These are the sectors that are confronted with new challenges, but at the same time have only limited options to react in the short term. One new challenge for infrastructure planning is also the result of the increasing interdependencies of critical infrastructure systems, which could result in cascade failure which occurs when failure in one infrastructure sector has a direct impact on the operation of other systems (Kelly 2015; Petit et al. 2015; Young and Hall 2015; Petit and Lewis 2016).

Today's infrastructure design reflects the state of knowledge about the climate as well as the climatic conditions of the past. Against the background of the seemingly inexhaustible availability of resources and the lack of information about the effects of the use of fossil resources, an infrastructure system develops which is responsible for the development and diffusion of energy and resource-intensive production and consumption patterns (Monstadt 2009). A transformation of the current infrastructure system is deemed necessary to provide incentives to climate-change mitigation and to adjust the system to new climatic conditions.

Based on the dominant infrastructure technology, specific socio-cultural habits as well as cognitive and normative regulatory rules have been established. The implementation of innovative solutions and the transformation of infrastructure sectors is therefore not primarily an engineering challenge. Numerous barriers result from the dominant regime and are revealed in the problem of path dependency.

A transformation of an infrastructure system is the result of numerous processes of change at very different levels. The multi-level model, known from transition research, focuses on the dynamics of this change in a more abstract manner. As shown in Fig. 10.2 this model differentiates between three levels on which changes are taking place in a parallel and dependent way. Each level is characterized by its own structures, cultures, routines and conventions. The levels can be interpreted as purely functional which means that they do not have a specific spatial or a

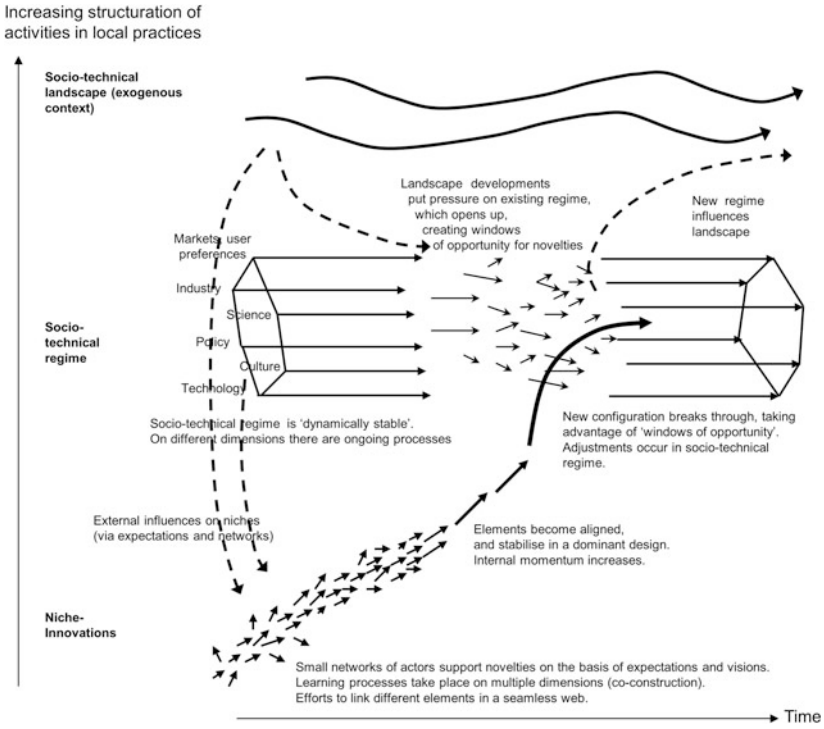

Fig. 10.2 Multi-level perspective on transitions (*Source* Geels 2012)

geographical reference (Rotmans and Loorbach 2010; Schneidewind and Scheck 2012).

The top level depicts the so-called socio-technical environment and includes exogenous factors such as climate change, specific stable social trends or fundamental geopolitical, economic and institutional developments. So, the socio-technical environment provides the broad context for the two other levels (Rotmans and Loorbach 2010). The middle tier is the socio-technical regime, which includes the following three dimensions (Geels 2004, 2005):

- Cognitive, normative, regulatory and formal routines: these include beliefs, models, problem definitions, objectives and innovation perspectives, central heuristics, laws, policies, values, roles and standards of conduct;
- Dominant players and acting organizations: This includes all established businesses and individuals with appropriate power, research institutes and universities but also relevant industrial organisations, lobby groups, NGOs etc.;
- Dominant socio-technical systems: the dominant regime is constructed by the established socio-technical systems and covers technologies, which have prevailed and shape the socio-cultural development of a society. This also includes most technologies of the infrastructure sectors.

The socio-technical regime is thus a construct of dominant structures, cultures, routines and conventions of an integrated system (Schneidewind and Scheck 2012). Given the strong links between actors, standards and rules, cultures and technologies, most of the promoters of the dominant regime tend to rather minor, incremental changes which do not jeopardize their own interests (Geels 2012). Initiating a long-term and effective change of the dominant regime to overcome the socio-cultural, economic and technological path dependencies is quite a challenge. Most radical innovations take place within the lowest level in the socio-technical niche. This level is also characterized by interactions between technologies, players and rules. The niches are however fragile, non-binding, and fuzzy and evolve over the course of the change process into innovations (Geels 2012). Niche areas can be understood as incubation rooms for trying out and testing new technologies, socio-cultural habits and standards and norms etc. regardless of market constraints, social norms and values (Rotmans and Loorbach 2010). Niches offer space for the demonstration of the applicability and benefits of alternative technologies, but also for the identification of potential hazards and disadvantages of application. An important result is to draw attention to potential conflicts with the dominant regime (Geels 2002).

Following Rotmans and Loorbach (2010) changes of the dominant regime can occur on the basis of three patterns:

- Bottom-up: The niche technology creates enough pressure to replace the dominant regime;
- Top-down: Changes in the socio-technical environment (climate change, demographic change etc.) could exert pressure on the dominant regime so that change becomes inevitable;
- Hybrid: Pressures out of the niche as well as from the socio-technical environment will lead to the adoption of niche technologies, so that the dominant regime can continue to exist even under a changed framework.

Changes at the level of the regime arise particularly when, by processes at the level of the niche and in the socio-technical environment, pressure is exerted on individual dimensions of the regime and creates a tension between the socio-technical environment, the socio-technical regime and the niche level as well. This constitutes a window of opportunity, which can be used to bring about structural change of the regime. The stimulus can come through outside intervention, but also through learning or adjustment processes within the regime (Geels 2012).

10.2.4 Innovation Gaps and the Multi-level Approach

In analysing the interactions between different actors and different levels according to the multi-level model it can be shown whether and where barriers to innovation or so-called "innovation gaps" exist as shown in Fig. 10.3.

Innovation gaps arise if the dominant socio-technical regime does not recognize or underestimates the need for adaptation and reforms. Neglecting the dimension and potential impacts of climate change is one example. Yet, there are significant uncertainties associated with the potential developments of the socio-technical environment. Innovation gaps arise from these uncertainties because, for example, it remains unclear what kind of innovation is required to meet the future challenges. Innovation gaps also exist at the level of the regime. They are the results of systemic path dependencies arising from structural, market-related or socio-cultural factors (Rotmans and Loorbach 2010). These factors are the construct of dominant markets and user preferences, industrial, political and institutional frameworks, technologies and socio-cultural habits. These conditions ensure social cohesion and

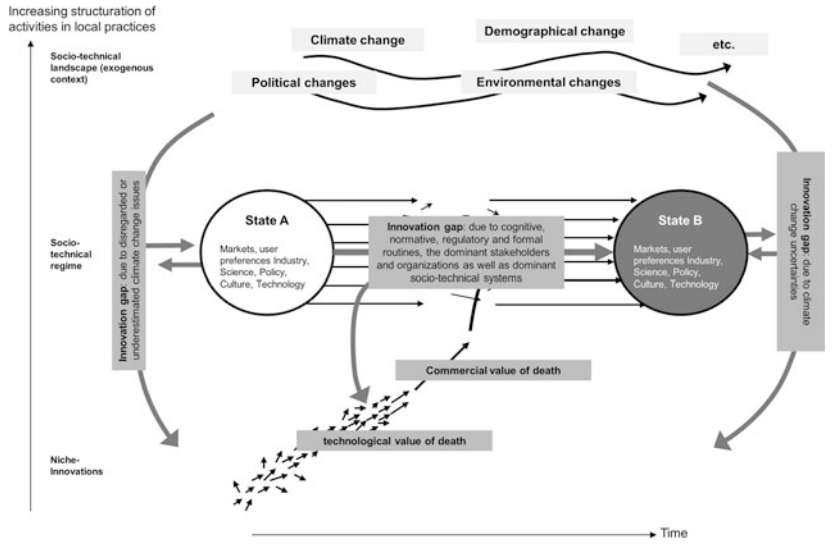

Fig. 10.3 Possible transition gaps from the multi-level perspective (*Source* by authors)

the stability of the systems, but at the same time allow only incremental changes or act even as a barrier to innovation (Rotmans and Loorbach 2010).

Actors who want to bring about change must overcome these path dependencies or at least be aware of them. Infrastructures are characterized by internal and external interdependencies: Changes within one infrastructure sector or even in subsections simultaneously lead to effects in other relevant areas. Adjustments in a sector must, therefore, take into account the compatibility of measures with other infrastructure sectors. Standards and norms, technologies and the socio-cultural habits need, maybe, to be reconsidered (O'Rourke 2007; BMI 2011). Changes in the infrastructure sectors therefore always have to be discussed in the context of heterogeneous groups of actors and distributed power structures (Maassen 2012).

This has numerous repercussions for the development of alternative technologies. If the extent and dynamics of changes in the socio-technical environment are underestimated, this can result in a lack of public and private funding for the innovation and diffusion of alternative technology paths. Then the potential of new technologies for climate protection and climate adaptation is not exploited. Uncertainties regarding the development of the socio-technical environment could act as a barrier since it is not clear which technologies are to be preferred or what

innovations are required, especially in the context of climate change. The path dependencies described above lead to a systematic discrimination against certain technologies, standards and norms, socio-cultural habits, etc. Potential intervention points for alternative technologies are not considered.

At the level of the niche this manifests itself in the so-called "technology valley of death" and "commercial valley of death": Technologies but also socio-cultural or institutional innovations are excluded in the course of the innovation process or are not taken into account, although these technologies and approaches may be more efficient or socially meaningful. This happens because incentives set by markets and political interventions favour short-term, incremental changes (Jenkins and Mansur 2011). Adaptation and adjustments in the infrastructure sector, however, always are of a long-term nature and tie up capital for long periods.

In order to restructure the infrastructure systems towards low carbon and climate resilient structures, it is not enough to rely on existing and known technologies and traditional patterns of thinking and habits. Holistic system innovations are required. Most authors argue in favour of a co-creation of technologies, regulatory and legal frameworks, as well as socio-cultural and ecological aspects (Schneidewind and Scheck 2012). This could help to overcome uncertainty as well as path dependencies and related innovation gaps, but also help to avoid rebound effects and a simple shifting of problems.

10.2.5 Implications for Infrastructure Innovation and Planning

To date, most infrastructure sectors have been dominated by conventional, centralized service models combined with appropriate planning approaches, organisational structures and financing models. Top-down planning approaches are prevalent (e.g. road infrastructure plans, energy network expansion plans) and, at the community level, most infrastructure services (water, wastewater, public transport and waste disposal) are still provided by local public utilities. Particularly in regions with high population density, the acceptance of large infrastructure projects diminishes over time, mainly due to the impacts of these projects on nature and the landscape.

The participation of local and regional stakeholders has now become a common strategy to cope with these challenges and to speed up the planning process. But participation is normally restricted to deciding how an infrastructure project should be implemented; the need for the project itself is not up for discussion. A particular

drawback is the fact that the involvement of local and regional stakeholders in planning procedures often remains an informal process, which means that the solutions developed are without political legitimation. So there is need for a better link between the informal and formal planning spheres.

Restructuring the infrastructure system can only take place slowly. Decentralized, modularly configured infrastructure systems with a higher degree of flexibility only evolve in niches. Crucial stimuli often arise when the energy systems are restructured: There is a growing number of local energy cooperatives, energy self-sufficient local communities and "bioenergy villages" (Chmutina and Goodier 2014; Goldthai 2014; Adil and Ko 2016). In the water sector, some new concepts are emerging, including green infrastructure, water reuse and the separation of wastewater streams so as to reduce the sewage treatment requirement (Deng et al. 2013; Arora et al. 2015; Quezada et al. 2015).

These new concepts mostly remain in a niche and are often operated and tested under model conditions. A diffusion of these concepts is seldom restricted by technical considerations; the barriers result from the problems—already outlined—of technical infrastructures embedded in a socio-economic system. For example, centralized and decentralized solutions are opposed and the advocates of the prevailing central concept often fear the loss of market positions and a deterioration of the performance of the entire infrastructure system. So, the key question remains: How can a process of innovation be initiated and sustained under such conditions.

The adaptation of infrastructure systems to changing climatic conditions can be described as a "wicked problem", defined as a category of problems for which there is only a limited common understanding among the actors and little clarity about the way to respond (Australian Public Service Commission (APSC 2007). Rittel and Webber (1973) defined the essential characteristics of these "wicked-problems":

- "Wicked problems" are difficult to define: The nature and scope of the problem depend on who you ask. As a rule, all relevant stakeholders have a very different perspective on the problem. Each perspective contains an element of truth; none of these perspectives is therefore completely wrong or right.
- "Wicked problems" are characterised by interdependencies and usually have multiple causes. Significant trade-offs are common within the broader context of the problem. This interdependence, the wide variety of causes and internal conflicts make it difficult to narrow down the problem. Walker et al. (2013) talk in this context, of "deep uncertainty", i.e. a situation in which there is uncertainty about what models are suitable for the description of the complex structures and to determine how the various key parameters in these models are

to be combined and how the results of the models can be evaluated: "This implies that one can enumerate (incompletely) multiple possibilities for the system model, the probability distribution, and sets of values, without being able or willing to rank order the possibilities in terms of how likely or plausible they are judged to be" (Walker et al. 2013).

- Strategies for solving a wicked problem lead often to unforeseeable consequences in other parts of the system due to their complexity. Selected problem-solving strategies can thus even exacerbate the problem.
- For a wicked problem, there is usually no clear and unambiguous solution. Since there is no clearly defined problem, there are also no definite solutions. A problem-solving procedure often ends when deadlines are achieved or the process is determined by resource constraints and not when the "right" solution is reached.
- Solutions are therefore not "right" or "wrong", but "better or worse" or "good" enough. Following Stahl (2014, p. 474) the results are "clumsy", i.e. not elegant solutions.
- Wicked problems are socially complex. A coordinated and integrated approach of all public and private stakeholders and non-profit organizations is hampered by the fact that power and decision-making authority is unevenly distributed.

A successful solution therefore comprises a wide variety of related and coordinated measures, taken into account the multiple causal relationships and the trade-offs between the objectives pursued. Lonsdale (2012) defines some general requirements for strategies to solve wicked problems:

- holistic rather than fragmented or linear thinking
- innovative and flexible approaches with a focus on the creation of a 'learning organisation'
- the ability of organizations and institutions to work across boundaries
- an effective engagement of stakeholders and citizens in the creation of a common understanding of the problem and the analysis of possible solutions
- establishing additional capacity in the area of communication; foster "big picture thinking" and strengthen the competencies and skills for cooperative forms of engagement
- strengthening the tolerance and acceptance of uncertainty in the context of long-term solutions.

The complex interactions between different factors of influence cannot be sufficiently explained by the usage of theoretical models like the multi-level-approach

(Schneidewind and Scheck (2013). In fact, numerous situation or context-specific factors exist, which can only be understood and transformed into useful social knowledge by the means of experiments which are run in real life contexts.

So-called living labs offer a sufficient environment for the implementation and realization of transdisciplinary innovation and transformation processes (Nevens et al. 2013; Scheele and Schäfer 2013; Schneidewind and Scheck 2013; Nevens and Roorda 2014).

10.3 Bridging Innovation Gaps with Living Labs

10.3.1 A Short Introduction

In recent times, real life experiments have been gaining importance, particularly in the social sciences and in socio-economic transformation research (Smith and Raven 2012; Bulkeley et al. 2014; Nevens et al. 2013; Heiskanen et al. 2015) and are an innovative approach in product development (Liedtke et al. 2012; von Geibler et al. 2013).

Unlike "in vitro" experiments "real life" or "in vivo" experiments take place in the context of a social, environmental and technical design process and therefore within a practical decision-making situation. A real life experiment can be thought of as a hybrid experimental form fluctuating between "knowledge production" and "knowledge use" and between "controlled laboratory conditions" and "situation-specific conditions" (Schneidewind and Scheck 2013). The purpose is to identify knowledge gaps and to create the conditions to take actions despite uncertainties and the existence of wicked problems.

The living lab can be considered as a framework in which to conduct real life experiments. A literature review on living labs revealed that the approach is mainly based on three pillars (Almirall et al. 2012; Liedtke et al. 2012; Reimer et al. 2012; Mulvenna and Martin 2013; von Geibler et al. 2013; Schäfer 2014; Meurer et al. 2015):

- Strong participatory orientation; user takes an active role in the early planning and design phases. The involvement of all relevant stakeholders can help to overcome the barriers between disciplines and the various levels of planning and will promote the exchange of knowledge and experiences between science and practice (transdisciplinarity).

- Consideration of the real social context (e.g. regions, cities, towns, neighborhoods, built infrastructure, brownfield sites, households, etc.) and of the relevant challenges (e.g. climate change, demographic change, technological progress).
- A focus on design and planning of innovative solutions in terms of sustainable development. The permanent reflection of the paths chosen and the anticipation of the possible consequences (e.g. rebound-effects) of these developments are central to the innovation process.

Inside a Living Lab co-creation takes place in two respects: on one hand, as a co-creation between different actors and on the other hand in form of the co-creation between interwoven levels of innovation, that is between socio-cultural innovations (e.g. norms, rules, cultural practices, standards), socio-economic innovations (e.g. new business models, non-market solutions, sufficiency) as well as technical innovations (e.g. technical applications, infrastructure).

Thus, Living Labs can be viewed as platforms for research and innovation in real societal contexts (e.g. cities, districts, regions) and issues (climate change, demographic change etc.) applied to the co-creation of policies, technologies, economical, socio-cultural as well as ecological solutions. It provides an institutionalized framework for transdisciplinary interaction between different actors (e.g. residents, users, policy makers, local citizens, industry representatives as well as academics) with various concerns. The actors aim at the development of practicable and acceptable solutions, which are suitable for the society in both present and future contexts.

A group of sustainability and science experts from the German Federal State Baden Württemberg defined six criteria, which should be fulfilled for a successful realization of transdisciplinary living labs (MWK-BAWÜ 2013):

- co-design and co-production within the research process in cooperation with civil society;
- stakeholders should understand research as an interdisciplinary process;
- long-term research design;
- broad spectrum of different disciplines;
- continuous assessment and reflection on the methodology;
- process coordination through institutions with experience in transdisciplinary research processes.

The following sections will examine the essential aspects of the living lab approach. These are the conceptual framework, the principles of transdisciplinary research and, in Sect. 10.4, potential real-life contexts.

10.3.2 Conceptual Framework

The structure of the living lab process is based on the transition-cycle, adapted from transition-management research. The cycle characteristically has four phases (Nevens et al. 2013; Schneidewind and Scheck 2013; Nevens and Roorda 2014):

- system analyses and problem definition;
- developing transition agenda, visions and pathways;
- initiating and running transition experiments;
- evaluating, monitoring and learning.

During this process different kinds of knowledge are generated. The problem analysis comprises the elaboration and definition of the problem (Jahn et al. 2012). In this way, existing knowledge from different disciplines and knowledge domains is used to generate a "snapshot" of the system (socio-cultural, economical, technical, institutional and ecological context) and of the existing and future problems (Nevens et al. 2013). In the course of the system analysis, the actors create so-called system knowledge (Schneidewind and Scheck 2013).

The system knowledge which is generated is then structured and transformed into knowledge through a transdisciplinary process with actors from science and non-academic practice. Within this phase science and practice (including civil society) create target states, which are reasonable for the society (Nevens et al. 2013; Schneidewind and Scheck 2013). Such target states could be common visions or target values, which create a base for long-term cooperation (Jahn et al. 2012; Nevens et al. 2013). The development of target states is also related to the creation of reasonable paths and measures based on visions and targets. According to Jahn et al. (2012) new knowledge is generated within this process. This phase also includes the anticipation of strengths, weaknesses, chances and risks of future scenarios and the prioritization of different measures, to ensure valid and legitimate decisions for or against specific measures (Scholz 2011; Nevens et al. 2013).

The generated knowledge has then to be converted into transformation knowledge, which means that scientific knowledge and practical action approaches are combined in specific real life experiments (Schneidewind and Scheck 2013). Such experiments create necessary space for the niche development of innovative

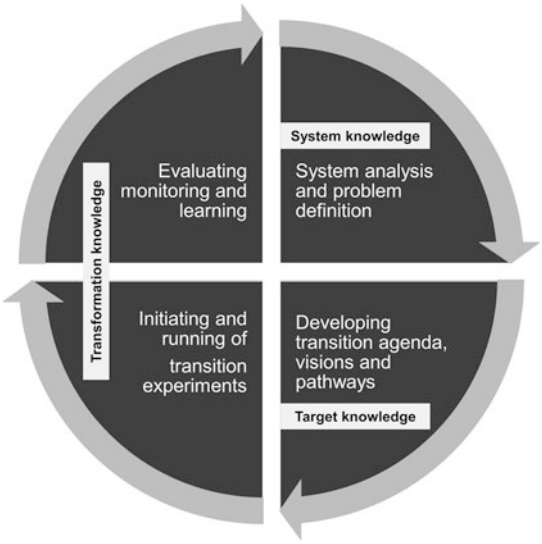

Fig. 10.4 Transition-cycle (*Source* adapted from Schneidewind and Scheck 2013)

solutions in real life contexts without the restrictions of the dominant regime. This enables the anticipation of strengths and weaknesses during the early stages of the development and innovation process—such as unexpected negative ecological side effects or direct and indirect rebound-effects and possible conflicts with the dominant regime.

Figure 10.4 illustrates the different types of knowledge generated during the process. In the phase of evaluation, monitoring and learning, valuable social knowledge is generated which can be processed for further practical and scientific discussions. This also includes the diffusion of experience and lessons learned from the real life experiments (Nevens et al. 2013; Schneidewind and Scheck 2013; Nevens and Roorda 2014).

10.3.3 Transdisciplinary Principles

Transdisciplinarity is the central aspect of the living lab approach. According to Scholz (2011) interdisciplinary processes are "just" combinations of methods and approaches from different disciplines. Thus, interdisciplinary processes try to explain scientific phenomena which cannot be explained by means of individual scientific or practical disciplines. Transdisciplinarity tries to coordinate processes

which take place on different horizontal and hierarchical levels (scientific, theoretical, abstract, and pragmatic). Thus "[…] a transdisciplinary process emerges if a legitimized decision-maker and member of the science community notices that they have joint interests in a complex, relevant phenomenon that can be better understood and dealt with if the knowledge from practice and science is combined." (Scholz 2011, p. 375).

The core elements of transdisciplinary processes are, thus, the cooperation between scientists, decision-makers, civic society and other stakeholders on an equal base (Scholz 2011) and the integration of different knowledge types. According to Scholz (2011) one can distinguish between five knowledge types:

- interdisciplinary and combination modelling;
- combining systems;
- relating different epistemics;
- combining different interests;
- interrelating different cultures.

The third principle of transdisciplinary processes is the creation of socially robust knowledge, which can draw on practical actions and scientific dialogue (Scholz 2011; Jahn et al. 2012).

10.3.4 Stakeholder Involvement

As shown in the previous section, a core component of transdisciplinary innovation processes is the cooperation between several stakeholders from science and non-academic practice. Problems related to climate change and infrastructural innovations are notably characterized by heterogeneous stakeholder constellations: scientists from different disciplines, stakeholder from civic society, experts on different political, economic and ecological decision levels, planners, engineers etc.

Considering the variety of actors, one could ask which stakeholders should be involved, why, when and how, in the context of transdisciplinary processes (Reed et al. 2009; Bell et al. 2012; Luyet et al. 2012). Essentially, every good process based on the involvement of heterogeneous stakeholder groups should consider clear principles, which encourages a cooperative approach. Such principles could be (Luyet et al. 2012):

- fair, equal and transparent processes that foster social learning, trust and respect among stakeholders;

- combining the latest local expertise and scientific knowledge;
- definition of rules in advance;
- early involvement of all relevant stakeholders;
- use of a strong facilitator during the process;
- provision of adequate personnel, time and financial resources.

The question as to which stakeholders should be involved can be approached from two different angles: First, from a generic normative perspective, and second, from a strategic perspective. Reasons for the stakeholder participation from a generic normative perspective are the creation of legitimacy and acceptance of the decision process as well as the facilitation of transparency. Such a generic perspective is useful for the initial identification of relevant stakeholders. Sooner or later during the strategic process a "when" and "why" prioritization of the stakeholders becomes inevitable (Luyet et al. 2012). The literature indicates several useful criteria for stakeholder prioritization (Schupisser 2002):

- Power-based criteria: This type of criteria is based on stakeholder power and controllability (Müller-Stewens and Lechner 2005);
- Normative-critical criteria: This criterion relies on power, legitimacy and urgency of the claims (Mitchell et al. 1997).

The different stakeholders can further be distinguished by criteria like benefit generator, benefit receiver, risk carrier or risk producer (Sachs et al. 2007). The process of stakeholder identification and characterization also depends on the person who or the group which conducts the process. This is due to the subjectivity of the point of view and the fact that every stakeholder analysis represents only a snapshot at a certain point of time. The importance of stakeholders and their positions can change over the time, especially in long-term projects and planning (Gerum 2009).

Based on the stakeholder assessment, it is possible to decide on both the participation or cooperation level and the convenient participation time in the transdisciplinary process. Based on Arnstein's (1969) participation ladder, Luyet et al. (2012): distinguish between five degrees of participation:

- Inform: presentation and explanation of the project to the stakeholders;
- Consult: presentation and explanation of the project to the stakeholders, stakeholders can make suggestions, stakeholder suggestions are or are not taken into account;

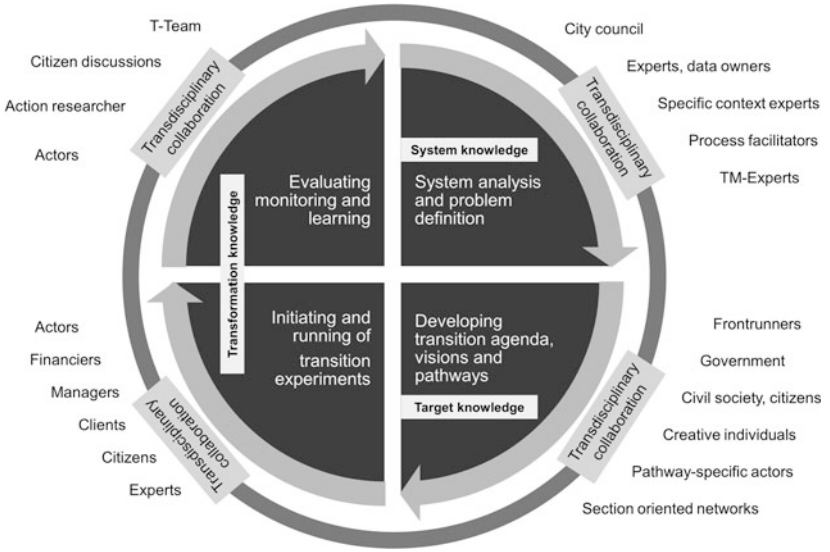

Fig. 10.5 Possible stakeholder compositions across the transition-cycle (*Source* by authors)

- Collaborate: presentation and explanation of the project to the stakeholders, stakeholders can make suggestions, stakeholder suggestions are taken into account;
- Co-decision: stakeholders cooperate with each other towards an agreement for solution and implementation;
- Empowerment: the decision-making processes are delegated to the stakeholders during the entire process.

Figure 10.5 shows possible stakeholder groupings across the transition cycle.

10.3.5 Spaces for Intervention

Since living labs affect different societal levels, the last question remains as to where living labs can best be implemented. Such points could be regions, cities or districts, brownfield areas, military conversion areas, built infrastructure as well as international sport or cultural events usually associated with large scale infrastructure projects and investments in urban regeneration.

Living labs could also be of interest in areas of significant demographic and economic change. In rural areas, the infrastructure systems in place are questioned due to decreasing demand and the consequent under-utilization. Such "cold spots" are plausible places to experiment with alternative infrastructural and technological paths (Moss 2008).

Projects with living lab characteristics have already been implemented in several cities, even though they were not planned as living labs (MWK-BAWÜ 2013). Examples of such projects are district projects in Vauban in Freiburg a.d. Breisgau in Germany (Sommer and Wiechert 2014) or the EVA Lanxmeer project in the Netherlands (Scheele and Schäfer 2016). These distinct projects attracted a lot of attention in the past since they count as best practice examples of modern and sustainable urban development. However, such projects also have in common that they exist like oases surrounded by the structures of the dominant regime, which do not provide any space and incentives for the diffusion of alternative infrastructure and planning approaches.

Against this background, the "eco-acupuncture" approach could be presented as a possible solution (Ryan 2011, 2013; Ryan et al. 2016). Using the solutions and measures already outlined, local, regional and scientific stakeholders examine a given community in order to identify possible intervention points for project realization. The aim is to find areas and facilities with low social, economic and cultural value, like abandoned houses, parks, open country, brownfield sites or infrastructure areas which are excess to requirements (Ryan 2013). This approach is based on the assumption that, the lower the value of land the less pronounced are the interests of dominant players and stakeholder and the greater is the likelihood that alternative infrastructure and planning paths can be successfully implemented.

10.4 Implementation of a Living Lab

Climate change affects regions in many ways. Sea level rise, there is an increase in the number of extreme weather events, rising temperatures and the shifting of climate zones has an impact on the economic and natural systems and the underlying infrastructure. Regions and their institutions are faced with new challenges.

A typical example of this is the catchment area of the River Ems in the German–Dutch border region. The German area is characterized by small municipalities and small- and medium sized cities. Agriculture, tourism, trades and a strong maritime sector form the economic base. A large part of the regional labour

force commutes to two big nearby companies (a shipyard, a manufacturer of wind turbines).

Compared to climate mitigation adaptation measures always have a very explicit local orientation: Adaptation measures have to be implemented in vulnerable places. Such measures are therefore often land-intensive and intensify existing land use conflicts. In the region, the pressure on land has greatly increased in recent years. This is due to several developments: The river Ems is an important shipping route and has to be permanently dredged, the material has to be stored on larger depositing sites alongside the river; there is much intensive farming with high land-use requirements; this also applies to the land demand of the tourism sector as well as land-use for nature conservation and safeguarding biodiversity. The transformation of the energy sector is also reflected in higher land requirements for the deployment of renewable energies and new energy-related infrastructures. Last but not least, this situation is exacerbated by the impact of climate change and the demands of flood protection measures.

The coastal area has, of course, long years of experience in dealing with water; infrastructure like dikes, drainage systems, canals, water storage capacities, pumping station, sluice gates and so on shape the landscape. In parallel to the technical dimension of this regional water management system, special institutional arrangements, planning and financing institutions have evolved.

The primary goal of the system is to protect the region against the impact of storm surges and flooding. But in future, climate change will not only increase the number of storm surges and lead to a sea level rise, changes in the average temperatures and rainfall patterns, more extreme weather events and drought periods will lead to new challenges for the regional water infrastructure systems. To put it concisely: Instead of keeping the sea water and the river water out using dikes and running the drainage system, the infrastructure system will have to cope with both large excesses of water and water shortages!

The picture that emerges is that of a typical wicked problem: An extremely complex problem situation characterized by a high degree of uncertainty, path dependency, and many actors with diverging interests and objectives. Actors also differ with respect to the planning timeframe and scope of action. As the key players, the municipalities are confronted with the dual problems of demographic change and limited financial resources, which make it more and more difficult for them to provide all public services.

Up to now, planning has largely followed traditional top-down concepts: Although regional spatial development plans, the implementation of the European Water Framework Directive and the European Floods Directive include participatory approaches, direct involvement of local actors and stakeholders does not

normally take place. In the region, a strong opposition to this type of planning was noted for the first time when the "Masterplan Ems" was presented. The plan provides a long-term approach to environmental remediation of the polluted river and, among other things, includes the designation of retention areas with an area of approximately 700 ha. It should, nevertheless, also be pointed out that the traditional approach of water management was not questioned at all, controversies centred on how to implement the measures.

The municipalities and water boards involved were given only limited opportunities to suggest their own ideas. Local knowledge and the experience of the local stakeholders were not taken into account. The implementation of adaptation measures at the local level will raise not only technological and economic issues: Ecological, social, legal and institutional aspects will also play a role. In addition, cultural differences, different attitudes and planning philosophies may hamper meaningful cross-border cooperation between Dutch and German communities and water boards.

These issues are being considered as part of an Interreg IVa network project. In a transdisciplinary Living Lab approach, innovative solutions should be found for these challenges. The objective was not to create a further big master plan but to look for new adaptation measures at the local level and the level of individual property which, taken together, support the implementation of the plans at regional and the catchment areas level. Ultimately, it is a matter of combining top down and bottom up planning approaches.

The first phase of the project consisted mainly of the analysis of the problems. In a series of workshops a common understanding of the problem was sought to help identify main areas of action. One of the main topics was also to show how the interaction of local adaptation measures could relieve the burden of adjustment at regional level.

New forms of participation were applied in the workshops. The procedure was successful and all the municipal planners and local decision-makers have embraced these new approaches (Biggs et al. 2014). The participants came together in a "water game" and tried to explore, in a playful manner, common measures and potential trade-offs between different decisions while taking into account all the restrictions. The main results of this first part of the project were that system knowledge was generated and a large unused potential for adaptation at the local level was identified.

In a follow up project Living Labs are to be set up, in which actors from both sides of the border develop solutions for very specific local problems:

- German and Dutch municipalities with a common border; the direct physical exchange of water and a common water management systems is possible, but have not been used so far.
- German and Dutch municipalities with similar problems resulting from climate change (floods, drought); the measures developed in Living Labs can be transferred as best practice.
- specific areas with problems like nature conservation areas, industrial zones, brownfield areas.

An information platform can create space and time to innovate, organize innovations, plan activities and support the actors in the exploration and development of partnerships. The Labs also take on the project management and provide the technical infrastructure necessary for knowledge transfer and for cooperation between the different actors. Furthermore, the platform will help in the design of organizational, financial and cooperative arrangements between the actors. Living Labs could also take the form of "virtual" knowledge transfer spaces. As a supplement to the more "traditional" real Living Labs the virtual concept seems to be an efficient way to coordinate activities and the foster communication in densely populated areas.

The project is still running, but it is possible to summarize the lessons learned during the first project phase:

- The living lab approach is an important step to give structure to the complexity of regional problems,
- Stakeholders get a deeper insight into the interdependencies of the problems and between the infrastructure systems,
- For the first time, relevant stakeholders are coming together to discuss the impacts of climate change problems and look for sustainable solutions;
- Some municipalities are taking the initiative because they are particularly affected by the impact of climate change on the operation of the sewage system and the flooding of residential areas;
- Local stakeholders will recognize that the transformation of the system is, to a large extent, a matter of economic, social and institutional aspects and that the development and the implementation of measures requires a transdisciplinary process;
- Local stakeholder become aware that the potential of bottom up approaches has not yet been exhausted;
- It is difficult to keep all actors on board over a long period of time;

- It is essential to translate the living lab approach to the level of the municipalities and to concrete solutions;
- The focus on a cross border area creates the conditions for "learning from others" but, at the same time, differences in cultures, planning strategies and institutional arrangements forms barriers for the transfer of solutions from one country to the other.
- Local and regional planners have now become familiar with participation procedures, but it is essential to highlight the very specific characteristics of the living lab approach;
- It should be emphasized that the living lab approach is a more general concept, not only limited to the transformation of the water infrastructure, but could also be used as an innovative model for other local challenges;
- Living labs could encourage the integration of the results from informal planning into the formal planning procedures and provide more legitimacy for innovative bottom-up solutions.

10.5 Conclusion

This paper explores whether there is a need for a fundamental restructuring of infrastructures. Climate change and transition research literature provide the theoretical basis for understanding the systems and the context in which infrastructure innovations takes place. Resilience is a key concept in the transformation of infrastructure systems. The objective is to create infrastructure systems that foster sustainable social models and lifestyles. Thus, resilience is not a state that can be reached in a specific period of time, it is rather a dynamic state, for which adaptation and transformation as well as the anticipation of future developments are the fundamental preconditions.

Cities and urban regions depend on a complex system of interdependent, centralized infrastructures that face significant challenges. New technologies, intensive global competition, demographic change, an ongoing urbanisation process and changes in customer behaviour are some of the driving forces. The potential impact of climate change could both exacerbate existing problems and also stimulate new developments.

The spatial concentration of essential infrastructure increases its vulnerability. A disruption of the system will have an effect on the total economy. Fostering the resilience of the urban systems it is, therefore, a cornerstone of future economic and

social sustainable development. Cities and urban regions could, therefore, act as test-beds for the development of new innovative infrastructure solutions.

The literature includes a wide range of principles and guidelines and describes how a resilient infrastructure system could look. These recommendations often remain rather vague and could not act as a blueprint. Previous research emphasizes the fact that the transformation of infrastructure is, only to a very limited extent, a technical challenge, but rather requires the adaptation of the economic and institutional systems including their intrinsic norms, rules and standards.

This demands a different approach. Living labs offer a conceptual framework to initiate, co-ordinate as well as implement bottom-up transition processes at the local level. The appropriate and meaningful involvement of stakeholders is essential to the transition process. Stakeholder involvement should not only increase the acceptance of some measures, but also facilitate access to the knowledge-base of possible solutions and actions and, moreover, aid the transfer of this knowledge into practical and reasonable measures. In this context public bodies can also take over an innovative and more active role in the process of infrastructure transformation. In summary, this will lend informal planning approaches a greater weight and a greater legitimacy.

Most experience with the living lab approach is to be found in the area of product innovation or the diffusion of "smart" technologies. The application of the living lab approach to complex urban and regional transformation processes towards resilience is still in its early stages. A growing number of projects will allow the methodological concept to be further developed.

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From Linear to Circular—Challenges for Changing Urban Metabolism?! An Analysis of Local Energy Transition Activities in Four European Cities

11

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Abstract

Challenges like climate change and peak oil are calling for a greater transformational process of urban regions. The vision of a regenerative and energy-efficient city with a high quality of life promotes an attractive future perception. The implementation requires changing urban metabolism from linear to circular. Promoting regional transformation encompasses creating new governance structures and realizing comprehensive measures. Acting on a municipal level, participation of society is as crucial as the active involvement of local actors and pioneers of vision. Changes of societal, political and economic framework conditions are strongly linked to an increase of individual awareness, activation of available resources and social learning processes. The paper outlines local transition processes of implementing this vision in four case study cities—Dobrich (Bulgaria), Modena (Italy), Munich (Germany) and Odense (Denmark).

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The research focused on identifying local actors and governance structures as well as strategies for communication and participation in municipal authorities.

11.1 The Transition from Linear to Circular Urban Metabolism

Global challenges like climate change and peak oil are symptomatic for the unsustainable production and consumption patterns, which exceed biological reproduction rates and the earth's capacity of absorption. Cities are concentration points of human population and economic activities and are thus major consumers of resources and emitters of waste, greenhouse gases, etc. The concept of the urban metabolism was developed to capture the input, output and storage of resources and waste of urban regions (Kennedy et al. 2010). Thus, it "*places the city within its environmental context*" (Golubiewski 2012, p. 751) and focuses the "*socio-environmental metabolic relations*" (Swyngedouw 2006, p. 21) interwoven in cities and urban regions. The urban metabolism of today's city regions is essentially linear (Kennedy et al. 2010), characterized by a constant throughput of resources, materials, products and wastes. This results in unsustainable city regions (Girardet and Mendonca 2009). However, oriented towards the ideal of a self-sufficient ecosystem the concept of urban metabolism can also function as a model for developing sustainable city regions (Kennedy et al. 2010). This requires changing the linear urban metabolisms to circular systems based on the highly increased efficiency of resource usage, the intake of sustainable amounts of resources, the reuse and recycling of products and materials and the reduction of outputs to a minimum. Thus, the environmental impacts of urban regions should be dramatically reduced (Girardet and Mendonca 2009) while simultaneously aiming towards increasing the liveability for urban citizens (Newman 1999).

Striving for the regenerative, self-sufficient city region requires fundamental transformational changes as the persistent problem of unsustainability is deeply rooted in the structure of the existing societal system (Frantzeskaki et al. 2012). This comprehensive change includes "shifts in perception and meaning, social network configurations, patterns of interactions among actors including leadership and political and power relations, and associated organizational and institutional arrangements" (Folke et al. 2010, p. 5). Based on the assumption that ecological, economic or social conditions can make an existing system unstable, there is an opportunity for a fundamental alteration of the nature of the current system

(Walker et al. 2004). Theoretical considerations about the non-linear stability of socio-ecological and socio-technical systems suggest that this change can result from external forces interacting with deliberative processes initiated and influenced by people involved on multiple scales (Folke et al. 2010; Smith and Stirling 2010). Thus, the dynamic stability of a resilient system can alter as the reaction to shocks and stresses but also as the result of shifting social values and "goal-directing processes" introduced by governance approaches focusing on the evolution of prevailing regimes towards more desirable states (Smith and Stirling 2010, p. 7; Walker et al. 2006).

Concepts of Transition Theory and the change of socio-technical systems as well as discussions about the resilience of socio-ecological systems apply perspectives on the interrelated, non-linear and self-organising relations of complex systems which are characterized by uncertainties and discontinuities (Davoudi 2012). In a systemic environment of chaotic, complex, uncertain and unpredictable change, holistic approaches based on social learning become crucial (Davoudi 2012; Davoudi et al. 2013; Safarzynska et al. 2012). Since change cannot be anticipated "a network of interrelated capacities […] support planners and decision-makers" (Galderisi 2014, p. 47) to manage, influence and react to systemic change. Among these are capacities for learning and innovation to allow for the transformation of external pressures into opportunities for new development paths (Galderisi 2014).

The aims of transformation processes are usually connected to the different normative dimensions of sustainability debates (Davoudi 2012; Smith and Stirling 2010). Governing transformational changes towards sustainability poses a great challenge for public actors on different levels as it constitutes a break with conventional approaches and "toolkits" of policy making and planning (Davoudi 2012, p. 303; Loorbach 2010, p. 162 f.). It involves substituting or complementing the government based, short-term oriented "*planning-and-implementation policy model aimed at achieving particular outcomes in a set period of time*" (Loorbach 2007, p. 83) with a long-term oriented learning-by-doing approach. It requires "the institutionalization of awareness of adaptability dynamics as a way of enhancing preparedness and with it, the capacity to influence the direction of future transformations" (Davoudi et al. 2013, p. 319). Following this understanding, policy making is supposed to be guided by sustainability visions and characterized by experimental projects and practices as well as selective and reflexive participatory processes focusing on frontrunners and actor networks (Loorbach 2007; Meadowcroft 2009; Smith and Stirling 2010). The concept of Transition Management was developed as new mode of governance, based on complexity theory and interrelated with the guiding principle of sustainability, to manage long-term societal change (Loorbach 2007).

This paper aims to explore the practice and associated challenges of local actors, i.e. on the level of cities and city regions, in governing transition processes towards sustainability. The contribution focuses on the energy sector as one sub-system crucial for the transformation of European cities towards sustainability. It outlines the empirical results of four case studies of the local transition processes in four European cities. After this short introduction, the following section outlines the research question and applied methods. The following chapter then introduces the theoretical basis of Transition Management and the derived analytical framework. This is followed by an outline of the major findings from the case studies. The presentation of the empirical results is structured in two parts: Firstly, a short overview of the specific characteristics of the local transition processes in each of the analyzed cities is given with a special emphasis on the role of the local authority in governing these processes. Then, the results of the comparative analysis of the local practices in all cities are described in order to identify practical challenges of governing local transition processes. The final chapter then discusses and reflects the results of the case studies against the background of the proposed processes and activities of the Transition Management concept.

11.2 Research Question and Methods

This chapter outlines the empirical results of four case studies focused at analyzing the local transition processes in the European cities of Munich (GER), Modena (IT), Odense (DK) and Dobrich (BG). The governance concept of Transition Management previously developed by Rotmans et al. (2001) and Loorbach (2007) was applied as analytical framework to examine the roles and activities of local actors in governing local transition processes. Focuses of the analysis are the energy sector and the roles and influence of local actors and activities in managing energy transition processes. The case studies gather practical experiences and challenges in governing local transitions and analyse them against the background of the theoretical governance concept of Transition Management. This chapter outlines the major findings of the case study analysis focused on answering the following question: *To what extent do the observed governance practices meet the requirements of Transition Management?*

The case studies were conducted as part of the EU INTERREG IVC project "IMAGINE – Low energy cities with a high quality of life for all" (2012–2014). Within the project, the influence, measures and associated opportunities of municipalities and municipal actors in promoting energy transition were discussed. Eight partner cities developed respective visions of a "low-energy city with a high

quality of life for all" as a guiding vision of an ultimately carbon-emission-free future in terms of energy supply and demand. Against this background, the case studies were designed to analyse the local energy transition processes and derive recommendations for the participating partner cities on how they can further enhance their local transition process. Following the focus and approach of the IMAGINE project, the case study realised a holistic analysis of the transition of the energy sector. Thus, it examined a field of action that is highly crucial for reaching sustainable development. Mitigating climate change and thus avoiding the loss of future development opportunities is considered to be key for achieving sustainability (IPCC 2014; Sikdar 2009; WBGU 2012). Therefore, the transition of the energy sector can be considered to be key for the transformational change of broader societal systems and thus offers learnings for the overall transformation to sustainability.

The four aforementioned IMAGINE partner cities were selected for the analysis. In a first step, a desk research of municipal documents (policies, strategies, etc.) relevant for the local energy transition and an exchange with members of the local municipality were undertaken to get a first impression on the local transition process and to identify relevant actors. Then, guideline based expert interviews were conducted with selected local actors. Both, the analysis of local policies as well as the questionnaires guiding the interviews, were derived from the Transition Management framework (see Sect. 11.3 and Fig. 11.3). Overall, 21 local actors from different backgrounds (local authorities, local businesses, NGOs, etc.) and domains (public, private, economic, social, ecological, etc.) were interviewed in face-to-face meetings. The interviews were transcribed and qualitatively interpreted (cf. Mayring 1993, 2004) against the analytical framework of Transition Management.

11.3 Governing Transitions

The analytical framework of the case study analysis is based on the concept of Transition Management as introduced by Rotmans et al. (2001) and redefined by Loorbach (2007). According to Rotmans and Loorbach (2009) a transition takes place if and when "*combating system failure requires a restructuring of societal systems*" (Rotmans and Loorbach 2009, p. 185).

In general terms, transition can be defined as a "*long-term process of change during which a society or a sub society fundamentally changes*" (Loorbach and Rotmans 2006, p. 188). Within this paper the definition of transition is based on the Multi-Level-Perspective (MLP) of Transition Theory, which views transition as an interaction between three levels of analysis (Geels 2002):

- Micro-level: niches (e.g. NGOs, activists group, etc.),
- Meso-Level: socio-technical regimes (established societal system, laws, regulation, markets, mind-sets, values, etc.),
- Macro-level: socio-technical landscape (a broader setting that impacts the development in both regimes and niches).

Within the transition process, the possibility for *niches* to compete against the existing *regime* arises with the pressure coming from the *landscape* level (i.e. climate change), which weakens the deeply-rooted regime structures (people's mind-sets, laws, values, etc.) and creates flexibility on the regime level that allows new developments at the niche level (see Fig. 11.1) (Geels and Kemp 2005; Geels and Schot 2007).

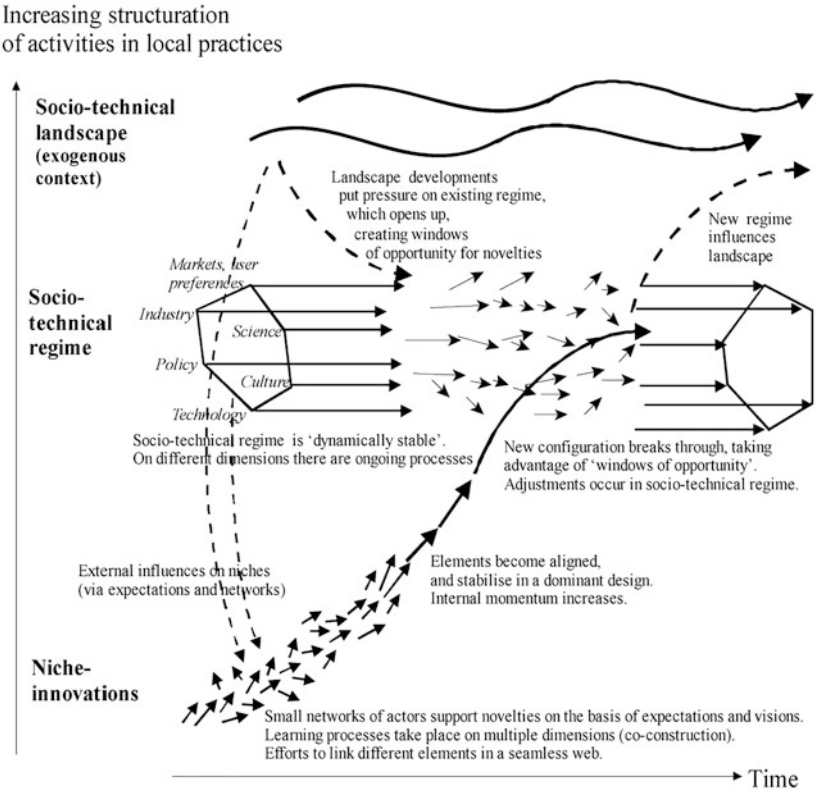

Fig. 11.1 Multi-level-perspective of transition management (*Source* Geels and Schot 2007)

The MLP provides the framework (Loorbach 2007) to approach Transition Management as a meta-governance concept (Loorbach and Rotmans 2010). Transition Management is a rather new approach to study governance, used by the Dutch government since 2001 in order to analyse the transition of various sub-systems, including the energy system (Loorbach and Rotmans 2006, 2010). The "IMAGINE" project builds on this approach and applies the Transition Management concept in the evaluation of the energy transition in the four case studies. This can enrich the concept of Transition Management with empirical findings.

Why does a transition require management? Loorbach (2007, p. 80) pointed out that "*managing transitions is (…) a highly uncertain and sometimes chaotic process, in which an attempt is made to link different actors and organizations with different time horizons, ambitions and values*". It is a process based on anticipation and adjustment, rather than control, and its impact is indirect, through highlighting development direction and timeframes (Loorbach and Rotmans 2006). This paper views Transition Management as a helpful framework that could provide fundamental guidance in ensuring that transition evolves in a satisfying way and reaches the most fitting aims. Using the Transition Management as a framework allows influencing activities at different governance levels (Loorbach 2007). The Transition Management framework proposes an iterative management cycle comprising four distinctive steps (see Fig. 11.2), which are related to corresponding types of governance activities: strategic, tactical, operational and evaluative.

On the *strategic level*, Transition Management seeks to provide direction towards a sustainable future through an envisioning process and reframes current trajectories through exchange of perspectives and new discourses. The *tactical level* translates the overall vision into specific goals and strategies by initiating new networks and coalitions. The *operational level* focuses on implementation and experimentation activities to further innovation and development. *Evaluation* strives to support the adaptation of visions and strategies, and process experiences in terms of social learning. The four activity clusters are not based on a linear approach to the steps that need to be fulfilled, but can rather be described as a *transition cycle*, consisting of four activities that can take between two and five years to complete, after which the process starts again (Loorbach and Rotmans 2006).

Based on the four activity clusters of Transition Management ten analytical categories can be derived from the activities suggested to govern transition processes (cf. Loorbach 2007, 2010). Figure 11.3 illustrates the operationalization of the Transition Management activities for the case study analysis and the specific characteristics of strategic, tactical, operational and reflexive transition activities.

Fig. 11.2 The transition management cycle (*Source* by authors, modified after Loorbach 2007)

The categories form the analytical framework to analyse the transition activities in the four case study cities.

11.4 The Praxis of Governing Energy Transitions in Four European Cities

This chapter illustrates major findings of the case study analyses in the cities of Dobrich, Modena, Munich, and Odense. It is structured in two parts: In the first sub-chapter the main characteristics of each process of energy transition are outlined. Special attention is given to the role of each local authority in governing the local transition process. This sub-chapter is not meant to summarize all activities of local actors that influence the local transition but to exemplify the specifics of each municipality's approach to energy transition. The second sub-chapter outlines local practices on strategic, tactical, operational and reflexive levels, which can be

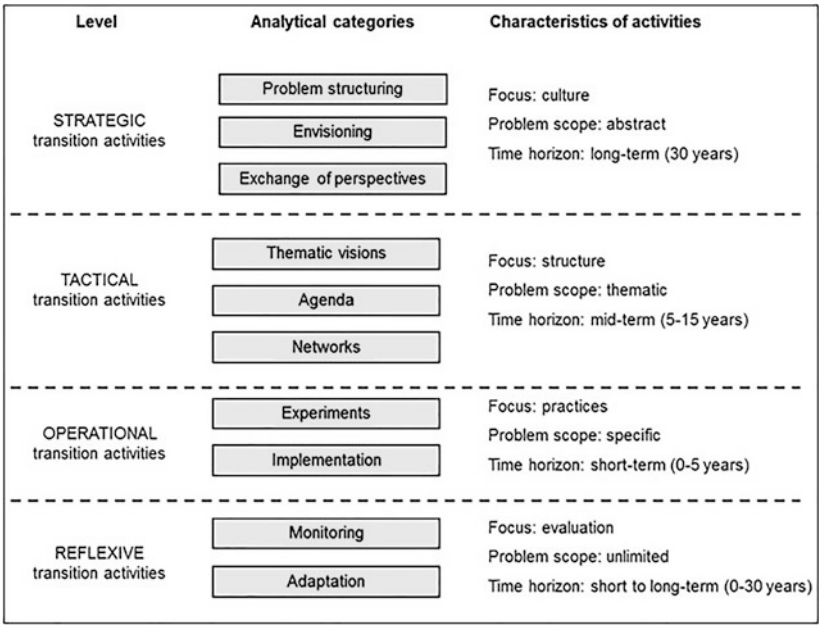

Fig. 11.3 Analytical categories applied for the case study analysis (*Source* by authors, modified after Loorbach 2010)

observed in the case study cities. Practical challenges of governing local energy transition processes are identified against the background of the proposed processes and activities of the Transition Management concept.

11.4.1 Local Characteristics of Transition Governance

11.4.1.1 Dobrich, Bulgaria

The energy transition process of the City of Dobrich more strongly focuses on increasing the energy efficiency of (municipal) buildings and technical infrastructures than on promoting renewable energy generation. Thus, the topic of local energy transition is closely related to local infrastructure renewal and the improvement of indoor climate conditions of buildings. Overall, the municipal activities for promoting energy transition are limited by the lack of financial resources of the local authority. The Bulgarian government transfers the

responsibility for developing plans and measures for improving the energy efficiency of buildings and infrastructures to the local level without providing financial incentives for these tasks. Therefore, the City of Dobrich depends on funding from other sources such as the European Union.

The local authority of Dobrich is at the stage of building its institutional capacity to act in the field of energy transition, which is characterized by measures of information and education of administrational staff as well as the creation and adaptation of administrational structures and processes. Within the past years, a local energy agency was installed and a local baseline inventory of municipal buildings and infrastructures was established. These measures can be considered to have long-term beneficial effects on Dobrich's ability to promote the local energy transition process. Furthermore, the local authority developed and implemented several projects to demonstrate the feasibility of the implemented technical measures to citizens and other Bulgarian municipalities. These projects are embedded in innovative forms of cooperative project development and implementation involving local stakeholders as well as information provision and awareness raising targeted at municipal employees and citizens.

Regional and national networks of Bulgarian municipalities also play an important role in building the capacity of the local authority to act in the field of energy transition. Within these networks the Bulgarian municipalities exchange information and cooperate for their mutual benefit. For example, one of these networks played an important role in establishing Dobrich's energy agency. Up to today, this network and the energy agency are institutionally connected with each other. These processes and structures of self-organisation of the Bulgarian municipalities may be considered as reactions to the lack of structures and resources provided by the national government.

The observed activities in Dobrich are strongly dominated by regime actors and are quite closed towards the involvement of stakeholders and citizens. Direct exchange and cooperation is only rarely realized, which may also be contributed to the specific historical and cultural context. Local policies and plans are characterised by a lack of long-term orientation and a narrow focus on the energy efficiency of municipal buildings and infrastructures. Overall, the local authority of Dobrich is in the process of building its capacity to enable future Transition Management activities.

11.4.1.2 Modena, Italy

The local authority of the City of Modena very actively enhances the dialogue between members of the municipality and local citizens, organisations and

businesses. For this purpose, the municipality has applied different forms of communication and participation. Furthermore, members of the municipality demonstrate high appreciation of the contribution of public participation to local plans and policies. They are open to integrate local community members in plan and policy development. Thus, local communication processes allow debates about municipal plans and measures as well as the introduction of new ideas and thus innovation to the local authority. However, these discussions are limited to tactical and operational activities of Transition Management. Up to now, the City of Modena lacks the discussion of overall, long-term goals. Furthermore, the local authority is the addressee or initiator of all identified forms of communication and collaboration regarding local energy transition.

The local authority of Modena has developed various technical measures to enhance energy transition focusing on energy generation, enhancing energy efficiency and increasing energy savings. Municipal plans and discourses do not take account of individual behaviour, consumption and values or their contribution to energy transition. Thus, the local authority of Modena has not yet unlocked the potential of these aspects for the local energy transition process.

The well-established forms of participation can also be considered networks among the municipality and local stakeholders. These are characterized through changing actors depending on the specific topic or measure of discussion, while more consistent networks among local stakeholders could not be identified. This approach offers the benefit of avoiding the establishment of elites which may result from including only selected stakeholders in consistent actor networks. Furthermore, the established participative structures allow the introduction of new ideas to the local authority, which may benefit the energy transition process. However, these ad hoc networks prevent the engagement and collaboration of local stakeholders to work towards mid- or long-term goals. This is especially the case when there is no shared vision to guide independent measures.

Overall, the Transition Management activities of the City of Modena are very open to non-municipal actors. The integration of new ideas and innovative approaches into municipal plan and project development is thus relatively easy. This could be further promoted by the targeted involvement of frontrunners and measures of strategic niche development (cf. Kemp et al. 1998). However, local activities are also characterized by a lack of integration and long-term orientation. A framework of guiding long-term goals and policies is still missing. Thus, plans and measures of different sectors and actors, within and beyond the municipal administration, are not coordinated towards the overall goal of energy sustainability, which makes complementary action and exploitation of synergies unlikely.

11.4.1.3 Munich, Germany

The local authority of the City of Munich has developed an integrated programme of climate mitigation measures, which has established processes of direct communication and cooperation among members of different departments of the local administration. Thus, this instrument has successfully led to the cross-sectoral and cross-departmental integration of measures. As the result, problem perception, as well as long- and mid-term goals, are widely shared among members of the local administration, gaining influence over their activities. Thus, the local transition activities of the different municipal departments are oriented towards the defined overall goals. However, these long-term goals are not widely shared among actors beyond the local administration as the established exchange of perspectives and processes of communication and cooperation quite strongly focus on municipal actors.

Munich's approach to energy transition focuses on the reduction of CO_2 emissions through increasing energy generation by renewable sources and increasing energy conservation. The measures are integrated in the city's urban development strategy and directly connected with newly established forms of cooperation among different actors, mainly but not exclusively from different administrative departments. The focus on reducing CO_2 emissions becomes especially evident on the levels of problem structuring and monitoring.

Furthermore, the local administration of the City of Munich acts as a facilitator of local transition activities by supporting third-party projects and initiatives. The analysis could not identify many transition-related activities that are completely independent of the local administration, e.g. the municipality is directly involved in both actor networks identified. Moreover, local experimenting is hindered by the lack of financing of experimental projects by the local authority. However, the experiments identified in Munich could be realized as they were funded by national sources.

Overall, regime actors dominate the Transition Management activities observed in Munich. The established high level of integration of goals and measures and the shared perceptions illustrate the successful communication and cooperation structures. However, these mainly involve regime actors and institutions and not the frontrunners with fundamentally different, creative ideas (Loorbach and Rotmans 2010; Loorbach 2007). Furthermore, the current praxis is relatively closed to innovative solutions and processes. This illustrates that, while being experienced in working with long-term timeframes and integrated approaches, opening up discussions, planning and implementation beyond the municipal administration, and thus to alternative views, ideas and solutions, is not (yet) practiced. Hence, it is

questionable if the current governance practices are suitable to develop truly alternative goals and solutions to guide the transition process.

11.4.1.4 Odense, Denmark

The approach of the City of Odense to energy transition is characterized by two fundamental aspects. On the one hand, Odense is strongly dedicated to promoting economic growth in "green" industries (green growth) on the local level. On the other hand, energy transition, as a component of sustainable development, is considered a common task that can only be realized cooperation of public, private and other societal sectors. Consequently, members of the local administration see the local authority in the role of a facilitator whose role is to bring different actors together, enabling and promoting cooperation and innovation. Thus, local and regional actor networks play an important role in Odense's transition process. Several institutionalised actor networks could be identified. While in some cases the networks were partially initiated by the local authorities, in others, the City of Odense is only an equal member in larger actor networks. The institutionalized networks act as independent units developing and implementing own projects and thus influencing the local transition process. Furthermore, they reflect Odense's focus on promoting green growth as they are most often networks of private businesses and public actors, whose joint activities focus on developing projects that are beneficial for the economic development in "green" industries. Overall, the local authority considers the work of these networks and its membership within those networks as highly important and valuable.

The City of Odense regards energy transition to be an open step-by-step process that is characterized by constant learning. Consequently, the local authority did not determine a defined set of measures as part of their transition agenda but only developed the first 30 projects within the sectoral energy plan. These projects shall only constitute the first step, while further projects are being cooperatively developed along the process. This iterative process is guided by the long-term goals and the framework set by the overall environmental policy of the city. This formulates mid- and long-term goals and defines guiding principles. Furthermore, it is connected to Odense's abstract overall vision, which applies the slogan "to live is to play" and formulates the overall goal of Odense becoming "Denmark's most sustainable city". Thus, the environmental policy integrates the transition activities of different actors, as well as sectors, and safeguards that these are oriented towards the abstract goals.

Overall, the identified Transition Management activities of Odense's local authority are very open towards stakeholders as well as innovation and learning.

Processes of policy making and planning are designed for the early stage involvement of selected private and societal actors and the iterative development of projects and measures. The basis for this approach has been the self-perception of the local authority as facilitator of cooperative and equal planning and policy-making processes. This attitude can be considered as both the prerequisite and the result of developing an adaptive and participatory governance system for transition, which requires regime actors to give away control and influence (Loorbach and Rotmans 2010).

11.4.2 Local Practices and Challenges of Transition Governance

11.4.2.1 Strategic Transition Management Activities

The comparative analysis of the case studies illustrates that the strategic activities of problem structuring, envisioning and exchanging perspectives among different local actors (see also Fig. 11.3) are highly crucial for the following tactical and operational activities of transition governance. The activities on this level quite often narrow down the approach to energy transition by taking a perspective that focuses on quantifying local CO_2 emissions and technical fields of action such as infrastructure, building stock, transportation and energy generation. Furthermore, this process is often dominated by regime actors of the municipal administration who establish the predominant perspective. Thus, subsequent strategies, plans and measures developed on the tactical and operational levels clearly reflect this technical focus on energy transition and consequently tend to neglect the influence of individual consumption, behaviour and awareness. Hence, energy transition has yet to exploit the full potential of these aspects for the local energy transition process. Furthermore, broadening the discussion may also result in innovations arising from addressing individual consumption, behaviour and awareness in local plans and measures.

The comparative analysis also illustrates that the participatory development of long-term visions and goals suggested by Transition Management poses a challenge for local authorities. In most of the case study cities, long-term visions and goals that could guide the local transition process were missing, which reflects the lacking institutionalisation of long-term concerns in traditional policy making (Loorbach 2010). In the analysed cities, this often resulted in a lack of integration of sectoral plans, strategies and measures as well as activities of different actors on the tactical and operational level. Furthermore, allowing fundamental discussions about the issues and future approaches seems to be very challenging for local

authorities, as this requires giving away steering and control of the transition process (Loorbach and Rotmans 2010). This is illustrated by the lack of participation that can often be observed on the strategic level. Especially the process of problem structuring is often a closed process, which mainly involves (technical) experts undertaking studies and analyses of local emission sources and potentials for reductions. The resulting documents and methods then form the basis for all following tactical, operational and reflexive activities.

Moreover, the case studies show that within the process of problem structuring the field of energy transition is connected with related challenges specific to the local situation such as air pollution, economic development and infrastructure renewal. This allows the integration of goals and measures in various sectors, strategies and plans as well as the generation of synergies among those. Thus, connecting energy transition with other fields of actions may broaden the activities and actors involved in contributing to energy transition. Also, framing energy transition as an opportunity for future urban and economic development of the city may lead to more support by private actors for energy transition activities.

11.4.2.2 Tactical Transition Management Activities

Tactical activities of developing thematic visions and goals, transition agendas and actor networks (see also Fig. 11.3) are mostly oriented towards mid-term timeframes and sectoral activities. Traditional policy making and local planning is used to working with a similar split of responsibilities and addressing mid-term time horizons as suggested by the tactical activities of Transition Management. This is also reflected in the tactical activities of the analysed case study cities. A number of relevant sectoral goals, strategies and plans relevant for energy transition could be identified in all cities. Quite often these are sectoral plan documents with technical focus following the definition of energy transition as a technical problem of energy generation and energy efficiency. As mentioned above, the lack of shared, overall visions and goals is likely to result in a lack of integration of different sectoral activities, which is in turn likely to hinder the local energy transition process. Furthermore, in most of the case study cities national legislation requires the local administration to develop local plans for increasing energy efficiency and renewable energy generation. As all of the analysed cities have developed Sustainable Energy Action Plans on voluntary basis, originating from their membership in the Covenant of Mayors, these plans quite often exist parallel to the legally required plans. This also illustrates the challenge of integrating various sectoral activities as basis for a holistic approach towards energy transition. In praxis, urban development strategies are often used to reach some level of integration on city level.

However, their eligibility to reach the needed integration for energy transition is doubtful as they are often oriented only towards mid-term timeframes and focused on the built environment and technical infrastructure. Thus, their focus is quite narrow and does not allow additionally integrating activities addressing consumption, behaviour, etc.

The tactical activities of developing sectoral goals, plans and measures are often embedded in participatory processes. All analysed local authorities demonstrate openness towards informal forms of direct communication and collaboration with societal actors. A great variety of different participatory formats could be identified, from information provision using different forms of media over public hearings and workshops, to the co-development of projects with citizens and private actors. All interviewed municipal actors consider such forms of direct communication and exchange as highly important for a successful energy transition process. The direct exchange and cooperation may lead to improved or even innovative projects that are crucial for promoting energy transition (Rotmans et al. 2001). Furthermore, the local authority can constantly learn from realized processes of cooperation and further develop and improve participatory tools and processes. However, the explicit identification and targeted involvement of frontrunners and niche actors, which are of crucial importance to the transition process (Loorbach and Rotmans 2010), is practiced in none of the analysed cities. This poses a challenge for municipalities as selecting actors requires selection criteria and methods specific for Transition Management purposes (Loorbach 2007).

Local and regional actor networks could be identified in all case study cities. Their structures in terms of actors, goals and functions vary significantly from city to city. Loose actor networks that have developed around the planning and implementation processes of concrete projects could be identified in all cities. They are direct results of the open approach needed for energy transition, which allows the co-development of (experimental) projects and measures. These kinds of loose actor networks have the advantage of being easily accessible to niche actors. Furthermore, they seem to be suitable for development and implementation of experiments, which is the context within which these networks were often observed in the case study cities. However, as these networks do not have their own organisational structures their persistence is uncertain and they may break up after project realisation, which hinders their work towards mid- or long-term goals of energy transition. Integrating activities of project-centred, short-term oriented actor networks is especially challenging if the integration of long-term goals and frameworks are missing.

More persistent, institutionalized actor networks could only be identified in some of the analysed cities. These are often formed by public actors and

representatives of private businesses. Those networks allow a more consistent cooperation and orientation towards mid- and long-term goals. However, these organisations tend to gather actors with same interests and similar perspectives to work together for their mutual benefit. Thus, they are selective and tend to exclude actors with different ideas and standpoints. Therefore, these networks may reach a point where they change from being "birthplaces" for innovations, as suggested by Transition Management (Rotmans and Loorbach 2009, p. 8) to preventing new ideas and projects and ending in lock in-structures. Overall, the identified institutionalized actor networks reflect the foci of the local approach to energy transition. As they can act more independently from their member institutions, they can become important actors that actively promote the local energy transition process.

11.4.2.3 Operational Transition Management Activities

The comparative analysis of the case studies illustrates that the implementation of plans and projects (see also Fig. 11.3) is strongly driven by regime actors of the local administration. There is only a low level of cooperation among municipal actors and stakeholders in implementing measures that are based on sectoral plans and agendas. Thus, most measures are implemented by regime actors and structures with only few opportunities for niche actors to participate. Only experimental projects are often implemented through cooperation of municipal actors, businesses, citizens and other organisations. On the one hand, this demonstrates that operational activities are dominated by regime actors, while direct cooperation with niche actors is only realized in exceptional cases. On the other hand, this illustrates the high value of experiments for the local transition process. Even though experiments are most often demonstrative projects of technical innovations, these are usually embedded in innovative forms of cooperative project development, implementation and financing. Thus, they provide the opportunity to try out and learn about innovative technical solutions and innovative processes and practices. Therefore, the case studies confirm their potential for introducing technological, institutional and societal innovations and thus promoting the local transition process (Loorbach 2010). However, in practice, the developed and implemented experimental projects are rarely derived from, or and integrated within, a systematic approach of experiment selection and evaluation, which could signify and assure that they fit to local transition pathways. Furthermore, the learned experiences from experiments are often not systematically fed back into existing practices and plans. As a result, the cities do not fully exploit the potential of promoting their local transition processes by undertaking experiments.

11.4.2.4 Reflexive Transition Management Activities

Reflexive activities of monitoring and evaluating local transition activities, as well as adapting or adjusting them based on the results of evaluation (see also Fig. 11.3), are strongly influenced by the information basis and methods established while structuring the problem on the strategic level. The quantitative analysis of local CO_2 emission is often the main focus of the local discussions and problem definitions, and it remains the focus when municipal goals, strategies, plans and projects are evaluated. Thus, the narrow focus established on the strategic level also tends to limit local learning and adaptation opportunities, which may hinder a transition process. The evaluation of goals and activities becomes a task of quantifying the effects of projects and measures on local CO_2 emissions.

Furthermore, the comparative analysis of the case study results shows that the reflexive activities of local authorities are focused on tactical and operational activities, i.e. municipal strategies, plans and projects are evaluated and adjusted on a regular basis and in an on-going process. However, this limited focus of the monitoring and evaluation activities does not meet the requirements of Transition Management. Changes on the landscape level and niche developments, such as activities and coalition forming of niche actors, are often not captured. Furthermore, measures that only indirectly effect local CO_2 emissions, such as the measures of awareness raising, become difficult to evaluate and adapt with the established evaluation tools and methods. Overall, the observed monitoring and evaluation processes are too strongly oriented towards short- and mid-term activities and too quantitative and technical to be able to capture the complexity of the transition process. Thus, if solely based on the evaluation results, the ability to improve local transition activities and promote the transition process as a societal process is limited.

11.5 Transition Management in Theory and Praxis

Sustainable cities require fundamental transformational changes of the highly complex structures of the societal system (Frantzeskaki et al. 2012). The Transition Management concept proposes an ideal mode of governance practices and processes targeted at influencing complex systems guided by the normative concept of sustainability in a “fundamentally new governance approach” (Loorbach 2007, p. 79). Following the idea of Transition Management consequently requires a break with traditional approaches to policy making (Loorbach 2010) to establish long-term thinking and a focus on forerunners, innovation and learning (Rotmans et al. 2001). Local governments are required to take a leading role in Transition

Management by enhancing collective learning and cooperation (Rotmans et al. 2001).

The empirical results from analysing the local energy transition processes in four European cities show that some of the specific elements of Transition Management can be identified among the practical activities of the local authorities. The cities have started to establish a multi-actor approach by applying innovative forms of direct communication, exchange and cooperation with different groups of actors. Furthermore, local and regional actor networks are involved in cooperative goal and plan development, and co-development of projects is practiced, even though to very different extents. These activities can form the basis for a process of exchange and planning based on learning as defined by Transition Management framework (Loorbach 2007; Meadcroft 2009).

Moreover, many of the observed governance practices of local authorities can fulfil the requirements of Transition Management on the tactical and operational level. In all analysed cities, sectoral goals, strategies and plans could be identified, which could potentially contribute to the local transition process. However, the strength in these sectorially structured short- to mid-term oriented activities may also result from their consistency with established forms of plan and policy making. On these levels, the applied instruments and processes mostly correspond to traditional forms of policy making and governance processes. Thus, it seems that most of the local authorities keep the traditional structures and processes, while adding elements of Transition Management, such as informal ways of communication and cooperation with groups of actors. Therefore, it remains unclear whether these processes of exchange and collaboration clearly address frontrunners and integrate niche actors.

This interpretation is supported by the fact that the analysed governance practices show most weaknesses on the strategic and reflexive levels, which are two of the key elements specific for Transition Management (Loorbach 2007). The analysis shows that the guiding visions and long-term goals could only be identified in one city (Odense). Consequently, the integration of sectoral goals, plans and measures poses a challenge for most of the cities. Furthermore, an open process of problem structuring and the exchange of perspective are hardly ever practiced. The process of problem definition is still dominated by a small number of experts who narrow down the challenge of energy transition to local CO_2 emissions sources, to be reduced by technical measures. The reflexive activities of the local authorities are also too limited to meet the requirements of Transition Management. They are designed to evaluate traditional policy making processes and their outcomes. Thus, they capture the tactical and operational activities, but are not able to evaluate and adjust processes and measures to the specific influences

suggested by Transition Management, such as changes on the landscape level and niche developments.

This leads to the conclusion that local authorities have started to open their processes of policy making and implementation to societal actors by new forms of communication and cooperation. However, the establishment of a new governance approach guided by the Transition Management concept has not been executed in a comprehensive understanding. The establishment of a long-term perspective which includes frontrunners in the development of innovative and inspiring long-term goals, as well as the development of systematic approaches towards experimenting and learning pose great challenges for local authorities. These elements of Transition Management also represent the deepest breaks with established governance practices and may thus be most challenging for local policy makers in practical implementation. Therefore, enriching traditional processes of policy making, instead of replacing them, with elements of Transition Management is still an ongoing and demanding process for the energy transition in European cities.

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