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Key messages

1. *A Focus on Communities and the Associated Blind Spots*

Prominent within the urban resilience literature are articles that focus on community resilience at a local level. There is a rich and diverse literature that establishes evidence of programs and practices that can be effective in developing urban resilience at the local level. Research at this scale is more dense and deep than research at other scales. There is a tendency, however, for these studies to focus on enabling strategies and impeding factors for enhancing community resilience. Largely absent is a consideration of the trade-offs involved in focusing on a community rather than city-wide or larger scale. A take-home message for practitioners, understanding that urban resilience operates at different scales, is not to lose track of the ‘forest’ when looking at the ‘trees.’

2. *A Growing Importance of Networks*

Shifting to the interconnections that play out across networks, there is an awareness in the literature of the role that inter-city networks can play in urban resilience. Practitioners may stand to gain considerably by using and building networks as they develop strategies for urban resilience.

3. *Trending Towards Trade-Offs*

The urban resilience literature has typically been only remotely concerned with the trade-offs involved in resilience programming, or trade-offs that emerge when decisions are made concerning resilience. The shortage of research considering trade-offs, however, seems to be changing, with a growing number of articles examining the effects that choices and programs to build resilience in one area might have on other domains. The focus on trade-offs can be a rich source of insights for urban resilience practitioners; it can help expose the consequences of certain actions, and can allow decision makers to realistically engage with the competing interests at play. This paper has worked to synthesize what knowledge can be found on trade-offs in the domains of urban resilience in the hopes of contributing to a trend that stands to greatly support the work of practitioners.

4. *A Clear Absence of Institutional Factors to Support Implementation*

Empirical research does not say much on actual governance mechanisms and institutional factors. Many papers call for multi-scale, multilevel, multi-stakeholder interventions but very few give the actual capacities and mechanisms needed to achieve these. The lack of institutional factors in the urban resilience literature is a clear absence that potentially glazes over a depth of impeding factors and trade-offs.

5. *A Clear Absence of Longitudinal Studies*

Across the urban resilience research base there is an absence of longitudinal studies. Nonetheless, longitudinal studies could be an important tool to better understand how cities and their people are affected by shocks and stresses and a key instrument in developing an evidence base of effective ways of addressing a new age of complex, ‘wicked’ problems.

Executive summary

Despite the growing popularity of the term, there is an important gap between the discourse on urban resilience and the capacity to develop resilience in practice. City officials are guided in their efforts by resilience frameworks (City Resilience Framework by Rockefeller and Arup 2015; Resilience Alliance 2007) but lack a clear picture of factors and strategies that facilitate the implementation of urban resilience and of barriers that might prevent it from being realized. They face a considerable challenge as implementing resilience may require a transformation of the core principles of public administration. As urban actors take on this ambitious agenda, there is a considerable opportunity to learn from each other's efforts. The present report assembles and shares the knowledge acquired to date from empirical studies that have attempted to implement urban resilience. We explore results through the lens of the City Resilience Framework (CRF) (Rockefeller and Arup 2015), which includes four dimensions (Health and Wellbeing, Economy and Society, Infrastructure and Environment, Leadership and Strategy) and 12 drivers of urban resilience. We determined that it would be helpful to organize findings about strategies for urban resilience implementation to match a framework that is actively guiding many city actors in their work. We viewed the CRF 'Leadership and Strategy' dimension as a governance component as integrally involved in all three other dimensions and intrinsic to the implementation of resilience. Results are presented in terms of the enabling strategies, impeding factors and trade-offs identified in the literature. We then provide an appraisal of the state of evidence on implementing urban resilience and propose promising avenues for future research.

The Health and Wellbeing dimension

Within the explicitly resilience-focused literature, this dimension has received limited attention to date. While it is likely that evidence regarding the enabling factors, barriers and trade-offs connected with these drivers exists within domains such as public health, epidemiology, livelihoods, food security and economic development, the resilience-branded literature approaches these themes only superficially or in passing.

In the CRF, ensuring public health services through integrated health facilities and responsive emergency services is described as a driver of the health and wellbeing dimension of urban resilience. As with supporting livelihoods and employment, the resilience-focused evidence in this area is patchy. In the context of international aid, there is evidence of resilience projects focused on health threats that are likely to increase with climate change, such as water-borne diseases with flooding, shifting incidence of vector (mosquito)-borne diseases over geographic areas and seasons, and the impact of heat stress (Brown 2012). The resilience of healthcare infrastructures in the global north, however, has received much less attention. This lack of attention persists despite lessons from contexts like New Orleans where two years after Hurricane Katrina, only one of the city's seven general hospitals was operating at pre-hurricane levels (Carthey 2009). In terms of public health research, some attention focuses on the integration of resilience into public health, looking in particular at the US experience following the implementation of the Department of Health and Human Services Preparedness and Emergency Response Research Centers (PERRCs) program. Despite these studies, the knowledge gaps in this area remain noteworthy.

The Economy and Society dimension

Economy and Society, and particularly the driver 'cohesive and engaged communities', represents a major focus of the urban resilience literature. There is considerable evidence on enabling and impeding factors as well as some important insights into trade-offs.

The promotion of cohesive and engaged communities is one of the drivers of urban resilience with the most robust evidence base. As the CRF suggests, engaged communities, social networks and integration can reinforce collective resilience (Arup 2015:3). Several enabling strategies emerge from the literature relating to crafting messages and information, increasing capabilities and cohesion, and supporting community initiatives. Still, important impeding factors are recognized, such as failing to deeply accommodate opposing views and trade-offs related to time and community concerns. The CRF proposes that ensuring social stability, security and justice can drive the Economy and Society dimension of urban resilience through activities such as law enforcement, crime prevention and justice (Arup 2015:3). Though security and justice are not deeply treated in the urban resilience literature, certain themes related to enabling strategies and trade-offs are emerging.

The Infrastructure and Environment dimension

This dimension represents a rich area of resilience scholarship across all three of its drivers. The evidence base on enabling strategies, impeding factors and potential trade-offs provides insights into the relationship between infrastructure, the environment and urban resilience. Natural and man-made assets, as well as the continuity of services, are particularly well-developed areas of research. Within the reliable communication and mobility driver, there is greater emphasis in the research on communication than on mobility.

Enhancing and providing protective natural and man-made assets through activities like environmental stewardship, effective land use planning, appropriate infrastructure and enforced regulations is presented by the CRF as one of the key drivers of this dimension. Integrating risk planning into urban design, engaging local perspectives, and building understanding and aligning incentives amongst parties are some of the strategies shown to enable this driver. Despite these experiences, however, multiple factors have been shown to hinder the implementation or adoption of protective asset strategies. From risk brokers with alternative priorities, to fragmented control and responsibility, to the constraints imposed by past decisions, there are numerous barriers to the provision of protective natural and man-made assets. The CRF proposes that through the provision of services, redundancy, active management and contingency planning, ensuring continuity of critical services can serve as a driver of the infrastructure and environment dimension of urban resilience (Arup 2015:3). The research focused on this driver reveals a number of enabling strategies, ranging from pre-established finance facilities to private sector engagement. However, the research also points to factors such as data and coordination gaps as well as trade-offs related to community involvement and local contractor engagement. The CRF presents diverse and affordable transport networks, along with information and communications technology, as key elements of reliable communication and mobility. While the evidence base on resilient transportation is sparse, literature on communication provides some insight into enabling strategies, impeding factors and trade-offs.

Knowledge strength and gaps in urban resilience implementation empirical literature

We identify some noteworthy observations into areas such as dominant focuses with the urban resilience literature, problems with the evidence in this domain, and gaps in lines of inquiry.

A Focus on Communities and the Associated Blind Spots

Prominent within the literature are articles that focus on community resilience at a local level. Be it the efficacy of narratives in empowering local resilience (Goldstein 2015), the role of dialogue in fostering urban resilience (Henceroth 2015), or the part that local culturally specific networks can play in disaster response (Kenney 2014), there is a rich and diverse literature that establishes evidence on the programs

and practices that can be effective in developing urban resilience at the local level. Research at this scale is more dense and deep than research at other scales within the urban resilience literature.

Within this community-focused research, there is a tendency for studies to focus on enabling strategies and impeding factors for enhancing community resilience. Largely absent, however, is a consideration of the trade-offs involved in focusing on a community rather than a city-wide or larger scale. For instance, while the resilience and DRR literature has long been critical of a top-down approach to risk management and disaster response, what trade-offs might emerge when shifting to a highly local and decentralized approach to resilience? A take-home message for practitioners—understanding that urban resilience operates at different scales—is not to lose track of the ‘forest’ when looking at the ‘trees.’

A Growing Importance of Networks

Shifting to the interconnections that play out across networks, there is an awareness in the literature of the role that inter-city networks can play in urban resilience. Nigg (2006), for instance, highlights how a city that experienced a shock could rely on nearby cities with whom it had network relationships to help accommodate its temporarily displaced persons. At a broader administrative level, work such as Martins’ (2011) study shows how transnational municipal networks can promote and help implement climate change action. By contrast, he also considers the constraints that can be engendered by such linkages. Beyond city administration, other work such as that done by Hope (2016) considers the role that networked urban universities can play in fostering sustainable cities. The fostering of networks by donors/foundations has also been considered in this space. Practitioners may stand to gain considerably by using and building networks as they develop strategies for urban resilience.

Trending Towards Trade-Offs

Much of the urban resilience literature discusses factors that enable resilience. A smaller, though still notable portion of the literature engages with elements that obstruct urban resilience or constrain the efficacy of enabling factors. Typically, however, the literature has been less concerned with the trade-offs involved in resilience programming, or trade-offs that emerge when decisions are made concerning resilience. Where papers consider constraints or obstacles, the elements invoked are often broad or vague. The obstacle of ‘politics’ is a notable example, where the elements within this black box are not deeply discussed. Literatures on other social goods, such as health or education, include deeper consideration of politics, looking at popular movements, lobby groups or political activism; resilience research deals in only very general terms with politics as a constraint.

The shortage of research considering trade-offs, however, seems to be changing, with a growing number of articles examining the effects that choices and programs to build resilience in one area might have on other domains. Meerow (2016), for instance, presents a hypothetical case of green infrastructure in Los Angeles to highlight how the impact of resilience decisions creates both spatial and temporal trade-offs with roots in politics and impacts on equity. Even papers that do not specifically address trade-offs raise issues that open avenues for future research enriched by this lens. In Gotham (2012), the notion of no-bid contracts is broached in relation to disaster response. While presented as a negative development, a thorough analysis of the trade-offs involved in their use could support policy makers in determining contexts in which these contracts might be appropriate, and instances where they are best avoided. The focus on trade-offs can be a rich source of insights for urban resilience practitioners; it helps expose the consequences of certain actions, and allows decision makers to realistically engage with the competing interests at play. This paper has worked to synthesize what knowledge can be found on trade-offs in the

domains of urban resilience in the hopes of contributing to a trend that stands to greatly support the work of practitioners.

Circular Reasoning in Resilience Evidence

Within the urban resilience literature, there is a tendency to present ‘results’ that are based on output indicators rather than outcome indicators. While an output represents the completion of a task—such as the building of a school—an outcome is the impact that results—such as any associated rise in literacy. In the urban resilience literature, these indicators are not often explicitly distinguished. For instance, based on UNISDR’s Making Cities Resilient “10 essentials” for making cities resilience, governance for disaster risk reduction is defined as a factor contributing to resilience. Based on this factor, Johnson 2014 provides a list of cities that have reported that they have taken actions towards this factor, thus building resilience. But just as ‘building a school’ does not necessarily ‘increase literacy,’ establishing resilience governance committee will not necessarily build resilience. There is a risk that this circular reasoning in the evidence of resilience can lead to the perpetuation of ineffective approaches or even approaches that have negative effects on urban resilience.

The Underlying “Normativity” of Papers

‘Most prior research dedicated to resilience’ suggests Sciulli ‘is prescriptive and normative’ (2015). The results of our scoping review support this statement. Our inquiry has shown that a great many papers are “normative” in their approach to resilience in that they are often steeped in a particular moral outlook and regularly directive in their conclusions. By normativity, we mean that authors tend to make value judgements about what practitioners “should” or “need to” do. This normativity is widely invoked to the detriment of evidence, hindering the capacity to make generalization. Cities are looking for expertise to determine which strategies to adopt and assess which changes are required to reach their adaptive potential (Revi et al., 2014). New knowledge must also be developed to handle complex problems involving multiple actors. Evidence and knowledge developed by internal and external experts can leverage transformations and advocate the development of new policies (Scolobig et al., 2014). By telling practitioners what they “should” or “need to” do, a wealth of alternatives are lost and the value of this research in providing practitioners with the capacity to weigh priorities and trade-offs when making complex decisions is curtailed.

The Overall Capacity of the CRF to Enable Practitioners

In recent years, though a number of frameworks for measuring urban resilience have been developed, none have been able to achieve strong consensus (Normandin et al., 2009; Therrien et al., 2015b), and few pay sufficient attention to the interrelation between indicators (Normandin and Therrien, 2016). While the CRF provides a credible framework for thinking about urban resilience, there is a disjuncture between its structure and the way the literature is organized. Whereas papers will often link two or three drivers in the different domains following patterns linked to underlying complexities and mindful of empirical contexts, a CRF style framework tries to aggregate data to provide more generalizable lessons. Identifying gaps within a comprehensive framework like the CRF is important as practitioners need to look to a diversity of different domains in constructing their resilience strategies. Given the important role that a constant learning process can have in urban resilience (Matyas and Pelling, 2014), the CRF framework can serve as a guidebook for the development of an evidence-based urban resilience “curriculum.”

A Clear Absence of Institutional Factors to Support Implementation

The development of urban resilience has the potential to transform urban governance by emphasizing horizontal work across municipal offices, by working through broader civil society networks and by challenging siloed approaches to governance. This potentially transformative implementation raises issues of power and hierarchical positions and poses questions related to management by administrations, political positioning and leadership. Cities are interdependent systems that do not necessarily work concertedly. Often, they muddle through problems as they seek solutions and rethink governance. They face challenges considering that individual organizations have their own objectives and mandates to fulfill. Unfortunately, the empirical research on urban resilience does not say much on actual governance mechanisms and institutional factors. Many papers call for multi-scale, multilevel, multi-stakeholder approaches but very few provide insights into the actual capacities and mechanisms that would be needed to activate these. The lack of institutional factors in the urban resilience literature is a clear absence that potentially glazes over a depth of impeding factors and trade-offs.

A Clear Absence of Longitudinal Studies

The interest in urban resilience seems to be catching on in many cities throughout the world. Though the definition and all the outcomes might not be completely clear for urban resilience practitioners or scholars, it must be remembered that the concept of resilience applied to the urban sphere has only been around for approximately 15 years. Considering the early state of inquiry into urban resilience, there is an opportunity for research projects be constructed as longitudinal studies. At present—as our analysis of the research on urban resilience reveals—however, such longitudinal studies are clearly absent. Nonetheless, longitudinal studies could be an important tool to better understand how cities and their people are affected by shocks and stresses and a key instrument in developing an evidence base of effective ways of addressing a new age of complex, ‘wicked’ problems

ABSTRACT

Despite the growing interest for urban resilience, there is an important gap between discourse and capacity to develop resilience in practice. This scoping review assembles and shares the knowledge acquired from empirical studies that have attempted to implement urban resilience, from 2005 to 2017. More precisely, it searches for facilitators, barriers and trade-offs in the implementation of urban resilience. We draw from the City Resilience Framework (CRF), looking at dimensions of resilience of Health and Wellbeing, Economy and Society, Infrastructure and Environment, and the overarching theme of Governance. While some enabling and impeding factors are characteristic to one specific dimension, others are common to all three base themes. This is the case for a transparent, community inclusive and supportive governance, which reduces the risks of negative impacts on communities. Opposing priorities between risk management and short-term needs, in the private as well as in the public sectors, diminish the possibilities of transformative action in all domains. Integrating risks into planning is solution applicable to all dimensions. Trade-offs inevitably appear when talking about resilience implementation, from infrastructures with adverse effects to the scale at which the transformative power is given.

1. CONTEXT

Recent studies recognize the magnitude of transformation required for the implementation of resilience at different levels (Coaffee 2013; Goldstein et al 2015; Stark 2014; Matyas and Pelling 2015; Pelling and Manuel-Navarrete 2011; Ross 2013; Scolobig et al 2014). Resilience policies may require the development of new adaptive capacities (Stark 2014; Matyas and Pelling 2015), along with cultural and structural changes in public administration to move from a “stovepipe” approach to collaborative networks (Bourgon 2009; Therrien 2010; Therrien et al., 2017). Case studies on resilience in socio-ecological systems have also highlighted the need to develop networks of actors capable of working together. Factors that can negatively influence these relationships include asymmetries in power, varying incentives for collaboration, and different interpretations of, and levels of interests in resilience (Lebel et al 2006; Valiquette et al 2013; Pelling et al 2008; Pelling 2003; 2010). Incremental and transformative adjustments may be required in multi-level urban risk governance, policies and incentives; relations with the private sector; and financing and institutional development (Pelling 2010; Revi et al 2014). While the literature to date includes syntheses and conceptual papers that attempt to better define urban resilience theoretically (Bahadur et al 2013; MacKinnon and Derickson 2013; Meerow et al 2016), no knowledge synthesis has yet been produced on the results of empirical studies of urban resilience implementation.

Analysis shows a generalized trend toward increasing numbers of natural and man-made disasters with ever-greater financial consequences (OECD 2003; Garschagen et al 2016: 6). Urban resilience appears as a relevant and potentially effective response to this challenge, and is supported by international organizations (UN 2005, 2015), governments (Public Safety 2011, Ministry of Public Security, 2014) and philanthropic organizations (Rockefeller Foundation and Arup 2015). Urban resilience is defined as “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” (Meerow et al 2016: 45, our emphasis). Better urban resilience could save lives (especially among the vulnerable), protect the environment and reduce economic losses. Moreover, it will likely support innovation and learning and thereby help societies adapt to emerging challenges and reduce their vulnerability.

Despite the growing popularity of the term, there is an important gap between the discourse on urban resilience and the capacity to develop resilience in practice (Pelling and Manuel-Navarrete 2011; Wagenaar and Wilkinson 2013). City officials are guided in their efforts by resilience frameworks (City Resilience Framework by Rockefeller and Arup 2015; Resilience Alliance 2007) and indices (Cutter et al 2010; Normandin et al 2009; Therrien et al 2015), but lack a clear picture of factors and strategies that facilitate the implementation of urban resilience and of barriers that need to be overcome. They face a considerable challenge as implementing resilience may require a transformation of the core principles of public administration (Bourgon 2009; Duit 2016; Stark 2014): siloed management may need to give way to transversal efforts capable of addressing 'wicked' problems; expertise may be required to become less concentrated and more distributed, emphasizing knowledge dissemination and the sharing of responsibilities in networks with new partners (private sector, NGOs, citizens); the routine processes developed to manage regular activities could evolve to be flexible enough to also enable the management of unpredictable and uncertain events. As urban actors take on this ambitious agenda, there are large opportunities to practitioners to learn from each other's efforts. The present paper assembles and shares the knowledge acquired to date from empirical study of attempts to implement urban resilience.

This paper begins with a description of the methodology used to conduct the scoping review. We then present a first level of analysis, exploring results through the lens of the City Resilience Framework (Rockefeller and Arup 2015), which includes four dimensions and 12 drivers of urban resilience. We chose this framework because the four Canadian cities (Vancouver, Calgary, Toronto and Montreal) participating in the Rockefeller Foundation's 100 Resilient Cities program are partnering with us in this scoping review, along with the Vice-Presidency of Knowledge and Impact at the Foundation. We considered that it would be helpful to organize findings about strategies for urban resilience implementation to match the framework that guides these city actors in their work. Results are presented in terms of the enabling strategies, impeding factors and trade-offs identified in the literature. We then provide an appraisal of the state of evidence on implementing urban resilience, examine trends in urban resilience scholarship, and highlight research gaps and propose promising avenues for future research.

2. RESEARCH APPROACH

This paper sets out to answer the question 'What are the barriers and facilitators in the implementation of urban resilience' by undertaking a scoping review of the academic literature. The selected time-period begins in 2005—the year the United Nations Hyogo Framework for Action entitled “Building the Resilience of Nations and Communities to Disasters” was published—and runs to 2017.

2.1 Search strategies

We began with a search on Google Scholar for scientific articles and books with the term “urban resilien*” in the title: 1120 records were identified, and review by title led us to retain 158 records. Two members of the research team independently reviewed abstracts of these records, assigning the code 2 for records based on empirical studies that dealt with barriers and facilitators to implementation of urban resilience; 1 for uncertainty around the record's pertinence to these questions; and 0 for records excluded because a) they were not based on empirical data; b) did not deal with implementation; or c) dealt with non-urban contexts. Inter-researcher comparison and discussion of this initial coding led us to retain 89 records for further analysis. Discussion around these papers also guided further searches to capture studies on governance and institutional aspects of urban resilience implementation.

Searches were then conducted in the Emerald database, for two search terms: 1) resilien* AND ((urban OR city) AND (institution OR governance)) AND (disaster OR crisis OR catastrophe); and 2) adaptati* AND ((urban/city) AND (institution OR governance)) AND (disaster OR crisis OR catastrophe),

3. RESULTS

3.1 What empirical studies reveal about implementation of drivers identified in the City Resilience Framework (CRF)

The CRF is a tool designed to help cities “assess the extent of their resilience, to identify critical areas of weakness, and to identify actions and programs to improve the city’s resilience” (Arup 2015: 2). The CRF outlines four dimensions of urban resilience, which are in turn supported by 12 drivers of resilience. These dimensions are a) Health and Wellbeing, b) Economy and Society, c) Infrastructure and Environment and d) Leadership and Strategy. The CRF also presents seven qualities or attributes that resilient cities tend to exhibit: reflectiveness, resourcefulness, robustness, redundancy, flexibility, inclusiveness and integration.

In this section, we probe the empirical research on urban resilience to unpack how these dimensions and drivers are substantiated. Focusing on the dimensions of Health and Wellbeing, Economy and Society, and Infrastructure and Environment, we explore the literature with three main questions: 1) What strategies have been identified that enable resilience in each of these dimensions? 2) What factors create barriers to the implementation of resilience in each of these dimensions? and 3) What trade-offs emerge as resilience initiatives are implemented?

Enabling strategies are approaches that allow for the actualization of a given driver or dimension of urban resilience. They can be elements that facilitate crisis resolution and mobilization to confront risks—such as situation awareness, trust, mindfulness, collaboration, deference to expertise, general agreement, perceived interdependence and environmental complexity (Berthod et al 2014; Ginter et al 2006; Roe and Schulman 2008, Roberts 1989; Therrien et al 2014)—or may be linked to network and collaborative attributes—such as working across organizational boundaries, creating joint capacity for action, and sharing common values and motivation.

Impeding factors are elements that act as barriers to the realisation of a given driver or dimension of urban resilience. They can refer to organizational values, resources, rules and management models, as well as the development of external network relationships that increase vulnerability (Therrien 2010, Therrien et al 2015b). The perceived “appropriateness” of behaviours, simplified interpretation of incidents, confusion and demobilization resulting from mishandled reforms or perceptions that precautions are unnecessary are further examples of impeding mechanisms (Busby 2006, Dalzell and Willing, 2000; Mitroff and Pauchant 1995; Sydow et al 2009; Bracco et al 2008; Wilson and Norris 2006; Weick and Sutcliffe 2006, 2011). Moreover, impeding mechanisms can also be linked to elements identified in institutional work, defined as “the purposive action of individuals and organizations aimed at creating, maintaining and disrupting institutions” (Lawrence and Suddaby, 2006:214), mechanisms related to the survival of routines, compliance rules, institutional assumptions, etc.

Trade-Offs represent the tensions and implications that may arise as urban resilience is forming or being programmed for. While urban resilience is frequently presented as a ‘positive-sum’ or ‘win-win’ situation for all involved, the notion of trade-offs explores how an action to build resilience at one scale (be it in time or space) can have negative consequences on another (Chelleri 2015).

Through these three lenses—enabling strategies, impeding factors and trade-offs—we begin our exploration of the evidence behind urban resilience. Our point of departure is the CRF dimension Health and Wellbeing.

3.2 Health and wellbeing

The Health and Wellbeing dimension of the CRF is described as “[t]he health and wellbeing of everyone living and working in the city” (Arup 2015:3). This dimension is supported by three drivers: a) Meets Basic Needs, b) Supports Livelihoods and Employment, and c) Ensures Public Health Services.

Within the explicitly resilience-focused literature, this dimension—and particularly the ‘meeting basic needs’ and ‘supporting livelihoods and employment’ drivers—has received limited attention to date. While it is likely that evidence regarding the enabling factors, barriers and trade-offs connected with these drivers exists within domains such as public health, epidemiology, livelihoods, food security and economic development, the resilience-branded literature approaches these themes only superficially or in passing. In this study, we present the evidence that does exist within the resilience literature related to enablers, barriers and trade-offs in the latter two drivers of the Health and Wellbeing dimension. This evidence should be understood as reflecting how resilience academics and practitioners have approached health and wellbeing challenges, rather than as a comprehensive evidence base on this dimension of resilience. The absence of the ‘Meets Basic Needs’ driver from the analysis below reflects the tendency for research to discuss basic needs either alongside other drivers, or as context for the implementation of other drivers.

3.2.1 Supporting Livelihoods and Employment

The CRF identifies livelihood opportunities that enable people to secure their basic needs as an important driver of the health and wellbeing dimension of urban resilience (Arup 2015:3). While literature is, as stated above, limited, some enabling strategies and important trade-offs have been acknowledged.

Enabling strategies

Inclusive and Transparent Governance

Inclusive and transparent approaches to resilience-building at the local level have been found to reduce the risk that resilience projects will negatively impact livelihoods. Strategies such as iterative planning processes can help marginalized urban residents engage with resilience planning and ensure their livelihood interests are taken into account (Anguelovski 2016). Using such bottom-up strategies helps ensure that the community’s priority issues are considered (Brown 2012).

Insulating Livelihoods from Financial Shocks

Innovative financial protection and insurance tools have been identified as helpful strategies for supporting livelihoods and employment. By spreading risk, these tools can provide affordable security against loss of assets and livelihoods. Moreover, with a financial buffer, poorer residents may have an alternative to migration or other coping strategies detrimental to their health, well-being or livelihoods (Kehinde 2014).

Investing in education

The investment in education has a more than one positive impact on urban resilience. First, it helps develop livelihoods and employment and second it diminishes the poor and vulnerable proportion of the population. It also contributes reducing the population and the city vulnerability. For example, Cuba has heavily invested in education and has included risk mitigation, prevention and emergency management at different levels of the education system (Lizzaralde 2014).

Impeding factors

The resilience literature focusses less on factors that impede efforts to bolster livelihoods and employment than on the negative impacts resilience-focused land-use policies can have on livelihoods. Some of these negative impacts are as follows. Land-use policies can increase the marginalization of the most vulnerable.

While the relocation of vulnerable communities may mean that they are no longer exposed in high-risk sites, it can also disrupt social networks and livelihoods and lead to isolation and greater vulnerability (Brown 2012). Policies to devolve responsibility to households to implement adaptive measures often fail to recognize existing inequalities in the ability to undertake these measures. Shifting adaptation responsibility to households may take time and energy from those households that could be directed to other livelihood activities. Furthermore, in thinking about the future of urban livelihoods in the context of climate risk, there is some evidence that local measures alone are unable to address vulnerabilities related to human resources and economic development, especially as households are trying to diversify their livelihoods away from climate-threatened sectors (Brown 2012), or recover following a disaster (Bornstein 2013). Focusing solely on the local level may limit the adaptability or recovery potential of certain urban livelihoods.

Lack of long-term investment

Finally, even though long-term investment would have a better impact on economy and resilience, instant solutions are often used in recovery efforts and in infrastructure and care services because of austerity measures in public expenditures (Lizzaralde 2014; Sciulli 2015). In addition, lack of sufficient long-term investment can undermine the benefits created by risk reduction and mitigation programs for livelihoods related agendas such as food security (Tadele 2009).

Trade-offs

The livelihoods of those living in urban centres do not always harmonize with resilience planning and oftentimes the two come into direct conflict. Packaging resilience policies and adaptation solutions as “win-win” solutions may boost their political salience, but often obscures the uneven costs and benefits borne by different groups (Anguelovski 2016). The development of flood flow zones and floodwater retention areas, for instance, may directly undermine agriculture and fishing-based livelihoods in those newly zoned areas (Anguelovski 2016). Time frames are also important when considering livelihoods in a resilience context: the global uptake in quinoa consumption was initially a boon to Bolivian farmers; however massive urban to rural migration to participate in the boon jeopardized the earlier farmers and brought a loss of traditional knowledge on sustainable agriculture in the area (Chelleri 2015).

3.2.2 Ensures Public Health Services

In the CRF, ensuring public health services through integrated health facilities and responsive emergency services is described as a driver of the health and wellbeing dimension of urban resilience. As with supporting livelihoods and employment, the resilience-focused evidence in this area is patchy. In the context of international aid, there is evidence of resilience projects focused on health threats that are likely to increase with climate change, such as water-borne diseases with flooding, shifting incidence of vector (mosquito)-borne diseases over geographic areas and seasons, and the impact of heat stress (Brown 2012). The resilience of healthcare infrastructures in the global north, however, has received much less attention. This lack of attention persists despite lessons from contexts like New Orleans where two years after Hurricane Katrina, only one of the city’s seven general hospitals was operating at pre-hurricane levels (Carthey 2009). In terms of public health research, some attention focuses on the integration of resilience into public health, looking in particular at the US experience following the implementation of the Department of Health and Human Services Preparedness and Emergency Response Research Centers (PERRCs) program. Despite these studies, the knowledge gaps in this area remain noteworthy.

Enabling strategies

Creating Public Health and Emergency Preparedness Research Networks

In public health, there is some support for the creation of knowledge and evidence-based tools for public health preparedness. For example, in the US the PERRC program supports a network of researchers and practitioners to conduct practice-relevant research (Leinhos 2014). Research to date has emphasized the need for a systems orientation in public health that involves many disciplines, works towards multiple interventions and leverages community resources to deliver results (Qari 2014). Networks such as these can help ensure that institutional actors have the resources to learn from multiple actors and continually improve their health and emergency preparedness system designs.

Creating Alignment through Community Resilience Frameworks

Community resilience frameworks have been found to facilitate the alignment of emergency preparedness, public health and health care (Plough 2013). These frameworks can enable this alignment by highlighting the potential for synergistic intervention impacts that reach beyond any individual organizational entities (Plough 2013, Qari 2014). Community resilience has been recognized by US Homeland Security as a top priority alongside bio surveillance and mass casualty care (Plough 2013). Health department staff receive training to improve community engagement skills and conduct preparedness activities that both engage and learn from vulnerable populations. In Rio de Janeiro, Brazil, Health Community Agents combine preventive health and home visits that allow them to understand the vulnerabilities of their community, and gain credibility with residents. Agents receive instruction on risks and alert systems and are key actors in creating a culture of prevention, information and assistance in emergencies (Motta 2014). Community Resilience Frameworks have been shown to be an effective enabler of the health and wellbeing dimension of urban resilience.

Coupling Community Communication with Community Participation

Community engagement strategies that couple communications with opportunities for participation promote partnerships and can be a useful health driver. The city of Los Angeles provides one example in which a preparedness campaign was launched that emphasized social connectivity along with stockpiling emergency supplies, encouraging people to: “Know your neighbors. Plan together” (Plough 2013). In 2010, following Greece’s financial crisis, a widespread media campaign on social solidarity publicized opportunities to contribute voluntary actions to meet people’s basic (food, clothes), health (medicines and medical services) and education (scholarships) needs. The message “All together, we can” attracted a wide range of civic, NGO professional, faith-based, corporate and public service groups and rallied enormous volunteer energy: In 2012, 3.6 million daily meals were being delivered through the NGO and volunteers (Drakaki 2017). Inclusiveness also increased legitimacy and oversight of the distribution of donated resources (Drakaki 2017). Though coupling community communication with community practice is an enabling strategy that extends beyond public health services, it has been shown to be effective in these areas as well.

Impeding factors

Treating Preparedness as an Add-On in Health Skills Training

A significant factor that can hinder resilience in public health and healthcare is the treatment of preparedness as an add-on. Often, expertise from the responder community is imported into public health organizations as an afterthought, with responders viewed as “interloper(s)” (Plough 2013). This approach can impede the development of the preparedness skills of public health professionals and does not encourage the formation of lasting collaborative relationships across these sectors.

Lack of proactivity in planning

The disaster management function “is regarded as being predominantly reactive, focused on short-term relief and welfare (e.g. handing out food and blankets) rather than proactively addressing strategic

planning issues that would allow disasters to be predicted and responded to in a cross-sectoral manner” (Roberts 2010). Effectively involving all the departments in risk assessment, monitoring and response activities requires institutional capacities. The objective is rarely attained because of the numerous hurdles, bringing frustration among staff (Roberts 2010).

Gaps between Healthcare Facilities and Disaster Management Strategies

Another impeding factor identified in the literature is a disconnect between healthcare facilities and disaster management strategies. Disaster management strategies can play a big role in shaping the volume and nature of cases that a hospital needs to address following an event. Nonetheless, the impact of events on health facilities is poorly understood and there is a lack of data for quantifying impact (Carthey 2009). We found little research in the resilience literature on the ability of healthcare facilities to adapt to the demands of catastrophic events, and this appears related to: the immaturity of the academic field of facilities management, ignorance of the role of hospital infrastructure in delivering quality healthcare services, and of the nature of impacts of events on health facilities (Carthey 2009). These gaps may impede the assurance of public health services.

Trade-offs

Numerous dimensions of health-related trade-offs in urban resilience are identified. To begin with, the urban space itself represents health-related trade-offs. High urban density can mean more available resources, better communication linkages, more developed medical infrastructure, and more established emergency services, all of which can mitigate the adverse effects of an extreme event. However, the urban space can also mean faster transmission of disease and more complicated evacuation and provision of relief (Siri 2016). Turning to the administration of public health, resource redundancies in preparation for an emergency event can represent a trade-off with efficient resource allocation in stable times. The hospital sector faces competing priorities for investment. The focus on efficiency in public expenditures involves reductions in capital costs in competitive tendering process, which works against increasing facility resilience; furthermore, the links between capital and operational costs are seldom sufficiently acknowledged in the tendering process (Carthey 2009). In addition, public health practice is subject to high scrutiny related to capability requirements and performance measures. This ensures that resources are tightly aligned with evidenced-based approaches to specifically improve emergency preparedness and response. However, it also makes it more challenging to dual-purpose public health emergency preparedness resources to ensure a social benefit even in the absence of a disaster or emergency event (Plough 2013).

3.3 Economy and society

The Economy and Society dimension of the CRF is described as “The social and financial systems that enable urban populations to live peacefully, and act collectively.” (Arup 2015:3). It is supported by three drivers: a) Promotes Cohesive and Engaged Communities, b) Ensures Social Stability, Security and Justice, and c) Fosters Economic Prosperity.

Economy and Society, and particularly the driver ‘cohesive and engaged communities’, represents a major focus of the urban resilience literature. There is considerable evidence on enabling and impeding factors as well as some important insights into trade-offs.

3.3.1 Promotes Cohesive and Engaged Communities

The promotion of cohesive and engaged communities is one of the drivers of urban resilience with the most robust evidence base. As the CRF suggests, engaged communities, social networks and integration

can reinforce collective resilience (Arup 2015:3). Several enabling strategies emerge from the literature relating to crafting messages and information, increasing capabilities and cohesion, and supporting community initiatives. Still, important impeding factors are recognized, such as failing to deeply accommodate opposing views and trade-offs related to time and community concerns.

Enabling Strategies

Crafting Messages and Information from Diverse Sources

Tools such as crowd-sourcing are increasingly being used to collate dispersed information held in communities (Akama 2014, Hendricks 2013). Involving entire communities in activities and organizations can, on the one hand, ensure that vital information is spread effectively (Ludin 2017) and, on the other hand, present opportunities for people with different perspectives to collectively construct narratives. These ‘plurivocal’ risk narratives can enable people to creatively conceive of resilient possibilities and develop common purpose. In Los Angeles, for instance, assembling different views on the LA River helped create a more inclusive and diverse understanding of how to engage in resilience (Goldstein). Within this public consultation process, using language that is clear, and employing cooperative strategies have been found to be effective in preventing elite domination of meetings (Bahadur 2014). Effectively, crafting messages from diverse sources can enable the driver of cohesive and engaged communities.

Increasing Community Cohesion through Capabilities

Another enabling strategy is to work through schools and increase community capabilities through children. The Amadora Resilient Cities campaign in Portugal, for instance, focused on schools, postulating that “children are at the centre of the neighbourhood network” (Burnside-Lawry 2014). Another example, in Brazil, used simulated exercises including evacuations in schools and involved parents in these exercises (Motta 2014). These strategies were shown to increase the preparedness of individual community members and also build cohesiveness and trust—elements that become crucial in the event of a disaster. As shown in several studies, people who know each other and are confident in receiving help from neighbours fare much better during an event (Islam 2014, Kapucu 2017; Lanfranco 2011).

Supporting Community-Led Initiatives

Supporting community groups can build cohesiveness in normal times that then becomes a valuable resource in response and recovery during events. Recovery efforts by local groups, both before emergency services arrive and to complement their activities later, have been shown to be strengthened when there are pre-existing community initiatives that can be re-directed to help with recovery. In New Zealand, for instance, community groups established as hubs of volunteer activity in normal times provided vehicles for prompt community mobilization following disaster (Cretney 2015). Local action groups can serve as an intermediary between official recovery organizations that have resources, and local people who can be engaged in efforts (Berke 2009). Government support for community-led initiatives is one way to enable engaged communities with broader knock-on effects in urban disaster management (Cretney 2015; Motta 2014). Additionally, in a preparedness stage, dialogue around risk assessments can provide opportunities for responders to engage with diverse groups of citizens and leaders, and develop relationships that set the stage for further collaboration (Henceroth 2015). As Kenny finds, recovery plans are more effective when they integrate local knowledge and respect and operationalize cultural values (Kenney 2014).

Impeding Factors

Failing to Deeply Accommodate Opposing Priorities

While collaborative decision-making is often presented as a key pathway towards adaptation and risk mitigation, the divergent or opposing priorities of parties involved can emerge as an impeding factor to engaged and cohesive communities. In an international context, communities may be reluctant to come

together around priorities that are principally selected by international groups (Bahadur 2014). Alternatively, where resilience plans are closely controlled by outside managers, the scope for ideas beyond a pre-established plan may be limited. Where a plan does not really allow for alternative ideas, residents may be caught defending a status quo simply because the plan presented to them cannot accommodate their vision of change (Goldstein 2015).

Content and Form of the Information Communicated

The content and the form in which information is shared may impede the development of engaged and cohesive communities. Regarding the content of information shared, local actors may find information more valuable when it is geared specifically to them (Mullins 2013). In the emergency field, while there is a demand for this type of segmentation of information, there is also pressure to avoid segmentation because it increases the risk that some segments of the community may be ignored (Akama 2014). The form of shared information is also relevant for how communities receive information. Internet communications, for instance, may be a less costly form of communication than other means, and can be updated more rapidly, but may not reach individuals who lack adequate internet connectivity (Amaratunga 2014).

Alienation of Local Actors

A myriad of factors that lead to the alienation of local actors can impede cohesive and engaged communities. First, local actors may not know how to begin engaging with risks if they lack information about these risks (Burnside-Lawry 2014b). As well, faced with a variety of other priorities in their day to day lives, resilience may seem like a luxury to local actors (Bahadur 2014). The assumption of responsibility can be impeded by belief among local actors that they can rely on policymakers “to deal with flooding and be responsible for their welfare” (Mullins 2013). Factors such as these can alienate communities and impair their ability to develop the cohesiveness and engagement that are drivers of resilience.

Trade-offs

While promoting cohesive and engaged communities is often presented as a purely positive initiative, trade-offs within this space have been identified related to fears, limits on individual resilience, and time. Building awareness is seen to require comprehensive two-way communication and opportunities for reflection (Mullins 2013); while planners and responders need to develop an awareness of community issues, experience and capabilities, communities need to obtain information about risks and mitigation options. However, communities have a social memory of experiences and events (Amaratunga 2014) that can include painful memories. There is a trade-off here, because much as fears raised by discussing risks and past events can prompt action, they can also be paralyzing (Grove 2014). In facing a shock, there may be trade-offs between community cohesiveness and engagement, and the exercise of individual resilience: high levels of individual resilience (such as the ability to leave an area prior to a shock) can be in tension with community resilience (where the departure of those individuals takes away from the skills and resources available in the community) (Chelleri 2015). Finally, the desire to undertake actions quickly is often in tension with community consultations (MacAskill 2016) that can be time consuming, thus creating trade-offs between efficiency and an community engagement.

3.3.2 Ensures Social Stability, Security and Justice

The CRF proposes that ensuring social stability, security and justice can drive the Economy and Society Dimension of urban resilience through activities such as law enforcement, crime prevention and justice

(Arup 2015:3). Though security and justice are not deeply treated in depth in the urban resilience literature, certain themes related to enabling strategies and trade-offs are emerging.

Enabling Strategies

Information Sharing

Information sharing has been identified as a helpful strategy for ensuring social stability and security. Coordinating bodies and formal multiagency partnerships have been found to play an important role (Caruson 2006, Coaffee 2006) in facilitating information sharing.

Relying on Community Security Services

Where state security forces are overstretched or lack cultural sensitivity, building relationships between state security services and community security services can help assure social stability, security and justice. One case focused on New Zealand following a major earthquake event, for instance, illustrated how police were able to rely on Māori wardens to provide security services. Their involvement brought benefits beyond security as it facilitated face to face needs assessments and the delivery of basic resources (Kenney 2014).

Trade-offs

Within this driver, trade-offs have been found between security on the one hand and, on the other hand, individual freedoms, rights to privacy, and enjoyment in using urban spaces. Though planners have tried to manage this trade-off by integrating protective security into the design of high-risk sites, challenges remain (Coaffee 2010). At a broader scale, trade-offs have been identified between government security policies “driven by the demands of global economic, financial networks and the convenience of transnational elites,” and the “liberty and mobility of ordinary citizens worldwide” (Coaffee 2006).

3.3.3 Fosters Economic Prosperity

Contrasting the livelihoods and employment driver of the Health and Wellbeing dimension which focuses on individuals, fostering economic prosperity is a driver of the Economy and Society dimension of urban resilience focused on the wider urban economy. Attracting business investment, effective management of city finances and a diverse economic profile are all elements of this driver (Arup 2015:3).

Enabling strategies

Spreading Risk through Financial Instruments and Regulation

In managing the financial risks associated with shocks, insurance mechanisms such as regional catastrophe insurance pools can help reduce the cost of insurance, facilitate access to reinsurance markets, and provide timely funds in the event of disaster (Kehinde 2014). Alternatively, governments can aid in spreading financial risk to businesses through regulation. While risk avoidance is not always popular among local governments—applying strict land use regulations to reduce the vulnerability of enterprises can mean foregoing tax revenue and jobs—local governments can use risk avoidance plans to manage the expectations of different actors and champion the spread of financial risk through land use and building regulations (Burby 2006).

Supporting Efforts of Small and Medium-Sized Enterprises to Manage Risks

Small and medium-sized enterprises (SMEs) often lack the resources and initiative to analyze and mitigate hazard risks. As Ingirige (2014) found, flood adaptation by SMEs is not “self-propelled”, with many ‘waiting to see’ what happens when faced with a hazard rather than acting pre-emptively. Strategies to

promote hazard risk reduction among businesses include the creation of a “Trust” unassociated with municipal politics to engage the business community in resilience activities in an ongoing way (Karanth 2014), communication of risk that is sensitive to the needs of SMEs, and promotion of a range of property-protection and non-structural business continuity options that would enable SMEs to reopen operations more quickly following an event (Ingirige 2014). Given the importance of SMEs to the prosperity of many cities, strategies to help businesses better manage hazard risk can enable this driver of the Economy and Society Dimension of urban resilience.

Impeding factors

Business Elites with Weak Links to the City

Business elites can play an important role in fostering economic prosperity. However, as one study notes, not all business elites are created equal. Where business elites have economic interests that are not embedded in the places in which they are based, or lack a sense of civic responsibility, they can impede the type of economic prosperity that supports urban resilience (Hobor 2015).

Priorities Competing with Risk Management

For many businesses, the risks that relate to a hazard represent just one consideration amongst many. Lacking financial or human resources to effectively develop an understanding of the risks posed by a hazard such as flooding, businesses (particularly small and medium-sized enterprises) will often prioritize other initiatives and develop a ‘wait and see’ attitude towards hazard risk (Ingirige 2014).

Gaps in Insurability Due to the Nature of Risks

While insurance can play an important role in fostering economic prosperity, the nature of risk in many cities creates gaps in insurance coverage. For some slow-onset shocks, such as climate change, it is hard to identify and map the range of possible risks, making it difficult to know what exactly to insure. Moreover, the longer time frames of these slow-onset shocks may not be built into the risk models of many insurers (Kehinde 2014).

Trade-offs

While the economic prosperity of a city can be a major driver of the Economy and Society dimension of urban resilience, the drive towards prosperity can simultaneously create trade-offs in other dimensions of urban resilience. In New Orleans, for instance, one study notes how a business elite focused on “economic growth at all costs” led to environmental degradation and the deepening of environmental risks (Hobor 2015). Shifting from the general economy to construction specifically, federal assistance disconnected from risk assessment can serve to encourage infrastructure and economic activity in hazardous areas. “The paradox is that in trying to make the most hazardous parts of New Orleans safe for urban expansion, it had the unintended effect of contributing directly to the devastation of Hurricane Katrina. It did that by increasing the amount of development possible in low-lying, flood-prone areas...” (Burby 2006). When looking at this driver of the Economy and Society dimension alongside other dimensions of urban resilience, we see how bolstering resilience in one area (here economic growth) can easily have negative effects in another (the environment).

3.4 Infrastructure & Environment

The Infrastructure and Environment dimension of the CRF is described as “effective leadership, empowered stakeholders and integrated planning” (Arup 2015:3). Three drivers are listed as supporting this dimension: a) Enhances and Provides Protective Natural and Man-Made Assets, b) Ensures Continuity of Critical Services, and c) Provides Reliable Communication and Mobility.

This dimension represents a rich area of resilience scholarship across all three drivers. The evidence base on enabling strategies, impeding factors and potential trade-offs provides insights into the relationship between infrastructure, the environment and urban resilience. Natural and man-made assets, as well as the continuity of services, are particularly well-developed areas of research. Within the reliable communication and mobility driver, there is greater emphasis in the research on communication, and less on mobility. Possible explanations and implications of this focus will be explored in section 5.

3.4.1 Enhances and Provides Protective Natural and Man-Made Assets

Enhancing and providing protective natural and man-made assets through activities like environmental stewardship, effective land use planning, appropriate infrastructure and enforced regulations is presented by the CRF as one of the key drivers of the Infrastructure and Environment Dimension of Urban Resilience. Integrating risk planning into urban design, engaging local perspectives, and building understanding and aligning incentives amongst parties are some of the strategies shown to enable this driver. Despite these experiences, however, multiple factors have been shown to hinder the implementation or adoption of protective asset strategies. From risk brokers with alternative priorities, to fragmented control and responsibility, to the constraints imposed by past decisions, there are numerous barriers to the provision of protective natural and man-made assets. We begin by looking at some of the enabling strategies.

Enabling strategies

Integrating Risk Planning into Urban Design Regulations and Plans

The literature identifies the integration of disaster risk reduction (DRR) into design as a factor that enables the infrastructure and environment dimension of urban resilience. Enforcing DRR building codes, integrating risk thinking into design and construction guidelines, engaging in relocation from disaster-prone areas, and mainstreaming DRR in urban development plans are some of the strategies used to enable a resilient built environment (Malalgodaa 2014, Johnson 2014). Moreover, this planning can draw on past experience of how communities use urban spaces in responding to an event before emergency responders arrive: what do they have on hand to help them survive/help each other (Allan 2013). The spatial layout of the city influences opportunities for survival. Open spaces can serve as shelter and in the distribution of aid following disaster. Multiple passageways to elevated sites away from the coast can prevent bottlenecks during escape (Allan 2013). Crowded spaces can be modified to reduce terrorist attacks risks and impacts (Coaffee, 2013). Integrating planning into urban design is thus an exercise in mainstreaming DRR into design, and thinking about how design influences how people access assets during an event. To achieve efficient spatial planning, Coaffee 2013 pinpoints that urban planners need to work holistically with other built environment specialists, decision-makers and security specialists (such as the police). On top of this cross-departments governance (Fitzgerald 2017) and data sharing (Wilby 2012) is crucial.

Engaging Local Perspectives in Design Processes

The opinions and perspectives of local stakeholders can help ensure protective assets are designed in ways that support those who will most closely engage with them during stresses and shocks. When conditions for urban development are imposed by external actors, plans do not benefit from local knowledge and may be inconsistent with local values, needs, and customs (Cigler 2008). Engaging local perspectives can ensure that design is adapted to local conditions and integrates community views and priorities (Bakker 2013). This means community engagement from the beginning to the end, but also handing the design phase to local professionals (bottom-up approach) (Dias 2014). This ensures a profound comprehension of problematics and sustainable, durable solutions. Schewenius 2014 invites to stronger links between “informal managers and formal governance”. For natural assets, managements should include not only stake holders but also user groups, and should span different ecological scales (Ernstson 2008-1). For

example, in Japan, some communities build their own recovery plans following a disaster, through “committees involving experts, residents and community representatives” (Danar 2014). This ensures popular consensus regarding issues such as resettlements. Planning also has to be done within the limits of the local context. Gradual reformation, using reasonable funds, may ensure long term success (Pierdet 2012).

Building Understanding and Incentives Amongst Parties

Some blockages to the development of green infrastructure or to the protection of natural protective resources can result from poor understanding amongst stakeholders and an absence of incentives. Awareness and education campaigns help protect systems such as wetlands and parks (Ernstson 2010), making communities more prone to protecting them (Ernstson 2008-1). Easily comprehended tools have a high impact (Wagenaar 2013). Redefining a problem in a way that points to solutions is one strategy to enable action. In an example of water management, a change in the definition of “water” to include urban runoff brought together municipal infrastructure managers and other concerned agencies to find solutions (Cousins 2016). As storm water flow was calculated to identify its value as a resource, more actors were incentivized to manage it effectively. The appeal of green infrastructure even grew amongst homeowners who were provided with new ways to manage storm water and incentives to encourage changes that saved water during drought and increased rainwater capture for subsequent use (Cousins 2016b). Financial incentives increase the citizen’s actions (such as changing blacktop driveways for permeable surfaces) (Fitzgerald 2017). Build environment professionals, who interact directly with householders, can play a key role in awareness raising (Smith 2013).

Impeding factors

Fragmented Control and Responsibility

Misalignment between control and responsibility at the urban level can impede actions on resilience related to the provision of natural and man-made assets. Municipalities and national governments often have limited ability to raise funds but are expected to undertake resilience investments. For instance, the federal government (in the US) will pay for local infrastructure damage after an event, but will not necessarily contribute to mitigating risk beforehand (Berke 2009). Alternatively, in England, insurance companies are expected to provide accessible coverage, however it was found that government does not consult with them around zoning decisions. This lack of consultation can be problematic given that the flood maps held by insurers are much better than those of the government (Chrichton 2007). Even in instances where multi-stakeholder platforms have been established to collaborate on issues such as water governance, these structures may have few legal powers, limiting their ability to control change. A consequence of this fragmented responsibility is a timing problem: security considerations are more effective when they come early in a building project, but this is often not the case (Coaffee 2013). Regarding fragmentation, bureaucratic silos can slow implementation progress, and a lack of communication, competing departments or disciplines (that could be overcome with collaborative planning), and differential regulations of fiscal environments can reduce the chances of success (Fitzgerald 2017). Collaborative work requires more time, hence more resources.

Risk Brokers with Alternative Priorities

An impeding factor within this driver is that the industries that control key assets may not be focused on risk and resilience-related elements. The construction industry, for instance, is a key player in urban man-made assets. However, there is a lack of designer and built environment input into the resilience agenda, and a lack of training on urban resilience with built environment professionals. In Vietnam, local

governments are indeed dependable on revenues from land transactions and private investments, making it hard to match with a resilience agenda and prone to non-transparent processes (Friend 2014). A further hindrance is the professional fragmentation of the construction industry, with architects, surveyors and engineers usually employed from outside construction firms as independent consultants (Bosher 2007, 2009). In some industries, inherent conflicts arise around the design of an infrastructure: while a levee might be crucial for risk reduction, it may have been built to primarily serve the shipping industry (Cigler 2008).

The Constraint of Past Decisions on Current Asset Planning

A major impeding factor to the provision of natural and man-made assets lies in the past infrastructure decisions in the urban plan. Gupta's (2007) look at the water management system in Mumbai, for instance, illustrates how the city's options for future infrastructure planning are shaped by decisions made in the past: major decisions regarding sewage discharge created infrastructure that is difficult to undo and shapes current options. Failed past experiences to tackle water pollution in Sweden is used as an excuse to refuse new projects (Galaz 2005).

Cultural specificities

While relocation is always controversial, some cultural characteristics can make it even more complex. For example, Danar 2014 reports that in Indonesia, people didn't mind going back to live in a tsunami prone area, because they believed death was determined by God. Moreover, their occupations being dependent on the sea, they did not want to move far from it. Values differences can also cause collaboration problems in-between city departments (Fitzgerald 2017). Smith 2013 notice some adaptations might require too big a change in the look of suburban houses to be attractive for householders.

Lack of information

A lack of information on risks, and a lack of information transmission to concerned parties, can lead to a reduction of resilience initiative success (Friend 2014, Sunarharum 2014).

Political vs implementation frameworks

There is an implicit inconsistency between the political framework, based on short-term yield, and resilience building, which is a long-term iterative process (Sharma 2016).

Trade-offs as impeding factors

When a project shows contradictive outputs for two different groups, the resulting conflicts will make the implementation more complex. This was the fact for a water pollution debate in Sweden, in which action was beneficial for water users, but costly and therefore harmful for municipalities and industries (Galaz 2015).

Trade-offs

The provision of natural and man-made assets is a domain rife with trade-offs. Trade-offs include situations where the design decisions for a man-made asset to guard against one hazard may create increased vulnerabilities to another, and where increased urban resilience may lead to decreased resilience in surrounding rural areas or vice versa. For example, infrastructures protective against weather hazards such as cold weather and floods are very vulnerable to the hazards caused by climate change effects such as heat waves (Zaidi 2015).

Resilient assets can often create key trade-offs related to risks and vulnerability. Discussing roads and flood risk, Brown 2012 writes "[e]levated roads may...prevent direct flood damage to transport routes,

but could also potentially increase the risk of flooding and inundation in adjacent areas by disrupting natural drainage flows or creating barriers that divert water towards specific locations.” (Brown 2012). Similarly, Kelman (2017) notes how heavy roofs are an engineering technique which reduces vulnerability to intense tropical cycles, but increases vulnerability to earthquakes. Alternatively, where parks are used for managing storm water, what happens to the urban poor residing in those parks (Meerow 2016)?

The structure of governance favoured for resilience can also have some trade-off effects on communities. Coaffee 2013 stresses that while more place has to be given to communities, they still need to be supported by local governments. There is a risk for governments to use resilience as an excuse to reduce support to communities. Citizen participation could also be used as a mean of manipulation of local opinion, according to Dias 2014, and could be used only as a way to look good. Built environment development can show to be harmful to the social and political spheres (Steele 2010, Surjan 2009).

While urban-rural partnerships can be developed to protect key natural assets, competing priorities can also lead to situations where the increased resilience of one area leads to the decreased resilience of another. The relationship between New York City and the Catskill-Delaware region provides an interesting look into watershed planning, and trade-offs between agricultural water demand and the drinking water needs of a growing urban centre (McPhearson 2014). Moving from urban-rural dynamics to local government vs. higher levels of government, the literature indicates that the asset interests of a local urban scale may compete with the interests of higher levels of government. While local users may seek flexibility and autonomy in how assets are managed, this approach can run counter to that of higher levels of government looking for certainty in resource management (Hill 2013). Here, short-term adaptation actions can undermine longer-term ecological resilience.

3.4.2 Ensuring Continuity of Critical Services

The CRF proposes that through the provision of services, redundancy, active management and contingency planning, ensuring continuity of critical services can serve as a driver of the infrastructure and environment dimension of urban resilience (Arup 2015:3). The research focused on this driver reveals a number of enabling strategies, ranging from pre-established finance facilities to private sector engagement. However, the research also points to factors such as data and coordination gaps as well as trade-offs related to community involvement and local contractor engagement.

Enabling Strategies

Pre-Disaster Recovery Planning

Several articles note the important role pre-disaster recovery planning can play in enabling the continuity of critical services. Identifying services central to an emergency response, such as hospitals, and developing planning for the maintenance of these services during a shock, along with their subsequent recovery, can help ensure the continuity of critical services (Gupta 2007). Cities can engage in broader pre-disaster recovery planning to help ensure the continuity of critical services. Within this process, engaging diverse stakeholders, including the elderly and those living in poverty, can improve both the recovery plans and the post-disaster recovery (Horney 2016).

Pre-Established Finance Facilities

Developing financing facilities prior to a shock that kick following the shock can be a helpful way to enable the continuity of critical services. Within existing budgets, administrations may create pre-defined (though still flexible) funding plans to expedite critical infrastructure recovery following a disaster (Liu 2016). Turning to private sector solutions, establishing insurance facilities can ensure that an urban centre

has the financial liquidity to continue critical services immediately after a disaster, and minimize medium-term setbacks to development (Kehinde 2014).

Private-Sector Engagement

As public capacity is overwhelmed during a disaster, collaboration with the private sector has been identified as an enabling factor in the continuity of critical services. The private sector represents a large portion of the assets that need to be protected (Stewart 2009). In major building and reconstruction projects, private contractors can fill skill shortages and deliver quality projects in a timely manner (Haigh 2012). Non-profit organizations, who are similarly private actors, can help fill existing and emerging gaps in critical services. For instance, in a major event such as the 9-11 attack in New York, private non-profit actors can ensure critical services for groups such as undocumented migrants and their families who are reluctant to use public emergency services (Kapucu 2007).

Develop Methodologies to Prioritise Critical Infrastructure

Prior to a disaster, developing a methodology to prioritize which critical infrastructure should be a focus of recovery and rebuild helps to enable critical services continuity. As effective rebuilds are often based around a single infrastructure asset (such as a water supply system), developing the methodology for choosing that asset prior to a shock can save time and facilitate continuity of services (Liu 2016). This strategy can combine technical and social factors as well as community involvement.

Impeding Factors

Role of Disaster Management Units

Structural and capacity limitations can prevent crisis management approaches from considering longer-term resilience considerations. According to Robert 2010, there is a mismatch between the role of crisis management units and climate change problematics, where the first is seen to have a reactive and not proactive function. The same is observed in London regarding heat wave plans (Zaidi 2015) and for urban sustainability implementation in Eskilstuna, Sweden (Sellberg 2015).

Incompatibility Between Private Responses to Crisis Situations

While private actors can enable the continuity of critical services following a disaster, the efficacy of their work can be impeded by lingering incompatibilities. The use of private contractors, particularly ones from outside the affected region, can undermine local leadership, stymied economic development and lead to culturally inappropriate results (Haigh 2012). Other elements that may be needed to attract private actors to respond and help ensure the continuity of critical services—such as no-bid contracts on the basis of pre-award authorization—can lead to soaring costs and impaired accountability—as was the case in the Hurricane Katrina recovery (Gotham 2012).

Data Gaps Following Disasters

The continuity of critical services following a disaster can also be impeded by major gaps in data (Horney 2016). As different assessment teams begin work to ensure continuity of services, gaps in integrated documentation mechanisms can result in inconsistent formats and incomplete data. These gaps can, in turn, limit how helpful different data sets are in guiding recovery operations (Liu 2016).

Coordination Shortcomings

While participation of the broader community in pre-disaster recovery planning can enable continuity of critical services, this process may be impeded by challenges of coordination. The individuals emergency managers wish to engage in recovery planning may find it difficult to participate because of work

commitments, lack of transportation to community meetings, or lack of awareness that such processes are underway (Horney 2016). Shifting from coordination of the general public to coordination of private non-profit actors, efforts may be hindered by the absence of interagency networks for communication, diverse priorities, lack of experience or lack of trust (Kapucu 2007).

Missing Financial Markets

Having pre-established finance facilities to ensure continuity of critical services is an enabling strategy, but it may face barriers if these financial markets are absent. In the context of slow-onset risks, the large-scale impact of these events and their recurrent nature may obstruct the pricing and insurability of risk (Kehinde 2014). In developing countries, lack of awareness or insurance mechanisms on the part of officials, or lack of data on risk exposure for insurers, may lead to gaps in insurance availability (Kehinde 2014).

Lack of realism of the existing plans

Even when plans exist to address different crisis situations, the success of those plans depends on the easiness to execute those plans and relate them to everyday work of the concerned professionals (Storsjö 2017).

Trade-offs

Ensuring the continuity of critical services following a disaster can involve numerous trade-offs. These relate to areas such as community involvement and local contractor engagement. Energy is a service on which lie multiple interests, such as sustainability, price and viability. Choices have to be made between technologies that offer different levels of adaptive capacity to climate change, environmental impact, price considerations and long-term viability, each choice involving trade-offs.

In ensuring continuity of critical services following a disaster, a tension may emerge between efficiency and community involvement. Managers may be torn between the desire to undertake reconstruction quickly, and interest in engaging communities throughout the process (MacAskill 2016). Alternatively, where managers may be driven by an interest in building back better (BBB), in the immediate aftermath of a disaster they may face the competing desire among residents to return to “normal” quickly (Berke 2009). Moving from time to skills, though communities may not have the skills to engage in reconstruction, a failure to involve them can lead to a rebuilding of services that are not suited to their needs (Hayat 2014). While a rebuild project prioritisation methodology can provide policy makers with solid information upon which recovery plans could be built, there are trade-offs related to time, expense and efficacy (Liu 2016).

Reconstruction following a disaster often suffers from a lack of available local resources, and increasing recourse to external companies and experts. Especially in less developed countries, there is a tension between timely reconstruction and the desire to utilize and develop local capacity (Haigh 2012). A tension emerges where, on the one hand, there is fear that “overseas construction enterprises would use the disaster as an opportunity to enter a new market and secure a long-term presence in the area, thereby potentially disadvantaging local enterprises; on the other, they appeared keen to secure long term engagement of enterprise through fear of being left with unsustainable buildings and infrastructure that the local communities would be ill equipped to maintain” (Haigh 2012). Responding quickly can undermine long-term capacity prospects. Developing long-term capacity through recovery can hinder the continuity of critical services.

3.4.3 Provides Reliable Communication and Mobility

The CRF presents diverse and affordable transport networks, along with information and communications technology, as key elements of reliable communication and mobility. While the evidence base on resilient transportation is sparse, literature on communication provides some insight into enabling strategies, impeding factors and trade-offs.

Enabling Strategies

Complementing Communication Systems with Response Training

The evidence indicates that communicated messages are more effective when complemented by training for local people around what to do when those warnings are triggered. Where individuals are trained by responders on how to react to warning signals, and actions to be taken by the community are clearly defined, communication is more effective (Alhmoudi 2016, Motta 2014).

Redundant and Automated Communication Systems

In an emergency, overlapping and redundant communication systems can help ensure that warnings are received. Evidence from Rio de Janeiro has highlighted the effectiveness of overlapping mediums such as cell phone warnings and community siren systems to communicate warnings (Motta 2014). Additionally, risk-monitoring systems, such as weather stations, that can automatically disseminate information to key decision makers can enhance response mechanisms (Gupta 2007).

Community-Sensitive Communication

In multi-ethnic and multi-cultural societies, risk information will not be understood in the same way by all people. One study noted the role that targeted and tailored strategies play in ensuring that minority ethnic groups and vulnerable members of the community receive useful risk information (Mullins 2013). Such bespoke means of sharing information are helpful to meet the needs of different ethnic and cultural groups.

Social capital and access to information

A high social capital in a community can increase the access to new information, essential for developing adaptive capacity (Pelling 2011).

Impeding Factors

Narrow Communication

Though few studies discussed impeding factors to communication, one paper discussed the narrowness of communication. In terms of the communication strategies used, overreliance on any one communication method or plan can impede communication (Alhmoudi 2016). In terms of the direction of communication, horizontal communication between organizations that does not reach down to the population, and the absence of community participation in emergency response exercises, can impede this driver (Alhmoudi 2016). A lack of communication and communication technologies in governmental organizations can be very detrimental to emergency actions, and is enhanced by State apparatus funding reduction (Garnett 2007).

Medias and the Precision of Information

Medias play an important role in information dissemination during catastrophic events. However, a study of the Katrina Hurricane highlighted how mass media often did not report accurate information, “hindering efforts of evacuation, rescue, aid, and security” (Garnett 2007). The Medias tended to disregard information about racial groups and elderlies, to concentrate on sensationalism and to inflate their role in

the crisis. Another pinpoints how media sources have also been known to exaggerate the intensity of a situation or prioritize fast information over accurate information (Nirumpama 2012).

Infrastructures and mobility

We found only one study discussing of the enabling factors to mobility. It highlights that often, reconstruction concentrates on housing and other similar built infrastructures, neglecting roads and public transportation (Romero 2016). This leads to the reduced connectivity of some regions.

Trade-Offs

A key trade-off identified in the domain of communication relates to the role of the media. While it can play a central role in the transmission of key messages, search and rescue information, evacuation signals and the unification of families following a shock, we have seen how media sources can exaggerate the intensity of a situation or prioritize fast information over accurate information. A tension thus emerges between keeping the media informed during a disaster and the risk that information provided to the media will be used for ends that hinder a recovery effort (Nirumpama 2012).

4.5 Governance and links between dimensions

As mentioned in the coding strategy, we did not code articles in the fourth dimension of the CRF (Leadership and strategy) as we considered these governance issues to be part of all dimensions. In cutting across themes we find that there are three overarching streams which can be harnessed in this review. This first is governance structures, the second is learning from experience and information management and the third is climate change and adaptation.

4.5.1 Governance structures

All extreme events or resilience measures cannot be assigned to one of the themes used above. Governance structures managing those objectives therefore span multiple themes. For example, decisions following a tsunami must be taken in consideration to infrastructures, but also to health, community and economic impacts. Doing so will make sure no consideration is forgotten, but also allow for mutual support between the solicited sectors. Governance is also a shared theme between the different areas of the CRF. Understanding institutions is essential to develop successful solutions. Therefore, we present here the elements fostering and hindering the implementation of general governance strategies working towards resilience.

Enabling Strategies

Inclusive and open governance structures

In all studied areas, the importance of supporting community initiatives and including communities in the design process are stressed as important enabling factors. Allowing for local governments to take decisions during catastrophic events can help to make faster decisions than when the whole national level is solicited (Nakanishi 2014). Local knowledge can also be of major importance for proper decision-making, and can be relied on (Prashar 2013). A number of studies in all three areas highlight how inclusive and transparent governance are beneficial. In addition, a general governance structure favoring resilience implementation will break horizontal (inter-sectoral) and vertical barriers (through different levels of governance) (Wilby 2012) and increase the initiative's visibility (Taylor 2016).

Planning

A common point to all areas is the advantage of enforcing resilience actions in planning. Some papers also suggest that designing actions that are in line with already in place structures, business plans, funding and available skills enhances the chances of success of the given measures (Roberts 2010).

Governance contradictions

Resilience, a long-term project, is often confronted to political and short-term return visions. Contradictions between risk management or resilience strategies appear in all areas of the CRF, between proactive resilience building and reactive event management, emanates from governance structural properties and political culture (Roberts 2010). Many studies highlight the benefits of a governance putting forward a long-term attitude (Sellberg 2015).

Holistic analysis process including governance processes

Whatever the subject of the project, developing an understanding of institutions and their interactions is essential for designing solutions. For example, Zaidi 2015 reveal the complexity of the interactions between the science community, the National Health System, and health and emergency practitioners during a heat wave. Information flow between those entities is crucial. The efficiency of those interactions has a strong impact on the success of the developed interventions.

Impeding Factors

Governance-sited contradictions

A recurrent barrier to implementation is the lack of resources (money, time in the professional's responsibilities, and/or skills) (Taylor 2016, Roberts 2010). Professionals in all disciplines also face a confrontation between urgent but short-sighted duty and long-term resilience goals. Other hurdles of bureaucratic or structural origin, among others, can emanate from institutions (Roberts 2010).

Unclear responsibilities

A governance leading to unclear responsibilities of the various stakeholders will make implementation of complex and broad intentions such as climate change adaptation and resilience less likely to be managed (Taylor 2016).

Trade-Offs

Local vs centralized governance

Many studies point to the benefit of relegating power to local governments regarding resilience. However, an increase in local capacities does not always lead to risk-reduction and positive impacts on communities. In turn, a centralized government supporting the right local initiatives can have a strong influence on transformative capacities (Revi 2014). Moreover, resilience at one scale can impede resilience at a lower or higher scale (Wilkinson and Wagenaar 2012:4).

4.5.2 Learning and information

A point common to many of the above themes is the importance of learning from experience, and how to harness knowledge learned from experience and from experiments from other cities to increase resilience. Data and information is also a recurrent point throughout the themes. We here present the enabling and hindering factors associated with learning mechanisms and information management.

Enabling Strategies

Learning from experience

Examples of successful initiatives can be an efficient accelerator of urban resilience, for example by learning from international experiences (Sharma 2016). Moreover, efficient planning needs to include a strategy for organisational learning and experimentations (Fitzgerald 2017). This inevitably relates to the governance structure of cities, which need “effective political organization and receptive political systems with the capacity both to respond positively to citizen and to learn” (Satterthwaite 2013).

Communication as a key to learning

While the importance of learning processes is confirmed by a number of studies, some factors can facilitate them. Cross-sectoral relations enable professionals to share their experience about plans and implementation of similar processes (Taylor 2016). Another approach is learning-by-doing. One research studying large cities in Asia that this method helped the professionals to obtain a better comprehension of the complexity of the stakes, and fostered innovation to respond to those challenges (Orleans 2013). The professionals, carrying their knowledge about local specificities, can then develop efficient solutions (Wagenaar 2013).

The importance of awareness

In all areas, studies show the importance of raising awareness to the problem. This is true for the population in general, as well as for the concerned professionals. If a concept (climate change, resilience, etc.) is absent from a political agenda or an institutions’ terminology, its implementation will be slowed down (Taylor 2016). More concretely, plans are useless if they are not communicated and explained to the concerned professionals, and this tends to happen often (Zaidi 2015).

Impeding Factors

Dealing with complex information

Open information sharing and community consultation is not always easy. Learning and information sharing strategies encounter challenges for heterogeneous populations with different cultures, affluences and education (Orleans 2013). Moreover, a lack of comprehension of complex concepts such as uncertainties related to weather and climate, (Taylor 2016) or climate change’s long term and vague implications (Roberts 2010), can be a barrier to implementation.

Trade-Offs

As we have seen throughout the analyzed themes, trade-offs emerging from urban resilience implementation are numerous and can have important consequences on some populations. Communication with stakeholders and transparency is a solution to minimize those unexpected outcomes (Orleans 2013). Also, local knowledge has been mentioned many times to be essential for quality solution-building. However, there are risks associated with the interpretation of local data by external researchers, which urges for a co-production of knowledge (Orleans 2013).

4.5.3 Climate change adaptation as an overarching theme

One overarching subject encompassing all three themes (economy & society, health & wellbeing, and infrastructure & environment) is adaptation to climate change. To implement adaptation, actions in all those three themes must be done. Therefore, an enabling factor of climate change adaptation is to use those themes and concrete actions as entry points for the latter, facilitating bureaucratic implementation (Funfgeld 2014). Such actions will face the contradictions between short-term risk-reduction actions and the longer-term climate change adaptation timeline. Climate change, by its complex nature, has to be addressed cross-sectorally (Roberts 2010).

Taking advantage of opportunity windows

A way to accelerate climate change resilience is to exploit its relation to events that have struck the population, such as hurricanes (Pelling 2011) or volcanic eruptions (Penalba 2012). However, real resilience will be achieved through careful planning, which requires time (Vallance 2012).

5. KNOWLEDGE STRENGTH AND GAPS

The results section represented a close look at the evidence related to urban resilience. In this section, we shift our focus to a broader scale, zooming out from the empirical details to survey the broader trends, strengths and gaps in the literature on urban resilience. The following sub-sections present some noteworthy observations into areas such as dominant focuses with the urban resilience literature, problems with the evidence in this domain, and gaps in lines of inquiry. We begin with how the ‘community-level’ is focused upon in the urban resilience literature.

A Focus on Communities and the Associated Blind Spots

Prominent within the literature are articles that focus on community resilience at a local level. Be it the efficacy of narratives in empowering local resilience (Goldstein 2015), the role of dialogue in fostering urban resilience (Henceroth 2015), or the part that local culturally specific networks can play in disaster response (Kenney 2014), there is a rich and diverse literature that establishes evidence of programs and practices that can be effective in developing urban resilience at the local level. Research at this scale is more dense and deep than research at other scales within the urban resilience literature.

Within this community-focused research, there is a tendency for studies to focus on enabling strategies and impeding factors for enhancing community resilience. Largely absent, however, is a consideration of the trade-offs involved in focusing on a community rather than a city-wide or larger scale. For instance, while the resilience and DRR literature has long been critical of a top-down approach to risk management and disaster response, what trade-offs might emerge when shifting to a highly local and decentralized approach to resilience? A take-home message for practitioners—understanding that urban resilience operates at different scales—is not to lose track of the ‘forest’ when looking at the ‘trees.’

A Growing Importance of Networks

Shifting to the interconnections that play out across networks, there is an awareness in the literature of the role that inter-city networks can play in urban resilience. Nigg (2006), for instance, highlights how a city that experienced a shock could rely on nearby cities with whom it had network relationships to help accommodate its temporarily displaced persons. At a broader administrative level, work such as Martins’ (2011) study shows how transnational municipal networks can promote and help implement climate change action. By contrast, he also considers the constraints that can be engendered by such linkages. Beyond city administration, other work such as that done by Hope (2016) considers the role that networked urban universities can play in fostering sustainable cities. The fostering of networks by donors/foundations has also been considered in this space. Practitioners may stand to gain considerably by using and building networks as they develop strategies for urban resilience.

Trending Towards Trade-Offs

Much of the urban resilience literature discusses factors that enable resilience. A smaller, though still notable portion of the literature engages with elements that obstruct urban resilience or constrain the

efficacy of enabling factors. Typically, however, the literature has been less concerned with the trade-offs involved in resilience programming, or trade-offs that emerge when decisions are made concerning resilience. Where papers consider constraints or obstacles, the elements invoked are often broad or vague. The obstacle of ‘politics’ is a notable example, where the elements within this black box are not deeply discussed. Literatures on other social goods, such as health or education, include deeper consideration of politics, looking at popular movements, lobby groups or political activism; resilience research deals in only very general terms with politics as a constraint.

The shortage of research considering trade-offs, however, seems to be changing, with a growing number of articles examining the effects that choices and programs to build resilience in one area might have on other domains. Meerow (2016), for instance, presents a hypothetical case of green infrastructure in Los Angeles to highlight how the impact of resilience decisions creates both spatial and temporal trade-offs with roots in politics and impacts on equity. Even papers that do not specifically address trade-offs raise issues that open avenues for future research enriched by this lens. In Gotham (2012), the notion of no-bid contracts is broached in relation to disaster response. While presented as a negative development, a thorough analysis of the trade-offs involved in their use could support policy makers in determining contexts in which these contracts might be appropriate, and instances where they are best avoided. The focus on trade-offs can be a rich source of insights for urban resilience practitioners; it helps expose the consequences of certain actions, and allows decision makers to realistically engage with the competing interests at play. This paper has worked to synthesize what knowledge can be found on trade-offs in the domains of urban resilience in the hopes of contributing to a trend that stands to greatly support the work of practitioners.

Circular Reasoning in Resilience Evidence

Within the urban resilience literature, there is a tendency to present ‘results’ that are based on output indicators rather than outcome indicators. While an output represents the completion of a task—such as the building of a school—an outcome is the impact that results—such as any associated rise in literacy. In the urban resilience literature, these indicators are not often explicitly distinguished. For instance, based on UNISDR’s Making Cities Resilient “10 essentials” for making cities resilience, governance for disaster risk reduction is defined as a factor contributing to resilience. Based on this factor, Johnson 2014 provides a list of cities that have reported that they have taken actions towards this factor, thus building resilience. But just as ‘building a school’ does not necessarily ‘increase literacy,’ establishing resilience governance committee will not necessarily build resilience. There is a risk that this circular reasoning in the evidence of resilience can lead to the perpetuation of ineffective approaches or even approaches that have negative effects on urban resilience.

The Underlying “Normativity” of Papers

‘Most prior research dedicated to resilience’ suggests Sciulli ‘is prescriptive and normative’ (2015). The results of our scoping review support this statement. Our inquiry has shown that a great many papers are “normative” in their approach to resilience in that they are often steeped in a particular moral outlook and regularly directive in their conclusions. By normativity, we mean that authors tend to make value judgements about what practitioners “should” or “need to” do. This normativity is widely invoked to the detriment of evidence, hindering the capacity to make generalization. Cities are looking for expertise to determine which strategies to adopt and assess which changes are required to reach their adaptive potential (Revi et al., 2014). New knowledge must also be developed to handle complex problems involving multiple actors. Evidence and knowledge developed by internal and external experts can leverage

transformations and advocate the development of new policies (Scolobig et al., 2014). By telling practitioners what they “should” or “need to” do, a wealth of alternatives are lost and the value of this research in providing practitioners with the capacity to weigh priorities and trade-offs when making complex decisions is curtailed. The question of enabling and impeding factors to resilience implementation is by definition normative. However, this review paper does not aim to determine what practitioners “should” do or to single out an ideal approach applicable to all situations. It rather seeks to gather in one place the empirically shown evidences, independently of their context, and to see if some similarities emerge, by themselves and not by a scaling up procedure.

The Overall Capacity of the CRF to Enable Practitioners

In recent years, though a number of frameworks for measuring urban resilience have been developed, none have been able to achieve strong consensus (Normandin et al., 2009; Therrien et al., 2015b), and few pay sufficient attention to the interrelation between indicators (Normandin and Therrien, 2016). While the CRF provides a credible framework for thinking about urban resilience, there is a disjuncture between its structure and the way the literature is organized. Whereas papers will often link two or three drivers in the different domains following patterns linked to underlying complexities and mindful of empirical contexts, a CRF style framework tries to aggregate data to provide more generalizable lessons. Identifying gaps within a comprehensive framework like the CRF is important as practitioners need to look to a diversity of different domains in constructing their resilience strategies. Given the important role that a constant learning process can have in urban resilience (Matyas and Pelling, 2014), the CRF framework can serve as a guidebook for the development of an evidence-based urban resilience “curriculum.”

A Clear Absence of Institutional Factors to Support Implementation

The development of urban resilience has the potential to transform urban governance by emphasizing horizontal work across municipal offices, by working through broader civil society networks and by challenging siloed approaches to governance. This potentially transformative implementation raises issues of power and hierarchical positions and poses questions related to management by administrations and also political positioning and leadership. Cities are interdependent systems that do not necessarily work concertedly. Often, they muddle through problems as they seek solutions and rethink governance. They face challenges considering that individual organizations have their own objectives and mandates to fulfill. Unfortunately, the empirical research on urban resilience does not say much on actual governance mechanisms and institutional factors. Many papers call for multi-scale, multilevel, multi-stakeholder approaches but very few provide insights into the actual capacities and mechanisms that would be needed to activate these. The lack of institutional factors in the urban resilience literature is a clear absence that potentially glazes over a depth of impeding factors and trade-offs.

A Clear Absence of Longitudinal Studies

The interest in urban resilience seems to be catching on in many cities throughout the world. Though the definition and all the outcomes might not be completely clear for urban resilience practitioners or scholars, it must be remembered that the concept of resilience applied to the urban sphere has only been around for approximately 15 years. Considering the early state of inquiry into urban resilience, there is an opportunity for research projects be constructed as longitudinal studies. At present, however,—as our analysis of the research on urban resilience reveals—such longitudinal studies are clearly absent. Nonetheless, longitudinal studies could be an important tool to better understand how cities and their people are affected

by shocks and stresses and a key instrument in developing an evidence base of effective ways of addressing a new age of complex, ‘wicked’ problems.

CONCLUSION

The objective of this Knowledge Synthesis review was to assemble and analyze the evidence from empirical studies focused on urban resilience implementation. In this review, 188 papers were analyzed and their findings organized based on the City Resilience Framework—an urban resilience framework used by many city actors in their work to implement urban resilience. In order to help urban resilience practitioners to make evidence informed choices and to better caution them about issues where claims are less supported by evidences, results were explored through a frame of enabling strategies, impeding factors and trade-offs.

Our results show that evidence within the urban resilience dimension of Infrastructure and Environment is the most developed, followed by the Economy and Society dimension. The Health and Well-being dimension of urban resilience has been treated more superficially within the resilience explicit literature. The overarching concept of governance (identified as Leadership and Strategy in the CRF) is mostly superficial, failing to discuss in substantive ways actual governance mechanisms and institutional factors.

Urban resilience implementation deals with complex issues and wicked problems which are tightly coupled across many dimensions of city governance. For city actors tackling these important 21st century challenges, a richer understanding of the enabling strategies, impeding factors and trade-offs of urban resilience can support their decision making and help them solve these ‘resilience-puzzles’ in their respective contexts.

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