

Enabling strategies and impeding factors to urban resilience implementation: A scoping review

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Abstract

Despite growing interest in urban resilience, there is a significant gap between discourse and the capacity to develop resilience in practice. This scoping review assembles and shares evidence and insights from empirical studies of attempts to implement urban resilience published between 2005 and 2017. More precisely, it seeks to identify enabling strategies, impeding factors and trade-offs in the implementation of urban resilience. Findings are presented along the dimensions of urban resilience detailed in the City Resilience Framework (ARUP/Rockefeller Foundation): Health and Wellbeing, Economy and Society, Infrastructure and Environment, and Leadership and Strategy (which we present as a cross-cutting theme). While some enabling and impeding factors in implementation are associated with a specific dimension, others are common to all three. Across dimensions, we find that transparent, inclusive and supportive governance reduces the risk of negative impact that resilience implementation will have on communities. Conflicting priorities of managing risk and meeting short-term needs are found to diminish the potential for transformative resilience action. Integrating risk into planning appears as a promising strategy in all dimensions of resilience. Trade-offs are found in resilience implementation, and range from adverse effects associated with infrastructure to power imbalances when the power to implement resilience privileges one system level over another.

KEYWORDS

enabling strategies, impeding factors, implementation, trade-offs, Urban resilience

1 | INTRODUCTION

In the face of increasingly unpredictable urban futures, replete with increasing numbers of disasters and ever-greater financial consequences (Garschagen et al., 2016; OCDE, 2003), urban resilience has emerged as a potentially relevant response. The resilience platform is broad and ambitious, promising a better ability to save lives (especially among the vulnerable), protect the environment and reduce economic losses. Moreover, it has been suggested that urban resilience, by supporting innovation and learning, will reduce risk and help societies adapt to emerging challenges.

Encouraged by this potential, the concept of resilience has received support from international organizations (UN, 2005a, 2015b),

governments (Ministry of Public Security, 2014; Public Safety, 2011) and philanthropic organizations (Rockefeller Foundation & Arup, 2015), and many cities now include dedicated resilience offices. The practitioners charged with bringing the concept into being in a particular context require evidence on how best to implement resilience.

To date, the literature on urban resilience includes syntheses and conceptual papers that attempt to better define urban resilience theoretically (Bahadur, Ibrahim, & Tanner, 2013; MacKinnon & Derickson, 2013; Meerow, Newell, & Stults, 2016). Recent studies allude to the magnitude of transformation required for the implementation of resilience at different levels (Coaffee, 2013, 2013b; Goldstein, Wessells, Lejano, & Butler, 2015; Matyas &

Pelling, 2015; Pelling & Manuel-Navarrete, 2011; Ross, 2013; Scolobig, Linnerooth-Bayer, & Pelling, 2014; Stark, 2014). Some suggest that resilience policies require the development of new adaptive capacities (Matyas & Pelling, 2015; Stark, 2014), others point to the cultural and structural changes in public administration that may be needed to move from a “stovepipe” approach to collaborative networks (Bourgon, 2009; Therrien, 2010; Therrien, M. C., Matyas, E. D., Usher, S., Jutras, M., & Beauregard-Guérin, I, 2017), while at the organizational level, conceptual shifts have been suggested, such as reframing recovery within resilience from the notion of “bouncing back” to attaining a “*new normal*” (Darkow, 2017). Case studies on resilience in socio-ecological systems have also highlighted the possible advantages of developing networks of actors capable of working together. Further, it has been advanced that in some circumstances, incremental adjustments or transformative change may be critical to effectively confronting risk across multi-level urban risk governance, policies and incentives; relations with the private sector; and financing and institutional development (Pelling, 2010; Revi et al., 2014). On the flip side, factors like asymmetries in power, varying incentives for collaboration and different interpretations of, and levels of interests in, resilience have been identified as elements that may negatively influence these relationships (Lebel et al., 2006; Pelling, 2003, 2010; Pelling, High, Dearing, & Smith, 2008; Valiquette L'Heureux & Therrien, 2013).

Beyond this conceptual scholarly focus, however, lies a gap in the evidence for developing resilience in practice (Pelling & Manuel-Navarrete, 2011; Wagenaar & Wilkinson, 2015). City officials who are guided in their efforts by resilience frameworks (City Resilience Framework [CRF] by Rockefeller & Arup, 2015; Resilience Alliance, 2007) and indices (Cutter, Burton, & Emrich, 2010; Normandin, Therrien, & Tanguay, 2009; Therrien, Beauregard, & Valiquette-L'Heureux, 2015; Therrien, Normandin, Paterson, & Pelling, 2015; Therrien, Tanguay, & Beauregard-Guérin, 2015) lack a clear picture of strategies and programmes that can facilitate urban resilience and barriers that may inhibit these efforts. There are significant opportunities for practitioners to learn from each other's experiences.

This paper seeks to contribute to the discourse and praxis of urban resilience by delving into the empirical evidence base behind this concept. While there is a long tradition of research on the implementation of elements related to urban resilience—for instance, disaster risk reduction (DDR) strategies and urban climate change adaptation approaches—there has not, as yet, been a knowledge synthesis focussed explicitly on the results of empirical studies of urban resilience implementation. The newness of the concept and its conceptual breadth may help explain this gap. Still, with cities being advised to work across siloes and develop resilience holistically, practitioners are increasingly searching for an evidence base that allows for more integrated resilience implementation. To that end, the present paper brings together and analyses evidence and insights arising from empirical studies of attempts to implement urban resilience.

To structure the evidence from these studies, our findings are categorized according to the CRF (ARUP developed/Rockefeller Foundation funded). 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” (Rockefeller & Arup, 2015, at 2). While this framework is not the sole urban resilience framework and is not necessarily referenced by the empirical studies reviewed, it has become a widely used schema to frame the efforts of cities, notably those involved in The Rockefeller Foundation's 100 Resilience Cities initiative. Accordingly, by categorizing findings based on CRF dimensions of urban resilience, we hope that this study is more usable by urban resilience practitioners.

In Section 2, we provide a description of the methodology used in the scoping review. Section 3 presents results from empirical studies, sub-divided to focus on the CRF's four dimensions of urban resilience: Health and Wellbeing, Economy and Society, Infrastructure and Environment and Leadership and Strategy. Each dimension is explored by looking at enabling strategies, impeding factors and trade-offs. In Section 4, we discuss the state of evidence on implementing urban resilience, examine trends in the literature and highlight research gaps. Finally, to conclude, we propose avenues for future research.

2 | RESEARCH APPROACH

This paper sets out to answer the question “What are the facilitators, barriers and trade-offs in the implementation of urban resilience?” To answer this question, we undertook a scoping review of the academic literature. This section details the search strategy, coding method and analytic framework.

2.1 | Search strategies

The researchers chose to review studies that were published between 2005—the publication date of the Hyogo Framework for Action (HFA): Building the Resilience of Nations and Communities to Disasters—and 2017—when we undertook the study. The literature thus spanned the duration of the HFA (2005–2015) as well as the initial years of the 2015–2030 Sendai Framework for DDR. These frameworks are self-styled “global blueprint(s) for DDR,” and represent moments of significant government (and scholarly) interest in, and commitment to, the theme of resilience and the reduction of disaster risk. While earlier work on urban resilience exists, this study seeks to capitalize on a time period when the concept was receiving increased attention through these United Nations initiatives.

We began with a search on Google Scholar for scientific articles and books with the term “urban resilient*” in the title: 1,120 records were identified, and review by title and abstract undertaken by two members led us to retain 158 records. Two members of the research team (MCT and SU) independently reviewed these retained articles, 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 of the following reasons: (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: (a) *resilien** AND ((urban OR city) AND (institution OR governance)) AND (disaster OR crisis OR catastrophe); and (b) *adaptati** AND ((urban/city) AND (institution OR governance)) AND (disaster OR crisis OR catastrophe), identifying 1,506 records. There was significant overlap between articles found with these two search terms. Review by title and abstract led to the identification of 258 new records from the Emerald search, one third of which were book sections. Searches in Sage, ProQuest and JSTOR databases used only the first search term in abstract, identifying a total of 115 records.

Following discussion among three members of the research team (MCT, SU and DM), a pointed search was then undertaken in JSTOR to identify papers dealing with financial, insurance and legislative aspects of resilience. This search proved difficult and no combination of these terms coupled with the terms used in the above searches was able to narrow results in a useful manner. Multiple search results were scanned for potentially relevant articles, leading to the addition of 34 records.

The records from these database searches were combined with the records from the initial Google Scholar search, for a total of 496 records. Article review by two researchers and discussion around divergences in coding led to the retention of an additional 99 records from the second-round searches, bringing us to a total of 188 records included in analysis. Inclusion and exclusion criteria were the same as in the initial review stage. A major challenge was found in distinguishing empirical findings from normative statements, which abound in this literature.

2.2 | Coding and analytic framework

To identify useful categories for analysis, each of the three researchers separately reviewed the key messages in a sample of papers dealing with major multi-city resilience efforts. Difficulties were acknowledged in combining the “preparedness-response-recovery” efforts involved in resilience; the different domains of resilience (i.e. transport, health, security, economy, social capital); and the facilitators, barriers and trade-offs involved in implementation.

While numerous frameworks for presenting findings were possible—each with their own advantages and limitations—the researchers decided on the widely used CRF framework. As a basis for the Rockefeller Foundation's 100 Resilient Cities initiative, this framework has widespread visibility amongst urban resilience practitioners, which would make it easier for the findings of this study to support their work.

The CRF outlines four dimensions of urban resilience, which are in turn supported by 12 drivers of resilience. These dimensions are as follows: (a) Health and Wellbeing; (b) Economy and Society; (c) Infrastructure and Environment; and (d) Leadership and Strategy. While the CRF has four dimensions, our codification centred on the first three. We observed early in our coding that the Leadership and Strategy component of the CRF was integrally involved in all three other dimensions. Thus, we did not code Leadership and Strategy findings separately, but instead explored it as a cross-cutting theme.

Across each dimension, the three researchers worked to disaggregate the data based on enabling strategies, impeding factors and trade-offs. *Enabling strategies* are approaches that allow for the actualization of a given driver or dimension of urban resilience. They are elements that facilitate crisis resolution and mobilization to confront risks, such as situation awareness, trust, mindfulness, collaboration, deference to expertise, general agreement and perceived interdependence (Berthod, Müller-Seitz, & Sydow, 2014; Ginter et al., 2006; Roe and Schulman, 2008; Roberts, 1989; Therrien, Tanguay, et al., 2015). *Impeding factors* are elements that act as barriers to a given driver or dimension of urban resilience. They can refer to organizational values, resources, rules and relationships that increase vulnerability (Therrien, 2010; Therrien, Tanguay, et al., 2015). Impeding factors can also be linked to elements identified in institutional work related to the survival of routines, compliance rules, institutional assumptions, etc. (Lawrence and Suddaby, 2006 at 215). *Trade-offs* represent the tensions that may arise through implementation decisions. While urban resilience is often referred to as a positive attribute, or “win-win” proposition (Anguelovski et al., 2016; Wilkinson, 2012), the notion of trade-offs acknowledges how an action to build resilience at one scale (be it in time or space) can have negative consequences on another (Chelleri, Schuetze, & Salvati, 2015; Chelleri, Waters, Olazabal, & Minucci, 2015). Time trade-offs often require managing transformations over time and assuring their persistence (Pelling, 2010). Space trade-offs often appear in debate around equity and social justice (Anguelovski et al., 2016). Trade-offs, and enabling and impeding factors, are used in this paper to highlight elements that will help decision-makers improve implementation practices and processes.

With a matrix of three dimensions of urban resilience and three analytic tools in enabling strategies, impeding factors and trade-offs, the researchers coded the selected papers using NVivo.

3 | RESULTS

In this section, we probe the empirical research along the CRF dimensions of urban resilience to answer three main questions: (a) What implementation strategies have been identified that enable resilience in each of these dimensions? (b) What factors create barriers to resilience in each of these dimensions? and (c) What trade-offs emerge as resilience initiatives are implemented? Through these three lenses, we can glean insights into the existing evidence on how

TABLE 1 Enabling strategies, impeding factors and trade-offs of urban resilience implementation: Health and Wellbeing dimension

City Resilience Framework domain and driver	Enabling factors: implementation strategies that support health and wellbeing as a driver of resilience	Impeding factors: implementation elements that compromise health and wellbeing as a driver of resilience	Trade-offs in implementation
Health and Wellbeing			
Livelihoods and employment	Inclusive governance and bottom-up strategies to consider priorities of communities and marginalized residents (1) Financial and insurance tools to spread risk and protect against loss of assets and livelihoods (2) Investment in education to diminish poverty and population vulnerability (3)	Disruption of social networks through land-use policies (4) Failure to consider inequalities when shifting responsibility to households (5) Inadequacy of local measures alone to address vulnerabilities related to human resources and economic development (6) Reliance on short-term solutions without long-term investment (7) Diminished state capacities during reconstruction (8)	Emphasis on “win-win” solutions, especially in adaptation, obscures uneven costs and benefits across different groups, spaces and times (9)
Public health services	Public health and emergency preparedness research networks to create evidence-based tools (10) Use of community resilience frameworks to align emergency preparedness, public health and health care (11) Embed public health agents in local communities (12) Use of community engagement strategies that couple communication with opportunities for participation (13)	Treatment of preparedness as an add-on in public health training (14) Lack of pro-activity in disaster management (15) Lack of consideration for healthcare facilities in disaster management strategies (16)	Urban density allows for more resources, but also a faster spread of disease and more difficult evacuation and provision of relief (17) Performance imperatives on healthcare and public health resources work against resilience during crises (18)

Note: (1) (Anguelovski et al., 2016; Brown et al., 2012); (2) (Kehinde, 2014); (3) (Lizzaralde, 2014); (4) (Brown et al., 2012); (5) (Anguelovski et al., 2016); (6) (Bornstein et al., 2013; Brown et al., 2012); (7) (Lizzaralde, 2014; Sciuili et al., 2015; Tadele & Manyena, 2009); (8) (Bornstein et al., 2013); (9) (Anguelovski et al., 2016; Chelleri, Schuetze, et al., 2015; Chelleri, Waters, et al., 2015); (10) (Leinhos et al., 2014; Qari et al., 2014); (11) (Plough et al., 2013; Qari et al., 2014); (12) (Motta et al., 2014); (13) (Drakaki & Tzionas, 2017; Plough et al., 2013); (14) (Plough et al., 2013); (15) (Roberts, 2010); (16) (Carthey et al., 2009); (17) (Siri et al., 2016); (18) (Carthey et al., 2009; Plough et al., 2013).

decisions made during the implementation of resilience policies and initiatives affect drivers of resilience in three of the Arup dimensions: the health and wellbeing of urban populations, the economic and societal systems that underpin collective life, and the planning and leadership that assure protective assets.

3.1 | 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” (Rockefeller & Arup, 2015 at 3). This dimension is supported by three drivers: (a) meets basic needs; (b) supports livelihoods and employment; and (c) ensures public health services.

The evidence presented here should be understood as reflecting how resilience academics and practitioners have considered health and wellbeing, rather than as a comprehensive evidence base on this dimension. 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, etc.; however, it has received little attention to date in the resilience-branded literature. The absence of the “Meets Basic Needs” driver from the analysis reflects the tendency for research to discuss

basic needs alongside other drivers, notably in the Economy and Society domain.

Table 1 presents findings in the literature on elements of resilience implementation that enable or impede two drivers of urban resilience: livelihood opportunities and public health services (Rockefeller & Arup, 2015, at 3). Policy areas with an impact on these dimensions range from resilience planning, investment, land use and insurance, to education, research, public health, community engagement and disaster management.

3.1.1 | Livelihoods and employment: enablers and impediments found in resilience implementation strategies

Around the “supports livelihoods and employment” driver, several enablers were found in resilience implementation strategies. Inclusive and transparent approaches to resilience building at the local level can reduce the risk that resilience projects will negatively impact livelihoods. Strategies such as iterative planning can help marginalized urban residents engage with resilience planning and ensure their livelihood interests are taken into account (Anguelovski et al., 2016). Using such bottom-up strategies increases the likelihood

that a community's priority issues are considered (Brown, Dayal, & Rio, 2012). Innovative financial protection and insurance tools can provide security against loss of assets and livelihoods by spreading risk. Further, investment in general education was found to reduce population vulnerability by supporting employment and diminishing poverty (Lizzaralde, 2014).

The literature also reveals a number of implementation factors that risk impeding resilience in livelihoods and health services. Land-use policies focussed on relocating vulnerable communities to reduce their exposure to risk can disrupt social networks and livelihoods (Brown et al., 2012). As well, these policies are often enforced unevenly, privileging developers and wealthier residents (Anguelovski et al., 2016). Policies that devolve responsibility for implementing adaptive measures to households often fail to recognize inequalities in the ability to take on this burden without compromising livelihood activities (Anguelovski et al., 2016). There is also some evidence that local measures alone are insufficient to address vulnerabilities related to economic development, especially when households are trying to diversify their livelihoods away from climate-threatened sectors (Brown et al., 2012) or recover following a disaster (Bornstein, Lizzaralde, Gould, & Davidson, 2013). However, in recovery efforts, state capacity to support local efforts may be diminished (Bornstein et al., 2013). Short-term solutions are often preferred by decision-makers over long-term investment that could have a greater impact on livelihoods in both recovery efforts and in the adaptation of infrastructure and services, where austerity measures limit public expenditures (Lizzaralde, 2014; Sciulli, D'Onza, & Greco, 2015). Lack of sufficient long-term investment can undermine risk reduction and mitigation programs in areas that require long-term efforts, such as food security (Tadele & Manyena, 2009).

3.1.2 | Public health services: enablers and impediments found in resilience implementation strategies

Despite the recognized importance of public health services as a driver of resilience, the resilience-focussed literature offers little guidance on how policy implementation affects services. In particular, healthcare infrastructure has received scant attention in the resilience-focussed literature, 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, Chandra, & Loosemore, 2009). In public health, research emphasizes the need for a systems orientation that involves many disciplines, works towards multiple interventions and leverages community resources to deliver results (Qari, Abramson, Kushma, & Halverson, 2014). This approach recognizes the need for institutional actors to learn from multiple other actors and continually improve their health and emergency preparedness system designs. Research networks are creating evidence-based tools for public health preparedness (Leinhos, Qari, & Williams-Johnson, 2014).

Community resilience frameworks have been found to facilitate the alignment of emergency preparedness, public health and health

care by highlighting the potential for synergistic impacts that reach beyond individual organizational entities (Plough et al., 2013; Qari et al., 2014). The importance of community resilience to the health domain has been recognized in both richer and poorer countries. US Homeland Security places it as a top priority alongside biosurveillance and mass casualty care (Plough et al., 2013), and US 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, Abelheira, Gomes, Fonseca, & Besen, 2014). Schools can also provide a venue for engagement and informing populations. Cuba, for example, includes risk mitigation, prevention and emergency management at different levels of the education system (Lizzaralde, 2014).

Engagement strategies create opportunities for participation and mobilize community efforts. In Los Angeles, a preparedness campaign emphasized social connectivity along with stockpiling emergency supplies, encouraging people to: "Know your neighbours. Plan together" (Plough et al., 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 NGOs and volunteers. Inclusiveness also increased legitimacy and oversight of the distribution of donated resources (Drakaki & Tzionas, 2017).

Implementation factors that impede the contribution of public health services relate to a lack of pro-activity, notably in equipping healthcare facilities to face disasters, and the treatment of preparedness as an add-on rather than an integral part of public health training. In public health organizations, expertise from the first-responder community is imported as an afterthought, with responders viewed as "interloper(s)" (Plough et al., 2013) rather than collaborators. The absence of institutional capacities has been suggested as an impediment to the involvement of multiple departments and sectors in risk assessment and response (Roberts, 2010).

Trade-offs

Across the Health and Wellbeing dimension, resilience policies are often presented as "win-win" solutions. While this framing may boost their political salience, it often obscures the uneven costs and benefits borne by different groups (Anguelovski et al., 2016), notably with regard to livelihoods. 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 et al., 2016). Time frames are also important

TABLE 2 Enabling strategies, impeding factors and trade-offs of urban resilience implementation identified in a review of 188 scientific papers

City Resilience Framework domain and driver	Enabling strategies: implementation strategies that support economic and societal resilience	Impeding factors: implementation elements that compromise economic and societal resilience	Trade-offs in implementation
Economy and society			
Cohesive and engaged communities	Draw information from diverse sources (1) Prevent elite domination of consultations (2) Increase community cohesion through development of capabilities, notably through schools (3) Support community groups (4)	Failure to acknowledge/accommodate opposing priorities (5) Information content and form inappropriate or inaccessible to some residents (6) Disengagement of local actors (competing priorities; "it's government's job") (7)	Discussion of past events raises awareness (action) but also fears (paralysis) (8) Individual resilience (ability to leave) can reduce community resilience (9) Acting quickly versus engaging community (which takes time) (10)
Social stability, security and justice	Information sharing among agencies (11) Enlist community security services (12)	Loss of expertise when services are re-configured to meet a new priority (13)	Security comes at the expense of freedom, privacy (14) Security demands of global elites versus liberty of citizens (15)
Economic prosperity	Spread risk through financial instruments and regulations (16) Support efforts of small- and medium-sized enterprises to manage risks (17)	Business elites with weak links to the city (18) Priorities that compete with risk management (19) Gaps in insurability (20)	Government assistance to promote economic expansion can lead businesses to establish in high-risk locations (21)

Note: (1) (Akama, Cooper, & Mees, 2016; Goldstein et al., 2015; Hendriks, 2014); (2) (Bahadur & Tanner, 2014); (3) (Burnside-Lawry & Carvalho, 2015; Islam & An, 2014; Kapucu, 2007; Lanfranco & Rapisardi, 2011; Motta et al., 2014); (4) (Berke & Campanella, 2006; Cretney, 2016; Henceroth et al., 2015; Kenney & Phibbs, 2014; Motta et al., 2014); (5) (Bahadur & Tanner, 2014; Goldstein et al., 2015); (6) (Akama et al., 2016; Ann Amaratunga, 2014; Mullins & Soetanto, 2013); (7) (Bahadur & Tanner, 2014; Burnside-Lawry & Carvalho, 2015; Mullins & Soetanto, 2013); (8) (Grove, 2014); (9) (Chelleri, Schuetze, et al., 2015; Chelleri, Waters, et al., 2015); (10) (MacAskill & Guthrie, 2016; Mullins & Soetanto, 2013); (11) (Caruson & MacManus, 2006; Coaffee & Wood, 2006); (12) (Kenney & Phibbs, 2014); (13) (Caruson & MacManus, 2006); (14) (Coaffee, 2010); (15) (Coaffee & Wood, 2006); (16) (Burby, 2006; Kehinde, 2014); (17) (Ingirige & Wedawatta, 2014; Karanth & Archer, 2014); (18) (Hobor, 2015); (19) (Cole, 2004; Ingirige & Wedawatta, 2014); (20) (Kehinde, 2014); (21) (Burby, 2006; Hobor, 2015)

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, Schuetze, et al., 2015; Chelleri, Waters, et al., 2015).

Health-related trade-offs are also evident in the literature. The urban space itself presents trade-offs, where high population density allows for better communication linkages and medical and emergency infrastructure, but also enables faster transmission of disease and complicates evacuation and the provision of relief (Siri, Newell, Proust, & Capon, 2016). In public health and health care, resource redundancies needed to prepare for and respond to emergency events can represent a trade-off with efficient resource allocation in stable times demanded by stringent performance requirements (Carthey et al., 2009; Plough et al., 2013).

3.2 | 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" (Rockefeller & Arup, 2015 at 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. This dimension, particularly the driver "cohesive and engaged communities," represents a major focus of the urban resilience literature. Table 2 presents findings in the literature on resilience implementation strategies that enable or impede these drivers, along with associated trade-offs.

3.2.1 | Cohesive and engaged communities: enablers and impediments found in resilience implementation strategies

Engaged communities are thought to enable collective resilience (Rockefeller & Arup, 2015 at 3). Studies reveal a number of implementation strategies in risk mitigation, emergency preparedness and post-disaster recovery that contribute to this driver. Communities can be engaged in the assembly of dispersed information, with crowdsourcing becoming more prevalent alongside more traditional consultations (Akama et al., 2016; Hendriks, 2014). Community activities can spread vital information (Ludin & Arbon, 2017) and provide opportunities for people with different perspectives to collectively construct "plurivocal" narratives around risk and adaptation. 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 et al., 2015). Within public consultation processes, using language that is clear and employing cooperative strategies appear effective in preventing elite domination of meetings (Bahadur & Tanner, 2014).

Schools can provide a privileged venue for informing community members, creating cohesion and trust, and developing capabilities. 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 & An, 2014; Kapucu, 2007; Lanfranco & Rapisardi, 2011). The Amadora Resilient Cities campaign in Portugal, for instance, considered that “children are at the centre of the neighbourhood network” (Burnside-Lawry, 2015). In Brazil, parents were involved in school evacuation exercises (Motta et al., 2014).

Support for 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 stronger when pre-existing community initiatives can be re-directed to help with recovery (Cretney, 2016). Local action groups serve as an intermediary between official recovery organizations that have resources and local people who can be engaged in efforts (Berke & Thomas, 2006). Additionally, in a preparedness stage, dialogue around risk assessments may provide opportunities for responders to engage with diverse groups of citizens and leaders, and to develop relationships that set the stage for further collaboration (Henceroth, Friend, Thinphanga, Tran, & Nghiem, 2015). Recovery plans have been shown to be more effective when they integrate local knowledge, and respect and operationalize cultural values (Kenney & Phibbs, 2014).

Regarding impediments, while collaborative decision-making is often presented as a key pathway towards adaptation and risk mitigation, failure to acknowledge and accommodate opposing priorities can impede engagement. Communities may be reluctant to come together around priorities that are principally selected by international aid or consultant groups (Bahadur & Tanner, 2014). Residents may defend the status quo simply because the plan presented to them does not accommodate their vision of change (Goldstein et al., 2015).

The content and the form in which information is shared may also impede the development of engaged and cohesive communities (Mullins & Soetanto, 2013). Information may be too general, or targeted information may leave out certain groups (Akama et al., 2016). Internet communications, for instance, are less costly and can be updated more rapidly, but may not reach individuals who lack adequate connectivity (Ann Amaratunga, 2014). Further, a myriad of factors that lead to the alienation of local actors can impede cohesive and engaged communities, from lack of information about risks (Burnside-Lawry, 2015) to competing priorities that make resilience seem like a luxury (Bahadur & Tanner, 2014). Community responsibility can also be compromised when local actors believe they can rely on policy-makers “to deal with flooding and be responsible for their welfare” (Mullins & Soetanto, 2013).

Trade-offs

Trade-offs within this driver have been identified related to fears, individual versus collective resilience and time. Communities have a social memory of experiences and events (Ann Amaratunga, 2014) that can include painful memories. Much as fears raised by discussing risks and past events can prompt action, they can also be paralyzing (Grove, 2014). In facing a shock, 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 the skills and resources they brought to the community) (Chelleri, Schuetze, et al., 2015; Chelleri, Waters, et al., 2015). Finally, the desire to undertake actions efficiently is often in tension with community consultation and engagement (MacAskill & Guthrie, 2016).

3.2.2 | Social stability, security and justice: enablers and impediments found in resilience implementation strategies

The CRF proposes that ensuring social stability, security and justice can drive urban resilience through activities such as law enforcement, crime prevention and justice (Rockefeller & Arup, 2015 at 3). Social stability has significant overlap with the cohesive communities addressed above. While security and justice are not treated in depth in the urban resilience literature, certain enablers and impediments were identified.

Information sharing among agencies, through coordinating bodies or formal partnerships, helps ensure social stability and security (Caruson & MacManus, 2006; Coaffee & Wood, 2006). Where state security forces are overstretched or lack cultural sensitivity, relationships with community security services can help. Following a major earthquake in New Zealand, for instance, police were able to rely on Māori wardens to provide security services. Their involvement further facilitated needs assessments and the delivery of basic resources (Kenney & Phibbs, 2014). Regarding impediments, the re-configuration of agencies around new priorities can lead to a loss of expertise and inter-agency relationships.

Trade-offs

Trade-offs have been found between security and individual freedoms, rights to privacy and enjoyment of urban spaces. Planners have tried to manage this trade-off by integrating protective security unobtrusively into the design of high-risk sites (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 & Wood, 2006).

3.2.3 | Economic prosperity: enablers and impediments found in resilience implementation strategies

In contrast with the livelihood and employment driver of the Health and Wellbeing dimension, which focuses on individuals, fostering

economic prosperity as expressed in CRF is concerned with resilience of the wider urban economy. Attracting business investment, effective management of city finances and a diverse economic profile are all elements of this driver (Rockefeller & Arup, 2015 at 3). Many of the initiatives that touch on the resilience of the urban economy involve advance planning for uncertain risk through financial and insurance tools.

In managing financial risks, mechanisms such as regional catastrophe insurance pools can be an enabler by helping to reduce the cost of insurance, facilitate access to reinsurance markets and provide timely funds in the event of disaster (Kehinde, 2014). Alternatively, governments can spread 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).

Given the importance of small and medium-sized enterprises (SMEs) to the prosperity of many cities, strategies to help businesses better manage hazard risk can enable this driver of urban resilience. SMEs often lack the resources and initiative to analyse and mitigate hazard risks. 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 & Archer, 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 & Wedawatta, 2014).

There are also several impediments related to this driver. Business elites can play an important role in fostering economic prosperity; however, when their economic interests are not embedded in the city where they are based, they may have less of a sense of civic responsibility (Hobor, 2015). For many businesses, hazard-related risks 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 SMEs) will often prioritize other initiatives and develop a “wait and see” attitude towards hazard risk (Ingirige & Wedawatta, 2014). Finally, while insurance can play an important role in fostering economic prosperity, the nature of risk in many cities creates gaps in coverage, especially for slow-onset shocks such as climate change (Kehinde, 2014).

Trade-offs

Assuring economic prosperity often involves trade-offs with other dimensions of urban resilience, notably the environment. In New Orleans, for instance, business elites focussed on “economic growth at all costs” led to environmental degradation and increased environmental risks (Hobor, 2015). In the area of construction, federal

assistance disconnected from risk assessment can serve to encourage infrastructure and economic activity in hazardous areas. As Burby (2006) notes, “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...”.

3.3 | Infrastructure and environment

The CRF describes the Infrastructure and Environment dimension as “effective leadership, empowered stakeholders and integrated planning” (Rockefeller & Arup, 2015 at 3). Three drivers support 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 urban resilience scholarship, with studies on risk reduction initiatives providing insight into how implementation strategies affect protective assets and continuity of services. Table 3 presents findings from empirical studies on elements of resilience implementation that enable or impede these drivers, as well as trade-offs in implementation.

3.3.1 | Protective natural and man-made assets: enablers and impediments found in resilience implementation strategies

Implementation strategies that enable resilience through protective assets include integrating risk planning into urban design regulations and plans, engaging local perspectives in the design process and providing appropriate incentives. Studies identify the incorporation (and enforcement) of DRR into building codes and urban development plans, and bringing risk thinking into design and construction guidelines as ways to enable a resilient built environment (Johnson & Blackburn, 2014; Malalgoda, Amaratunga, & Haigh, 2014). The spatial layout of the city can also influence opportunities for survival: open spaces can serve as shelter and for the distribution of aid following disaster, multiple passageways to elevated sites away from the coast can prevent bottlenecks during escape (Allan, Bryant, Wirsching, Garcia, & Rodriguez, 2013) and crowded spaces can be modified to reduce terrorist attack risk and impact (Coaffee, 2013, 2013b). To achieve efficient spatial planning, there is added value when urban planners work holistically with other built environment specialists, decision-makers and security specialists (such as the police) (Coaffee, 2013, 2013b). Cross-department governance (Fitzgerald & Laufer, 2017) and data sharing (Wilby & Keenan, 2012) are crucial.

The opinions and perspectives of local stakeholders can also be an enabler, helping to ensure protective assets are designed to support those who will most closely engage with them during stresses and shocks, and that they are consistent with local values and customs (Bakker, 2013; Cigler, 2007). In Japan, popular consensus regarding issues such as resettlement was increased in

TABLE 3 Enabling strategies, impeding factors and trade-offs of urban resilience implementation identified in a review of 188 scientific papers

City Resilience Framework domain and driver	Enabling strategies: implementation strategies that support infrastructure and environment as drivers of resilience	Impeding factors: implementation elements that compromise infrastructure and environment as drivers of resilience	Trade-offs in implementation
Infrastructure and environment			
Protective natural and man-made assets	Integration of risk planning into urban design regulations and plans (1) Engaging local perspectives in design processes (2) Building understanding and providing incentives (3)	Fragmented resources, control and responsibility (4) Risk brokers with alternative priorities or poor information (5) Past infrastructure decisions (6) Awareness of trade-offs (7)	Protection of one asset compromises another (8) Local autonomy over resource management versus quest for certainty in resource management by higher levels of government (9)
Continuity of critical services	Pre-disaster recovery planning (10) Pre-established finance facilities (11) Private-sector engagement (12) Prioritization of critical infrastructure prior to a crisis (13)	Reactive role of disaster management units (14) Concessions made to private actors in crisis response (15) Data gaps following disasters (16) Poor coordination (17) Absence of financial markets (18)	Efficiency versus community involvement (19) Rebuilding quickly with outside contractors versus developing local capacity (20)
Reliable communication and mobilities	Combine risk communication with disaster response training (21) Redundant and automated communication systems (22) Community-sensitive communication (23)	Limited communication capacity (24) Neglect of roads and transport in reconstruction (25)	Media can transmit key messages broadly but may broadcast inaccurate information (26)

Note: (1) (Allan et al., 2013; Coaffee, 2013, 2013b; Fitzgerald & Laufer, 2017; Johnson & Blackburn, 2014; Malalgoda et al., 2014; Wilby & Keenan, 2012); (2) (Bakker & Morinville, 2013; Cigler, 2007; Danar & Pushpalal, 2014; Dias et al., 2014; Ernstson, 2008a, 2008b; Pierdet, 2012; Schewenius, McPhearson, & Elmqvist, 2014); (3) (Cousins, 2017a; Ernstson, 2008a, 2008b; Ernstson et al., 2010; Fitzgerald & Laufer, 2017; Smith et al., 2013; Wagenaar & Wilkinson, 2015); (4) (Berke & Campanella, 2006; Coaffee, 2013, 2013b; Crichton, 2007; Fitzgerald & Laufer, 2017; Sharma & Singh, 2016); (5) (Bosher et al., 2007, 2009; Cigler, 2007; Friend et al., 2014; Sunarharum et al., 2014); (6) (Galaz, 2005; Gupta, 2007); (7) (Galaz, 2005); (8) (Brown et al., 2012; Kelman, 2017; Meerow & Newell, 2016; Zaidi & Pelling, 2015); (9) (Hill, 2013; McPhearson et al., 2014); (10) (Gupta, 2007; Horney et al., 2016); (11) (Kehinde, 2014; Liu et al., 2016); (12) (Haigh & Sutton, 2012; Kapucu, 2007; Stewart, Kolluru, & Smith, 2009); (13) (Liu et al., 2016); (14) (Roberts, 2010; Sellberg et al., 2015; Zaidi & Pelling, 2015); (15) (Gotham, 2012; Haigh and Amaratunga, 2012); (16) (Horney et al., 2016; Liu et al., 2016); (17) (Horney et al., 2016; Kapucu, 2007; Storsjö & Kachali, 2017); (18) (Kehinde, 2014); (19) (Berke & Campanella, 2006; Liu et al., 2016; MacAskill & Guthrie, 2016); (20) (Haigh & Sutton, 2012; Hayat & Amaratunga, 2014); (21) (Alhmoudi & Aziz, 2016; Motta et al., 2014); (22) (Gupta, 2007; Motta et al., 2014); (23) (Mullins & Soetanto, 2013; Pelling & Manuel-Navarrete, 2011); (24) (Alhmoudi & Aziz, 2016; Garnett & Kouzmin, 2007); (25) (Romero & Albornoz, 2016); (26) (Garnett & Kouzmin, 2007; Nirupama & Etkin, 2012).

communities that built their own recovery plans following a disaster (Danar & Pushpalal, 2014). Further, awareness and education campaigns using tools that are easily understood can help protect fragile natural protective assets (Ernstson et al., 2010; Ernstson, 2008a, 2008b; Wagner & White, 2009). Problems can also be reformulated in ways that point to actionable solutions. 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, 2017a): as storm water flow was calculated to measure its value as a resource, more actors were incentivized to manage it effectively (Cousins, 2017b). Finally, financial incentives can increase citizen actions (such as changing blacktop driveways for permeable surfaces) (Fitzgerald & Laufer, 2017) and built environment professionals can raise awareness by interacting directly with homeowners (Smith et al., 2013).

Impediments to resilience through natural and man-made assets include a fragmentation of resources and responsibilities in both government and industry, and conflicting priorities among risk brokers such as municipalities. Though municipalities often have limited abilities to raise funds, they are expected to undertake resilience investments. Policies can even have perverse incentives; for example, the federal government in the United States will pay for local infrastructure damage after an event, but will not necessarily contribute to mitigating risk beforehand (Berke & Thomas, 2006). In England, insurance companies are expected to provide accessible coverage; however, government does not consult with them around zoning decisions, despite knowledge that insurers have more accurate flood maps (Crichton, 2007). Even 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. Bureaucratic silos can slow

progress on implementation, and a lack of communication, competing departments or disciplines and differential regulation of fiscal environments can reduce the chances of success (Fitzgerald & Laufer, 2017). Collaborative work requires more time, hence more resources.

Another impediment is that the industries that control key assets may not be focussed on risk and resilience-related elements. The construction industry, for instance, is a key player in urban man-made assets, but designers and built environment professionals lack input into the resilience agenda and training on urban resilience. In Vietnam, local government dependence on revenues from land transactions and private investments was seen to discourage the pursuit of a resilience agenda while encouraging non-transparent processes (Friend et al., 2014). A further hindrance is the professional fragmentation of the construction industry, where architects, surveyors and engineers are usually employed as independent consultants by construction firms (Bosher, Dainty, Carrillo, & Glass, 2007; Bosher, Dainty, Carrillo, Glass, & Price, 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, 2007). During implementation, a lack of information on risks and poor information transmission to concerned parties can also impede resilience initiatives (Friend et al., 2014; Sunarharum, Sloan, & Susilawati, 2014). Moreover, past infrastructure decisions can be a major impeding factor as they are difficult to undo and shape views about current options (Gupta, 2007). Finally, when a project involves clear benefits for one group and disadvantages for another, conflict can make implementation more complex (Galaz, 2005).

Trade-offs

This driver is rife with trade-offs, not least because design decisions to guard against one hazard may increase vulnerability to another, or increase risk on another territory (Zaidi & Pelling, 2015). As Brown et al. (2012) finds, "[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." Similarly, heavy roofs can reduce vulnerability to intense tropical winds, while increasing vulnerability to earthquakes (Kelman, 2017). Watershed planning involves trade-offs between agricultural water demand and the drinking water needs of urban centres (McPhearson, Hamstead, & Kremer, 2014). Built environment development can also entail trade-offs in social and political spheres (Steele & Gleeson, 2010; Surjan & Shaw, 2009). While resilience governance requires a more prominent role for communities, there is a risk that governments may use resilience as an excuse to reduce support to communities (Coaffee, 2013, 2013b) or that citizen participation will be used to manipulate local opinion (Dias, Curwell, & Bichard, 2014). Local users' desire for flexibility and autonomy in how assets are managed may run counter to the desire for certainty in resource management at higher levels of government (Hill, 2013).

3.3.2 | Continuity of critical services: enablers and impediments found in resilience implementation strategies

The CRF proposes that redundancy, active management and contingency planning to ensure continuity of critical services can serve as a driver of resilience in the infrastructure and environment dimension (Rockefeller & Arup, 2015 at 3). Research examines both risk reduction and recovery initiatives, providing insight into their interconnection and the impact of implementation strategies on other drivers of resilience.

Pre-disaster recovery planning enables the continuity of services central to emergency response by planning for the maintenance of these services during shock and recovery (Gupta, 2007). Engaging diverse stakeholders in planning is also seen to facilitate post-disaster recovery (Horney, Simon, Ricchetti-Masterson, & Berke, 2016). Financing facilities that kick in following the shock can be helpful in enabling the continuity of critical services and may include pre-defined funding plans to expedite critical infrastructure recovery (Liu, Scheepbouwer, & Giovinazzi, 2016). Insurance companies can assure an urban centre's financial liquidity for continued critical services immediately after a disaster, minimizing medium-term setbacks to development (Kehinde, 2014). Public-sector capacity can be overwhelmed during a disaster, and collaboration with the private sector has been identified as another enabling factor in the continuity of critical services. In major reconstruction projects, private contractors and non-profit organizations can fill skill shortages and gaps in critical services (Haigh & Sutton, 2012; Kapucu, 2007). Finally, developing a methodology prior to a disaster for prioritizing critical infrastructure for recovery and rebuilding can help assure critical service continuity (Liu et al., 2016).

A significant impediment is the mismatch between the reactive roles assigned to crisis management units and the proactive efforts that may be needed (Roberts, 2010). This was seen in London's heat wave planning (Zaidi & Pelling, 2015) and in the implementation of urban sustainability in Sweden (Sellberg, Wilkinson, & Peterson, 2015). Following a disaster, use of private contractors, particularly from outside the affected region, can undermine local leadership, stymie economic development and lead to culturally inappropriate results (Haigh & Sutton, 2012). Concessions made to attract these private actors, such as no-bid contracts, can lead to soaring costs and impaired accountability, as was the case in recovery following Hurricane Katrina (Gotham, 2012). Major gaps in data (Horney et al., 2016) and poor integration of documentation (Liu et al., 2016) as different teams begin work to ensure continuity of services can also pose problems in guiding recovery operations. Further, coordination among and between emergency managers, agencies, community members and non-profit actors may be hindered by lack of transportation, communication and time, as well as by divergent priorities or lack of trust (Horney et al., 2016; Kapucu, 2007). Finally, pre-established finance facilities to ensure continuity of critical services may be impeded where financial markets are absent (Kehinde, 2014).

Trade-offs

In ensuring continuity of critical services following a disaster, tension may emerge between a desire to undertake reconstruction quickly and an interest in engaging communities in the process (MacAskill & Guthrie, 2016). Alternatively, managers driven by an interest in “building back better” may confront the competing priority of residents to return to “normal” quickly (Berke & Thomas, 2006). Further, reconstruction often suffers from a lack of available local resources and entails 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 and meet local service needs (Haigh & Sutton, 2012; Hayat & Amaratunga, 2014). Though responding quickly can diminish prospects for long-term capacity, developing long-term capacity through recovery can hinder the continuity of critical services in the short term.

3.3.3 | Reliable communication and mobility: enablers and impediments found in resilience implementation strategies

Diverse and affordable transport networks, along with information and communication technology, are presented in the CRF as key elements of resilience in the infrastructure domain. We found only one study, however, discussing factors that enable mobility. This gap highlights an important observation that reconstruction often concentrates on housing and other buildings, but neglects roads and public transportation (Romero & Albornoz, 2016).

Implementation strategies that support communication as a driver of resilience include combining risk communication with training in disaster response, assuring redundancy in communication systems and cultural sensitivity in messaging. First responders can train local communities and clearly define actions to be taken by the community when disaster warnings are triggered (Alhmodi & Aziz, 2016; Motta et al., 2014). In an emergency, overlapping and redundant communication systems can help ensure that warnings are received. Evidence from Rio de Janeiro highlights the effectiveness of overlapping mediums such as cell phone warnings and community siren systems (Motta et al., 2014). Additionally, risk-monitoring systems, such as weather stations, that automatically disseminate information to key decision-makers are seen to enhance response (Gupta, 2007). Further, tailored information may be beneficial in multi-ethnic and multi-cultural societies (Mullins & Soetanto, 2013). Social capital in a community can also increase access to new information (Pelling & Manuel-Navarrete, 2011).

Impeding factors to communication include overreliance on any one method or plan to communicate warnings or risk information (Alhmodi & Aziz, 2016). Horizontal communication between organizations that does not reach down to the population, and lack of community participation in emergency response exercises, can also hamper this driver of resilience (Alhmodi & Aziz, 2016). Further, a lack of communication capacity and technology in government

organizations can be highly detrimental to emergency actions (Garnett & Kouzmin, 2007).

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 help family unification following a shock, media outlets can exaggerate the intensity of a situation or prioritize speed over accuracy in relaying information (Garnett & Kouzmin, 2007; Nirupama & Etkin, 2012). A tension thus emerges between keeping the media informed during a disaster to help with dissemination and the risk that information provided to the media will be inaccurate or used in a way that hinders recovery efforts.

3.4 | Evidence on governance of resilience implementation

As stated earlier, we did not analyse the fourth dimension of the CRF directly, as leadership and strategy were seen as an intrinsic part of research on each of the three other CRF domains and relate to governance issues. In this next section, we summarize some cross-cutting evidence on the governance of resilience implementation found in the literature. Governance structures, time frames and ongoing learning in governance appear as major themes.

3.4.1 | Governance structures

Governance structures involved in crisis management or resilience building span across multiple domains. For example, decisions following a tsunami touch not only infrastructure, but also health, community and the economy. A comprehensive approach can ensure that actions in each domain are mutually supportive. Understanding the institutions of governance can aid in developing solutions. In this section, we present elements that appear, in the literature, to foster and hinder the implementation of governance strategies suited to resilience.

Inclusive and multi-level governance structures

In all of the CRF domains, the literature stresses the importance of supporting community initiatives and including communities in decision-making. Local governments can take decisions during catastrophic events faster than the national-level governments (Nakanishi, Black, & Matsuo, 2014) and local knowledge appears crucial for decision-making (Prashar, Shaw, & Takeuchi, 2013). A number of studies highlight the benefits of inclusive and transparent governance to break down horizontal (inter-sectoral) and vertical (different levels of governance) barriers (Wilby & Keenan, 2012) and increase an initiative's visibility (Taylor, 2016). Developing an understanding of institutions and their interactions offers important advantages when designing solutions. For example, Zaidi and Pelling (2015) reveals the complexity of interactions between the science community, the National Health System and health and emergency

practitioners during a heat wave. Efficient information flow between these entities can have a major impact on the success of interventions. Designing actions that are in line with existing structures, business plans, funding and available skills can further enhance the chance of success (Roberts, 2010).

Many studies point to the benefit of delegating power over resilience implementation to local governments; however, centralized government also has important roles: its support for the right local initiatives can help develop transformative capacities (Revi et al., 2014), and central coordination may reduce the risk that resilience at one scale will impede resilience at another (Wagenaar & Wilkinson, 2015 at 4).

Time frames

Resilience, a long-term project, often confronts barriers related to short-term electoral cycles, despite recognized benefits of governance putting forward a long-term vision (Sellberg et al., 2015). Contradictions also appear between proactive resilience building and reactive disaster management, and these emanate from the structural properties of governance and political culture as well as conflicting demands on professionals to handle immediate duties as well as meet long-term resilience goals (Roberts, 2010). Governance that fails to clarify responsibilities of various stakeholders makes it more difficult to manage implementation of complex long-term projects (Taylor, 2016).

3.4.2 | Learning

The importance of learning processes is highlighted in a number of studies, and certain facilitating factors have been identified. Satterthwaite (2013) suggests that the governance structure of cities requires “effective political organization and receptive political systems with the capacity both to respond positively to citizens and to learn.” Cross-sectoral relations can enable professionals to share their experience about planning and implementation of similar processes (Taylor, 2016). Further, examples of successful initiatives can help accelerate urban resilience (Sharma & Singh, 2016). Another approach is learning by doing. A study conducted in large cities in Asia found that this method helped professionals understand the complexity of interests involved and fostered innovation to respond to them (Orleans Reed et al., 2013). Professionals, carrying their own knowledge of local specificities, can then develop efficient solutions (Wagner & White, 2009).

In all areas, studies show the importance of raising awareness about the problems posed by various risks. This is true for the population in general, as well as for professionals. If a concept (climate change, resilience, etc.) is absent from a political agenda or an institution’s terminology, its implementation will be slower (Taylor, 2016). Efficient planning may thus include a strategy for organizational learning and experimentation (Fitzgerald & Laufer, 2017). More concretely, plans are useless when they are not communicated and explained to the professionals involved, and this still happens too often (Zaidi & Pelling, 2015).

4 | EVIDENCE TO GUIDE RESILIENCE PRACTICE: CURRENT TRENDS

This review has attempted to present a detailed look at the evidence on urban resilience implementation. Organizing this evidence according to the domains and drivers of the CRF aligns findings from the literature with a framework in broad use by practitioners in many cities. The categorization should enable practitioners to anticipate how a given strategy will enable or limit the development of resilience along the different domains of the CRF, and draw their attention to inherent trade-offs. In this section, we present a number of trends and characteristics that stood out in the papers reviewed.

Community engagement is prominent in studies, ranging from the efficacy of narratives in empowering local resilience (Goldstein et al., 2015), to the role of dialogue in fostering urban resilience (Henceroth et al., 2015), or the role local networks play in disaster response (Kenney & Phibbs, 2014). This is a rich and diverse literature that establishes evidence of programs and practices that build capacity. In evidence on governance, we see that central levels have a contribution to make, even as the advantages of local leadership are recognized. However, despite the large body of evidence on local engagement in resilience efforts, there is as yet little empirical research on the impact of shifting to a highly decentralized approach to resilience, or on strategies to facilitate productive multi-level collaboration or alignment.

We see a focus on factors that enable resilience and some discussion of elements that obstruct implementation of resilience. Too often, barriers to implementation are mentioned in broad or vague terms. Trade-offs, on the other hand, demonstrate a deeper understanding of the consequences of a given action on different groups, in different places and at different times. The inclusion of trade-offs in our analysis recognizes that balancing interests is perhaps the major challenge for practitioners and that better understanding the consequences of taking a given step may help with preparation, communication and compensation that can make decisions more acceptable. There is evidence in the literature of trade-offs between individual and community resilience, between speed and consultation/involvement of different parties in decision-making, between security and freedom, and between efficiency and flexibility. Knowledge related to complex problems involving multiple actors, however, is limited and may be a fruitful area for further research.

Further, we see increasing attention to the role 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, Martins’ and da Costa Ferreira (2011) study shows how transnational municipal networks can promote and help implement climate change action. Networked urban universities may play a role in fostering sustainable cities (Hope, 2016), and donors and foundations can be valuable in promoting such networks. Practitioners may also stand to gain considerably by building and using networks as they develop strategies for urban resilience.

5 | CONCLUSION

Further research is needed to confirm some of the findings reported in this review and expand the knowledge base in areas where evidence is sparse. Two areas in particular stand out as highly promising and necessary areas of study: governance and institutional factors in urban resilience, and longitudinal studies that might demonstrate improvements in resilience as strategies are implemented and tested in real situations.

Regarding governance and institutional factors, the development of urban resilience has the potential to transform urban governance by emphasizing horizontal work across municipal offices, working through broader civil society networks and challenging siloed approaches. This raises issues of power and hierarchical positions, and poses questions related to management, political positioning and leadership. Cities are interdependent systems that do not necessarily work in concert. Often, they muddle through problems as they seek solutions and rethink governance. Unfortunately, while many papers call for multi-scale, multi-level, multi-stakeholder approaches, very few provide insight into the actual capacities and mechanisms needed to activate these approaches. The lack of institutional factors in the urban resilience literature is a clear gap that potentially glosses over many impeding factors and trade-offs.

Though the definition of resilience might not be completely clear for urban practitioners or scholars—the concept of resilience applied to the urban sphere has only been around for approximately 15 years—longitudinal studies have the potential to make sense of ongoing efforts. Much of the literature at present reports on output indicators rather than outcome indicators. This is to be expected given the newness of resilience efforts; however, further research should validate the connection between output indicators and outcomes, and identify contingencies that affect this connection. Longitudinal studies stand to fill that gap. Such studies could also provide an important tool to better understand how cities and their people are affected by shocks and stresses.

This review raises a few questions about how a particular urban resilience framework (CRF) can be used in resilience-building efforts. In recent years, a number of frameworks for measuring urban resilience have been developed, though few pay particular attention to the interrelation between indicators (Normandin & Therrien, 2016). Efforts within cities to organize strategies to match the domains of the CRF may be counterproductive: as we find in this review, drivers of resilience in different domains are often enhanced by the same strategies. However, the CRF framework may serve as a guide for the development of an evidence-based urban resilience “curriculum” that evolves as researchers continue to study how, why and under what circumstances strategies have an effect. Ongoing learning can play a crucial role in urban resilience (Matyas & Pelling, 2015). We also see interdependence among strategies targeting the preparedness, response and recovery aspects of resilience, with decisions around implementation of preparedness strategies exerting an important impact on

response and recovery capacities. Further research might explore these relationships in greater depth.

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 enabling strategies, impeding factors and trade-offs can support decision-making and help solve what might be viewed as *resilience-puzzles* in their respective contexts.

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How to cite this article: Therrien M-C. Enabling strategies and impeding factors to urban resilience implementation: A scoping review. *J Contingencies and Crisis Management*. 2020;28:83–102. <https://doi.org/10.1111/1468-5973.12283>