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REALIZING RESILIENCE: A STUDY OF DEFINITION, INDICATORS, AND OPERATIONALIZATION

by

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Resilience is a term ubiquitously used to gauge how communities fare during and following disasters. Academics and practitioners see resilience as a critical driver of a community's success or failure in recovering or bouncing back from disasters. This thesis aims to provide insight into improving resilience by bridging how it is studied in theory and practiced in the field. This thesis examines resilience in the literature and presents four case studies, which focus on resilience governance and social, physical, and economic resilience indicators. The findings of this thesis show the necessity of community cohesion in growing a community's resilience. The cases also show the benefit of clear resilience governance frameworks rooted in diverse, equitable leadership that represents the communities served. Moreover, fostering individual resilience contributes to a community's resilience level. Finally, the term resilience needs both reconceptualizing and reimagining in a way that better aligns with current-day challenges.

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REALIZING RESILIENCE: A STUDY OF DEFINITION, INDICATORS, AND OPERATIONALIZATION

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ABSTRACT

Resilience is a term ubiquitously used to gauge how communities fare during and following disasters. Academics and practitioners see resilience as a critical driver of a community's success or failure in recovering or bouncing back from disasters. This thesis aims to provide insight into improving resilience by bridging how it is studied in theory and practiced in the field. This thesis examines resilience in the literature and presents four case studies, which focus on resilience governance and social, physical, and economic resilience indicators. The findings of this thesis show the necessity of community cohesion in growing a community's resilience. The cases also show the benefit of clear resilience governance frameworks rooted in diverse, equitable leadership that represents the communities served. Moreover, fostering individual resilience contributes to a community's resilience level. Finally, the term resilience needs both reconceptualizing and reimagining in a way that better aligns with current-day challenges.

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LIST OF ACRONYMS AND ABBREVIATIONS

100RC	100 Resilient Cities
CEA	California Earthquake Authority
CERT	Community Emergency Response Team
CRO	Chief Resilience Officer
DRR	disaster risk reduction
EMD	Emergency Management Department
EOC	Emergency Operations Center
FEMA	Federal Emergency Management Agency
G8	Group of Eight
GDP	gross domestic product
NIST	National Institute of Standards and Technology
PTSD	post-traumatic stress disorder
ROI	return on investment
UASI	Urban Areas Security Initiative
UN	United Nations
WeLG	Wellington Lifelines Group
WREMO	Wellington Region Emergency Management Office

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EXECUTIVE SUMMARY

The scale of disasters is increasing worldwide, as are the associated costs, with governments spending over $300 billion on disasters each year.[1] Resilience is a term universally and frequently used as a rallying cry for communities that bounce back after disasters. As an abstract, ambiguous concept, resilience is challenging to define. This difficulty in understanding resilience is rooted in the disaster lexicon's focusing on resilience theory and not discussing observable and, therefore, tangible, operationalized resilience.[2] There is much debate about how to define and practice resilience.[3] Having no one definition or cohesive, agreed-upon resilience framework or strategy may create a disconnect in how resilience is studied and practiced.

This thesis examines how the operationalization of resilience can be improved. The following sub-questions structure the study:

1. How is resilience defined in the literature?
2. How do practitioners operationalize resilience in cities?
3. What opportunities exist to operationalize academic research and/or study existing practices?

The research design includes four pieces that build on each other. The first examines how resilience is defined in the literature. The second reveals how practitioners apply resilience through four resilience indicators (social, physical, and economic resilience and resilience governance). The third piece examines how four cities operationalize resilience through case studies that analyze their resilience strategies. Finally, cross-case analysis unearths similar, distinct, and creative ways the cities operationalize resilience.

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[1] "UN Resilience 'Scorecard' to Help Cities Curb Disaster Losses from Climate Change, Other Risk Drivers," UN News, May 23, 2017, https://news.un.org/en/story/2017/05/558002-un-resilience-scorecard-help-cities-curb-disaster-losses-climate-change-other.

[2] Patricia H. Longstaff et al., "Building Resilient Communities: A Preliminary Framework for Assessment," *Homeland Security Affairs* 6, no. 3 (2010): 1–2. https://www.hsaj.org/articles/81.

[3] Longstaff et al., 1–2.

RESILIENCE DEFINITIONS

There is a constellation of thought around resilience in the academic community. Some scholars believe that a unifying definition of resilience is unnecessary and that diverse frameworks help achieve different objectives.[4] Brand and Jax encourage varying definitions of resilience that converge at a center point or boundary line, where various disciplines, academics, and practitioners can join.[5] These resilience disciplines include sociology, ecology, psychology, built-environment studies (e.g., architecture, urban planning, design, and engineering), and others.[6] There is recognition of each discipline's trepidations and motivations through the boundary object construct, in tandem with the ability to communicate across disciplines.[7]

Resilience is often defined through abstractions and metaphor: communities "spring back" from disaster or "spring forward." Norris et al. use a linking metaphor for community resilience, whereby, following disasters, community responses are linked to adaptive capacities.[8] Klein, Nicholls, and Thomalla agree with Norris et al., writing that the term resilience is often a metaphor "to describe systems that undergo stress and have the ability to recover and return to their original state."[9] This nonliteral analysis of the definition of resilience is simple but remarkably similar to the 1973 ecological resilience framework that delineates resilience as a return to homeostasis.[10]

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[4] Longstaff et al., 1–2.

[5] Fridolin Simon Brand and Kurt Jax, "Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object," *Ecology and Society* 12, no. 1 (2007): 23, ProQuest.

[6] Susan L. Cutter et al., "A Place-Based Model for Understanding Community Resilience to Natural Disasters," *Global Environmental Change* 18, no. 4 (2008): 600, https://doi.org/10.1016/j.gloenvcha.2008.07.013.

[7] Brand and Jax, "Focusing the Meaning(s) of Resilience," 23.

[8] Fran H. Norris et al., "Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness," *American Journal of Community Psychology* 41, no. 1–2 (2008): 130, https://doi.org/10.1007/s10464-007-9156-6.

[9] Richard J. T. Klein, Robert J. Nicholls, and Frank Thomalla, "Resilience to Natural Hazards: How Useful Is This Concept?," *Environmental Hazards* 5 (2003): 37, https://doi.org/10.1016/j.hazards.2004.02.001.

[10] Crawford S. Holling, "Resilience and Stability of Ecological Systems," *Annual Review of Ecology and Systematics* 4 (1973): 14, https://doi.org/10.1146/annurev.es.04.110173.000245.

Tierney and Bruneau look at resilience as the capacity to recover with few disturbances and the ability to lessen or completely negate damage.[11] Cutter et al., inspired by the work of Tierney and Bruneau, assert, "Resilience within hazards research is generally focused on engineered and social systems, and includes pre-event measures to prevent hazard-related damage and losses (preparedness) and post-event strategies to help cope with and minimize disaster impacts."[12] This definition, too, includes prevention and mitigation as well as restoration and recovery.

Resilience definitions started as broad abstractions and metaphors, made more explicit when other terms helped to explain the concept. The associative words and their measures—risk (and its reduction), mitigation, sustainability, vulnerability, capacity, and recovery—add mass to the term resilience. At the center point of resilience is the ability to adapt, take on risk, sustain oneself and community, and recover. Terms that relate to resilience can buoy its meaning and provide a deeper context for its applicability.

APPLICATION OF RESILIENCE

Resilience definitions provide a basis for understanding how resilience is operationalized. Resilience indicators can move from the theoretical concepts of resilience to the application thereof in communities and provide shape and structure to the definition. They can also extract resilience value through their measurement. Social, physical, and economic resilience and resilience governance indicators show the application of resilience. Social resilience, which manifests in social cohesion or social capital, is the most common application in the literature.

CASE STUDIES

Following from resilience definitions and the breakdown of resilience types into indicators used to measure resilience levels, case studies qualitatively examine how four cities operationalize resilience through various strategies. These sociocultural cases

[11] Kathleen J. Tierney and Michel Bruneau, "Conceptualizing and Measuring Resilience: A Key to Disaster Loss Reduction," *TR News*, May/June 2007, 15, http://www.trb.org/Main/Blurbs/158992.aspx.

[12] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

uncover how Kyoto City, Japan; Los Angeles, California; Vancouver, Canada; and Wellington, New Zealand operationalize resilience through the application of resilience research. The research approach includes both deductive and inductive analysis. The deductive piece examines the operationalization of resilience in each city using the National Institute of Standards and Technology (NIST)'s 2016 Community Disaster Resilience Program framework, whose resilience indicators—resilience governance, economic resilience, physical resilience, and social resilience—are the basis for analysis. The cases all provide examples of operationalized resilience that do not align precisely with the NIST framework but relate to NIST's resilience indicators. These elements are labeled "framework extensions." A cross-case analysis shows areas of consensus and dissimilarity around operationalized resilience in the four cities.

CROSS-CASE ANALYSIS

The most common discovery in the case studies is the perennial challenge of finding the metric for success for resilience across the case studies and in the literature. The literature and a few models suggest a community's adaptive capacity to changes following a disaster is a measure of its resilience. Still, the cities' strategies do not measure this capacity explicitly. The case study research also repeatedly shows that strong resilience governance is vital to resilience's operationalization. The cities' resilience strategies put forward lofty goals broken down into governance, economic, physical, and social resilience indicators, but accountability and clear paths forward are not always present. However, none of the strategies point to specific benchmarks for resilience.

Resilience topics in the case studies and literature overwhelmingly emphasize the need for community cohesion, called social capital in the literature, in growing a community's resilience. The cases and the literature show that social capital, which relies on connections, is the key to resilience. Connections form due to shared experiences and geographic locations. Unity through the web of relationships between formal social capital networks in government agencies, private-sector companies, and community groups and informal social capital can precipitate effort in making change. The need to account for social isolation and ensure that community members have a cohesive network that can

support them is critical. If academics could clearly articulate a social-mitigation return-on-investment akin to that of hazard mitigation, practitioners might operationalize resilience more easily.

Each resilience strategy focuses on disaster education and volunteers to help build a culture of resilience. The strategies also focus on the need to share data and information transparently with the community and ensure that diverse community members are at the table to make decisions around the built environment and community needs. The cities' resilience strategies show that a lifelines council can bring together public and private utilities and transportation providers to ensure the coordination of resilience work in the built environment.

As disasters know no geographic boundaries, the strategies also point to the need to embark on resilience work regionally. Resilience projects do not need to be novel; they can co-opt and aggregate existing projects and then augment them with new projects under a resilience moniker. Then, project executioners can easily analyze the independencies and areas for collaboration. The cases and literature illustrate that insurance gaps—the difference between insurable and insured items—can cause undue financial burdens on institutions and individuals after a disaster, as insurance is a costly investment.[13] The resilience strategies also address food security and the need to address the homeless population's resilience in the cities.

RECOMMENDATIONS

The study of resilience systems and structures needs to be interdisciplinary and possibly transdisciplinary. The research reveals the nexus between design, policy, and social science, and there is a need to visualize what resilience is and how to achieve it within and beyond these disciplines. If the academic study of resilience is more interdisciplinary or transdisciplinary, the solutions to resilience problems, both on the

[13] Public Safety Canada, *Advancing and Empowering Disaster Risk Reduction in Canada: Canada's Platform for Disaster Risk Reduction* (Vancouver: Public Safety Canada, 2018), https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/pltfrm-dsstr-rdctn-2018/index-en.aspx.

conceptual and operational side, may find more integrated and, possibly, sustainable approaches.[14]

A reimagining of resilience will propel its best concepts forward to be absorbed into the next iteration and leave the rest behind. Suggestions for further areas of resilience study align with a revised conceptualization of resilience. Some ways to clarify resilience's definition begin with including resilience governance in the composite of resilience definitions. Resilience governance is a prime way to operationalize resilience and provide the venue for resilience ecosystems to reside collectively and interdependently. The term gives issues a place to sit at all government levels, consolidates problems, and may more forcibly push collaboration, budgeting, and policy support.

[14] "Definitions," Harvard Transdisciplinary Research in Energetics and Cancer Center, accessed April 15, 2020, https://www.hsph.harvard.edu/trec/about-us/definitions/#targetText=Transdisciplinary%20Research%20is%20defined%20as,to%20address%20a%20common%20problem.

ACKNOWLEDGMENTS

The years 2020 and 2021 have upended our lives and transformed us. The global pandemic has forced us to adapt, and our resilience has grown in response—what a befitting time to write about resilience.

If you continue to the thesis part of this thesis, spoiler alert, you will learn that resilience is not attained on one's own—it is a community effort. The pandemic has shown us that personal choices and rugged individualism do not always make us resilient. The community that helped shore up my resilience in thesis writing includes my thesis advisors, newfound CHDS friends and old friends, my mother, my partner, new and old emergency management colleagues responding with me to COVID-19, and family members. Taking hikes and walks, doing yoga, looking at the ocean and mountains, and connecting with loved ones remotely also helped build my resilience.

In this thesis, you will glean that adversity makes people resilient—you learn to adapt and, hopefully, grow through disastrous situations. The act of writing a thesis and constantly pivoting, stretching, and experimenting throughout the process is thus a study in resilience. It takes time and reflection, connecting the dots and seeing patterns that may not be apparent at first glance.

I want to acknowledge the professors at CHDS who help students think critically about the framing of homeland security, a topic often plagued with the same issues as the term resilience—it is challenging to define precisely and, therefore, hard to bring it from concept to reality. Words and definitions matter; it is impossible to categorize, differentiate, measure, and give meaning and, thus, power to ideas when they are nameless.

Homeland security inhabits more space than most understand. To be secure in the homeland is a subjective notion, varying from those with privilege to those without it. CHDS taught me that to be a homeland security steward, one must question outdated ideas and move toward just and creative possibilities. CHDS has shone a light on homeland security, not as a binary—"this is homeland security, and that is not"—but as a tapestry sewn with diverse hands, much like resilience.

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I. INTRODUCTION

> Definitions are vital starting points for the imagination. What we cannot imagine cannot come into being. A good definition marks our starting point and lets us know where we want to end up. As we move toward our desired destination we chart the journey, creating a map.
>
> —bell hooks[1]

A. INCREASING DISASTERS REQUIRE MORE PROACTIVE PLANNING

In the 20th century, 30 global events killed more than 10,000 people per event.[2] From 2000 to 2011, approximately 700,000 deaths were attributable to earthquakes alone.[3] The scale of disasters is increasing worldwide, as are the associated costs, with governments spending over $300 billion on disasters each year.[4] An increase in "megadisasters" precipitated by sea-level rise and climate change has left an outsized loss of life and property damage in their wake.[5] The continued population growth, especially in high-vulnerability areas, magnifies disasters' impact, both in devastation and economic implications.[6] Megacities—cities with 10 million inhabitants or more—are a particular concern due to their size and location in disaster-vulnerable areas.[7] The ongoing development of urban areas requires more attention to resilience through funding allocation

[1] bell hooks, *All about Love: New Visions* (New York: Harper Perennial, 2001), 14.

[2] K. Crowley and John R. Elliott, "Earthquake Disasters and Resilience in the Global North: Lessons from New Zealand and Japan," *Geographical Journal* 178, no. 3 (2012): 209, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.664.7529&rep=rep1&type=pdf.

[3] Crowley and Elliott, 209.

[4] "UN Resilience 'Scorecard' to Help Cities Curb Disaster Losses from Climate Change, Other Risk Drivers," UN News, May 23, 2017, https://news.un.org/en/story/2017/05/558002-un-resilience-scorecard-help-cities-curb-disaster-losses-climate-change-other.

[5] Kathleen J. Tierney, *The Social Roots of Risk: Producing Disasters, Promoting Resilience* (Stanford: Stanford Business Books, 2014), 238.

[6] UN News, "'Scorecard' to Help Cities Curb Disaster Losses."

[7] Ben G. Wisner, "Disaster Risk Reduction in Megacities: Making the Best of Human and Social Capital," in *Building Safer Cities: The Future of Disaster Risk*, ed. Alcira Kreimer, Margaret Arnold, and Anne Carlin (Washington, DC: World Bank, 2003), 181.

to mitigation, risk reduction, and recovery planning, instead of the reactionary efforts that are most common today.[8]

Resilience is the notion that pre-planning will help a community recover and possibly thrive following a disaster. Resilience is a term used universally as a rallying cry for communities that bounce back after disasters. However, the difficulty with using the term is that it has become a catch-all to describe when planning and disaster response "go well." It is challenging to define and difficult to understand because the disaster lexicon does not widely discuss observable operationalized resilience. Without clear indications of what resilience looks like, it is impossible to create a plan in advance for mitigating against what disasters leave in their wake.

In 2006, David Alexander, professor of risk and disaster reduction at University College London and editor in chief of the *International Journal of Disaster Risk Reduction*, was optimistic that the increase in disasters, as well as their scale and scope, would precipitate a shift globally from response to disaster risk reduction and resilience. He writes, "Within a generation there will be a more methodical and comprehensive international strategy for managing disasters, one that places greater weight on risk reduction rather than merely reacting to the impacts of events as they occur."[9] The United Nations (UN) spearheaded the work Alexander hoped for, at times with participation from the United States. The UN has recognized globally an "evolution of disaster management from a reactive to a proactive approach" accentuated during disaster conferences from 1994 to 2015.[10] Thus, the international narrative now couches disaster management in the frame of disaster risk reduction, which is a significant component of resilience.

[8] Susan L. Cutter et al., "A Place-Based Model for Understanding Community Resilience to Natural Disasters," *Global Environmental Change* 18, no. 4 (2008): 601, https://doi.org/10.1016/j.gloenvcha.2008.07.013.

[9] David E. Alexander, "Globalization of Disaster: Trends, Problems and Dilemmas," *Journal of International Affairs* (Spring/Summer 2006): 17.

[10] Ranit Chatterjee et al, "Bangkok to Sendai and Beyond: Implications for Disaster Risk Reduction in Asia," *International Journal of Disaster Risk Science* 6, no. 2 (2015): 177–78.

B. BENEFITS OF DISASTER RESEARCH

Research can inform practitioners about resilience, including risk-reduction methods, ways to decrease mortality and morbidity, and strategies to improve recovery levels.[11] In this context, practitioners are decision-makers charged with executing and funding resilience and emergency management programs at the local, state, and federal level and within non-governmental agencies and the private sector.[12] Understanding risk is the first step in discerning how to mitigate against it, which is also the initial stage for resilience work. Resilience can help reduce the impact of disasters, and therefore, resilience concepts must be realized so that practitioners can operationalize them optimally.

Resilience disaster research has grown in popularity over the last 20 years, and literature on the subject is abundant. Many academics now design disaster research through comparative analyses of pre-event resilience levels. Understanding antecedent conditions and ways to bolster a community's resilience can enable more expeditious recovery after a disaster.[13] Kathleen Tierney, University of Colorado Boulder professor of sociology and director of the Natural Hazards Center, claims that disaster and risk research before the early 2000s focused predominately on adverse post-disaster outcomes instead of community resilience before disasters.[14] Research since the early 2000s has shifted chiefly to the examination of resilience following increasing disaster events.[15] A more robust understanding of the potential to operationalize resilience will enable communities, non-governmental organizations, the private sector, and government bodies to optimize collaboration and resource allocation before, during, and after disasters.

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[11] "Frameworks for Disaster Research and Evaluation," World Association of Disaster and Emergency Medicine, accessed April 23, 2019, https://wadem.org/publications/frameworks/.

[12] Joseph Trainor and Tony Subbio, eds., *Critical Issues in Disaster Science and Management: A Dialogue between Researchers and Practitioners* (Washington, DC: Federal Emergency Management Agency, 2015), 1, https://training.fema.gov/hiedu/docs/critical-issues-in-disaster-science-and-management.pdf.

[13] Tierney, *Social Roots of Risk*, 5.

[14] Tierney, 5.

[15] Tierney, 5.

C. RESEARCH QUESTIONS

1. How can the operationalization of resilience be improved?
2. How is resilience defined in the literature?
3. How do practitioners operationalize resilience in cities?
4. What opportunities exist to operationalize academic research and/or study existing practices?

D. RESEARCH DESIGN

The approach to answer the research questions comprises four parts.

1. Defining Resilience in the Literature

This research aims to complete an exploratory analysis of multidisciplinary academic work and examine the literature's resilience definitions. This inquiry provides an understanding of what academics have learned about resilience. The backdrop of resilience concepts in sociology, ecology, and psychology offers a latticework from which the term disaster or community resilience has sprung. Sources include journal articles, newspaper articles, and books.

2. Showing How Resilience Is Operationalized through Resilience Indicators

Resilience definitions provide a base for understanding how resilience is operationalized. Four indicators—social resilience, physical resilience, economic resilience, and resilience governance—provide shape and structure to the definition of resilience. These indicators can move from theoretical concepts of resilience to the application thereof in communities. They can also extract resilience value through their measurement.

3. Case Studies

Case studies can help define and clarify the concept of resilience using real-world examples to illustrate abstract concepts.[16] Revealing how scholars theoretically define resilience and how practitioners perform resilience is the first step in understanding how to evaluate practiced resilience.[17] Following the analysis of resilience definitions and the breakdown of resilience types into indicators used to measure resilience levels, case studies examine how four cities operationalize resilience through various strategies. A critical piece of evidence-based research is translating research and data into practitioners' language, and the city resilience strategies do this. Moreover, the resilience strategies all reveal underlying conditions in their respective cities. These sociocultural cases uncover how Kyoto City, Japan; Los Angeles, California; Vancouver, Canada; and Wellington, New Zealand operationalize resilience through the application of resilience research.

The research approach includes both deductive and inductive analysis. The deductive piece examines the operationalization of resilience in each city using the resilience indicators outlined in the National Institute of Standards and Technology (NIST)'s 2016 Community Disaster Resilience Program framework. The case studies use NIST's four resilience indicators—resilience governance, economic resilience, physical resilience, and social resilience—as the basis for analysis. The cases all provide examples of operationalized resilience that do not align precisely with the NIST framework but relate to NIST's resilience indicators. These elements are labeled "framework extensions." A cross-case analysis shows areas of consensus and dissimilarity around operationalized resilience in the four cities.

The four cities chosen have similar risk profiles as they are all located in the geologically conceived Ring of Fire. According to the United States Geological Survey, "The 'Ring of Fire,' also called the Circum-Pacific belt, is the zone of earthquakes

[16] Fran H. Norris et al., "Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness," *American Journal of Community Psychology* 41, no. 1–2 (2008): 146, https://doi.org/10.1007/s10464-007-9156-6.

[17] Robert K. Yin, *Case Study Research and Applications: Design and Methods* (Thousand Oaks: SAGE Publications, 2017), 37.

surrounding the Pacific Ocean—about 90% of the world's earthquakes occur there."[18] The cities selected all have a high cost of living, with sizable populations ranging from 418,000 to 3.9 million. Three cities are coastal with lucrative commercial port facilities, with Kyoto City approximately 45 miles from the coast, making them susceptible to tsunamis. Coastal areas are also frequently situated on land that is unstable and vulnerable to disasters exacerbated by rising sea levels and climate change.[19] Urban cores with larger metropolises reaching far beyond their city centers comprise the four cities. They also contain local emergency management agencies and programs buoyed by state, regional, prefectural, or provincial and national emergency management agencies and policies.

The four cities were part of the Rockefeller Foundation's 100 Resilient Cities (100RC) program, launched by the Rockefeller Foundation in 2013, which awarded money to 32 international cities to define what resilience means for their localities and initiate projects to shore up resilience through data collected in multi-stakeholder workshops.[20] The 100RC program pathways ensured that the cities selected for the case studies had, at minimum, a local resilience strategy and a Chief Resilience Officer able to operationalize resilience.[21] According to the 100RC program, this foundation gives shape to resilience in the selected cities.[22] Said another way, having a resilience strategy and Chief Resilience Officer may supply the resilience leadership necessary to promote the chosen measurement of the cities' resilience operationalization. This baseline, coupled with NIST's framework of analysis, indicates how the various cities operationalize resilience.

The cases, side by side, enable a better understanding of both standard and unique themes across them related to four resilience indicators. Relational concepts get teased out

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[18] "Earthquake Glossary," United States Geological Survey, accessed August 24, 2019, https://earthquake.usgs.gov/learn/glossary/?term=Ring%20of%20Fire.

[19] Rajib Shaw et al., "Climate Disaster Resilience: Focus on Coastal Urban Cities in Asia," *Asian Journal of Environment and Disaster Management* 1 (2009): 103.

[20] Eillie Anzilotti, "Why did the Rockefeller Foundation Just Unceremoniously End Its Successful Resilience Program?," *Fast Company*, April 2, 2019, https://www.fastcompany.com/90328267/the-rockefeller-foundation-is-unceremoniously-ending-its-successful-resilience-program.

[21] "100 Resilient Cities," Rockefeller Foundation, accessed February 20, 2021, https://www.rockefellerfoundation.org/100-resilient-cities/.

[22] Rockefeller Foundation.

in the careful orchestration of community resilience at the city level through their similarities and juxtapositions. The case studies also show distinctive resilience potentials creatively grown out of community need and will.

A limit of these case studies is that they are illustrative and not meant as conclusive evidence. They generalize the theoretical concepts that encompass resilience.[23] Furthermore, once an explicit definition of the cases forms, the construction of specific limits or bounds ensures that the scope is reasonable.[24]

4. Conclusions and Recommendations

The conclusions and recommendations provide salient ideas about what lies on the horizon for resilience. A reimagining of resilience's constraints can propel its best concepts forward to be absorbed into its next iteration, and leave the rest behind. Suggestions for further areas of resilience study align with a revised conceptualization of resilience.

E. OVERVIEW OF CHAPTERS

This thesis provides a building block approach. Chapter II defines resilience in the literature, which renders patterns that provide subtopics. Chapter III narrows the topic of resilience into four primary indicators: resilience governance and physical, economic, and social resilience. These four indicators correspond with those utilized in the NIST framework, as discussed in this chapter. In Chapter IV, NIST's framework is the guide for evaluating the operationalization of resilience in the case study cities. Chapter V carefully undertakes a cross-case analysis of lessons learned about resilience's operationalization in the four cities. These findings distinctly display how well resilience in the four cities marries up with the literature's definition of resilience and examples in the case studies. Chapter VI proposes conclusions and recommendations following findings from the case studies and the literature, as well as reflects on the future of resilience.

[23] Yin, *Case Study Research and Applications*, 20.

[24] Yin, 24.

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II. DEFINING RESILIENCE IN THE LITERATURE

This chapter examines numerous resilience definitions in the literature and begins by tracing the origin of the word resilience and its prevalence in disaster research. It then investigates related terms used to define and measure resilience, as they contribute to the meaning of resilience and can be used interchangeably with the concept.

A. HOW RESILIENCE IS DEFINED

1. The Roots of the Term Disaster or Community Resilience and Inconclusive Academic Definition of Resilience

Resilience is an abstract, ambiguous concept and, therefore, challenging to define. Having no one definition or cohesive, agreed-upon resilience framework or strategy may create a disconnect in how resilience is studied and practiced. The history of the word sheds some light on its meaning. Richard Klein of the Stockholm Environment Institute; Robert Nicholls, professor of coastal engineering at the University of Southampton; and Frank Thomalla of Climate and Disaster Risk Research and Consulting write, "The origin of this word is in Latin, where resilio means to jump back."[25] Therefore, the basis of the word resilience is to return to an original state. The literal breaking apart of an object under stress and the figurative ability to bounce back elastically to an original state form the basis of the meaning of resilience.[26]

Resilience as a concept entered the social science fray in the 1950s through developmental child psychology.[27] Resilience appears extensively in the 1973 work of Canadian ecologist Crawford Holling. He defines resilience as the "measure of the persistence of systems and of their ability to absorb change and disturbance and still

[25] Richard J. T. Klein, Robert J. Nicholls, and Frank Thomalla, "Resilience to Natural Hazards: How Useful Is This Concept?," *Environmental Hazards* 5 (2003): 37, https://doi.org/10.1016/j.hazards.2004.02.001.

[26] Chris Zebrowski, "The Biopolitics of Resilience" (PhD diss., Keele University, 2012), 14, https://eprints.keele.ac.uk/3827/1/Zebrowski%20PhD%202012.pdf.

[27] David E. Alexander, "Resilience and Disaster Risk Reduction: An Etymological Journey," *Natural Hazards and Earth System Sciences* 13, no. 11 (2013): 2712, https://www.nat-hazards-earth-syst-sci.net/13/2707/2013/nhess-13-2707-2013.pdf.

maintain the same relationships between populations or state variables."[28] In this ecological context, Holling looks at resilience as a state of sustained equilibrium while absorbing disruption.

Disaster research introduced the notion of resilience through disaster *resistance*, an idea prevalent in the 1990s that supports a focus on resisting disaster consequences through planning efforts. In the late 1990s, resilience theory replaced disaster resistance as a term and concept in disaster scholarship, as resistance seemed an impossible goal.[29] In their research, public policy scholars Patricia Longstaff et al. write that resilience stems "from *resistance* strategies focused solely on the anticipation of risk and the mitigation of vulnerability to more inclusive strategies that integrate both *resistance* (prevent, protect) and *resilience* (respond, recover) in the face of disasters."[30] Thus, resilience can encompass both mitigative behavior and work done after a disaster strikes.

As a way to understand resilience, Susan Cutter, director of the Hazards and Vulnerability Research Institute at the University of South Carolina, and colleagues argue that resilience is an outcome as opposed to the act of getting back to a pre-disaster state.[31] Comparing various definitions of resilience from specific sources like the National Research Council's 2006 *Disaster Resilience: A National Imperative*, they write, "In hazard research, the definition of resilience is refined to mean the ability to survive and cope with a disaster with minimum impact and damage."[32] This definition encompasses a predetermined ability that manifests during response and recovery.

In 2007, Tierney and Bruneau examined resilience as the capacity to recover with few disturbances and the ability to lessen or completely negate damage.[33] Cutter et al.,

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[28] Crawford S. Holling, "Resilience and Stability of Ecological Systems," *Annual Review of Ecology and Systematics* 4 (1973): 14, https://doi.org/10.1146/annurev.es.04.110173.000245.

[29] Tierney, *Social Roots of Risk*, 165.

[30] Patricia H. Longstaff et al, "Building Resilient Communities: A Preliminary Framework for Assessment," *Homeland Security Affairs* 6, no. 3 (2010): 2, https://www.hsaj.org/articles/81.

[31] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

[32] Cutter et al., 600.

[33] Kathleen J. Tierney and Michel Bruneau, "Conceptualizing and Measuring Resilience: A Key to Disaster Loss Reduction," *TR News*, May/June 2007, 15, http://www.trb.org/Main/Blurbs/158992.aspx.

inspired by the work of Tierney and Bruneau, assert, "Resilience within hazards research is generally focused on engineered and social systems, and includes pre-event measures to prevent hazard-related damage and losses (preparedness) and post-event strategies to help cope with and minimize disaster impacts."[34] This definition, too, includes prevention and mitigation as well as restoration and recovery. Seven years later, after her resilience work with Bruneau, Tierney defined disaster resilience similarly but peeled back resilience causation. In her 2014 book *The Social Roots of Risk: Producing Disasters*, Tierney writes, "Disaster resilience in its many forms is rooted in a range of social structural, economic, and cultural preconditions."[35] Thus, because resilience levels are rooted in existing preconditions, resilience does not merely appear during and after a disaster without a connection to what came before.

In writing about preparedness and resilience, John Preston, professor of sociology at the University of Essex, describes how preparedness came from government-supported civil defense. Resilience, he writes, "is concerned with resources and capabilities to survive a disaster whereas 'preparedness' implies vigilance, planning and anticipatory skills in dealing with a crisis."[36] Preston argues that neither preparedness nor resilience focus on civic or national disaster efforts; instead, both focus on individuals and families.[37] He claims this is "not only an inversion but also an intertwining of the relationship between the individual and the nation state."[38] Government efforts to promote personal and community preparedness and resilience capacity-building reflect the evolution from national preparedness efforts promoted during the civil defense era to individual and community-focused resilience.

[34] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

[35] Tierney, *Social Roots of Risk*, 6.

[36] John Preston, *Disaster Education: "Race," Equity and Pedagogy* (Rotterdam: SensePublishers, 2012), 1.

[37] Preston, 1.

[38] Preston, 1.

Fran Norris et al. use a linking metaphor for community resilience, whereby, following disasters, community responses are linked to adaptive capacities.[39] Klein, Nicholls, and Thomalla agree with Norris et al. and others that the term resilience is often a metaphor "to describe systems that undergo stress and have the ability to recover and return to their original state."[40] This nonliteral analysis of the definition of resilience is simple but remarkably similar to the 1973 ecological resilience framework that delineates resilience as a return to homeostasis.[41] Klein, Nicholls, and Thomalla apply the term to the community, a system whose resilience is challenging to measure.

Some scholars believe that a unifying definition of resilience is unnecessary and that diverse frameworks help achieve different objectives. The broadness in the descriptions of resilience allows for a breadth of analysis across a multitude of disciplines. Longstaff et al. acknowledge the extensive debate over how to define and practice resilience.[42] However, they see enough cohesive intersection among the definitions to determine what makes a system resilient.[43] Perhaps having one definition should not be the ultimate aspiration; a better goal would be collaborative agreement on the common underlying factors that make a system resilient.

Resilience represents a constellation of thought in the academic community, including such disciplines as sociology, ecology, psychology, and built environment studies such as architecture, urban planning, design, and engineering.[44] The multidisciplinary aspect of resilience lends both difficulty in defining it and richness. Zurich University Professor Fridolin Simon Brand and German biologist and ecologist Kurt Jax encourage varying definitions of resilience that converge at a center point where various disciplines, academics, and practitioners can join. They write that the result is "to grasp the ambivalent character of boundary objects and, hence, of a wide and vague use of

[39] Norris et al., "Community Resilience as a Metaphor," 130.

[40] Klein, Nicholls, and Thomalla, "Resilience to Natural Hazards," 37.

[41] Holling, "Resilience and Stability of Ecological Systems," 14.

[42] Longstaff et al., "Building Resilient Communities," 1–2.

[43] Longstaff et al., 1–2.

[44] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

resilience."[45] Brand and Jax's use of Star and Griesemer's "boundary objects" concept indispensably moves resilience work into a multidisciplinary and shared academic–practitioner sphere, without experts' losing stake in their discipline's notion of resilience. Star and Griesemer define boundary objects as those "which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites."[46] The boundary object construct recognizes each discipline's trepidations and motivations in tandem with the ability to communicate across disciplines.

Resilience is defined in different ways, depending on what discipline is at the helm. Binary opposition and cases of dissonance become fluid and create space for the integration of diverse sectoral academic fields through the boundary object concept. Beyond definition, resilience must be useful to practitioners and academics in other fields to move past its conceptual derivation.

Crowley and Elliott affirm that scholars can use the ambiguity of resilience "to bring conventionally disparate realms together for practical research and action."[47] Thus, in its broader context, resilience must be plastic and malleable to solicit communication and cooperation across academic and practitioner groups while more concrete and specific within disciplines. According to Brand and Jax, the indeterminateness of resilience can foster creative links between disciplines as they use definitions of resilience attuned to their courses of study. Nevertheless, no research to date has explored the effect of the ambiguity surrounding resilience.

2. Terms Related to Resilience

Some words related to resilience aid in its understanding, are used interchangeably, or contrast with the term to better illuminate its meaning. *Risk* is another way to say *cost*.

[45] Brand and Jax, "Focusing the Meaning(s) of Resilience," 23.

[46] Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39," *Social Studies of Science* 19, no. 3 (1989): 393, https://doi.org/10.1177/030631289019003001.

[47] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 209.

The notion of risk and its reduction or complete avoidance negatively correlates with higher resilience levels. Cutter et al. write that the ideas of risk "construct the physical and natural world as essentially a collection of resources over which human beings hold dominion."[48] Thus, levels of resilience tether to access to resources.

Disaster risk is quantifiable. The equation $R = [H \times V] - M$ schematically represents and expresses risk.[49] Wisner breaks down the risk equation as follows:

> Risk (R) is a function of the frequency and magnitude of natural events, often called hazards (H), the vulnerability (or capacity) of people (V), and the ability of government agencies, other groups and institutions, or households to prevent or mitigate, and prepare for, hazard events (M, as the shorthand for all these activities, is usually "mitigation").[50]

Risk is not "solely an outcome of the probability and magnitude of the natural hazard event (flood, storm, earthquake, drought and sea-level rise) but is also determined by the vulnerability of the exposed society."[51] Thus, resilience is a piece of the risk equation, and quantifying risk can quantify resilience. Risk is accepted, transferred, or reduced through mitigation and adaptation. Consequently, the meeting point of vulnerability and disasters determines the level of a community's risk.

Disaster risk reduction (DRR) not only aims to take on less risk but may altogether eschew an activity due to its high level of risk.[52] Cutter et al. support the "shift from ad hoc, disaster-driven, and reactive systems and policies to a proactive, threat-driven, and mitigative focus."[53] This shift to DRR from reactive action is critical. Alexander, too, looks at the amalgamation of DRR and sustainability, with local self-sufficiency acting as a

[48] Tierney, *Social Roots of Risk*, 56.

[49] Wisner, "Disaster Risk Reduction in Megacities," 184.

[50] Wisner, 184.

[51] Jörn Birkmann, *Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies* (Tokyo: United Nations University, 2006), 220.

[52] John Spacey, "Risk Mitigation vs Risk Reduction," *Simplicable* (blog), November 13, 2015, https://simplicable.com/new/risk-mitigation-vs-risk-reduction.

[53] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 601.

sustainability proxy. He writes, "The key to disaster risk reduction is local self-sufficiency."[54] Thus, Alexander puts the onus of DRR on communities.

The notion of resilience in relation to risk has also shifted away from the limitation of specific hazards. According to the Rockefeller Foundation, "traditional disaster risk management, which is founded on risk assessments that relate to specific hazards," has evolved into "a wide range of disruptive events—both stresses and shocks—[that] may occur but are not necessarily predictable."[55] DRR focuses on many risks, not on specific hazards. This broader focus has created the opportunity for more creative solutions through a wider community of effort.

Hazard *mitigation* is a type of DRR, and mitigation, like risk, is quantifiable. Globally, the term DRR is utilized more than hazard mitigation, and it is central, like mitigation, to the connection of community resilience and sustainability. Dollar amounts can quantify mitigation and, therefore, make it more actionable and concrete than resilience. In 2018, when the National Institute of Building Sciences researched the financial investment in mitigation and outcome, it found the following:

- Adopting model codes saves $11 per $1 spent
- Federal mitigation grants save $6 per $1 spent
- Exceeding codes saves $4 per $1 spent
- Mitigating infrastructure saves $4 per $1 spent[56]

These numbers indicate that spending one dollar in the United States on mitigation measures will save 600 percent in costs during and following disasters. Moreover, changing the built environment to mitigate against futures disasters returns four dollars for every one dollar spent.[57] Funding mitigation work by government bodies and the private

[54] Alexander, "Globalization of Disaster," 12.

[55] Rockefeller Foundation and Arup International Development, *City Resilience Framework*, 2nd ed. (New York: Rockefeller Foundation, 2015), 3.

[56] Multihazard Mitigation Council, *Natural Hazard Mitigation Saves: 2018 Interim Report* (Washington, DC: National Institute of Building Sciences, December 2018), 1, https://cdn.ymaws.com/www.nibs.org/resource/resmgr/mmc/NIBS_MSv2-2018_Interim-Repor.pdf.

[57] Multihazard Mitigation Council, 1.

sector, which owns a bulk of the infrastructure, is a sound financial practice and will add to a community's resilience.

Implementing hazard mitigation strategies is a significant theme in resilience literature and inspired the resilience movement, especially related to the physical built environment. Hazard mitigation is the hazard-specific effort to reduce risk. In the disaster context, mitigation actions occur in planning for communities and fortifying the built environment.[58] Hazard-mitigation planning efforts, like adaptive capacity, reduce the severity of recovery needs and support resilience growth.[59]

More resilient communities may rely less on external aid, so they are more *sustainable*. Dennis Mileti, former director of the Natural Hazards Center at the University of Colorado Boulder, argues, "Sustainability means that a locality can tolerate—and overcome—damage, diminished productivity, and reduced quality of life from an extreme event without significant outside assistance."[60] This definition of sustainability mirrors definitions of community resilience and adaptive capacity. The difference here is the accentuation of self-sustainability. The closed-loop system that Mileti advocates does not rely on outside help, thus presenting a stark contrast to resilience, which often increases as the community system accepts external support. Sustainability and resilience do not converge in a closed system, as resilience is a concept bolstered by resources both inside and outside a network.

In 1999, Mileti wrote that one of the objectives to mitigate hazards sustainably would be to "foster local resiliency and responsibility. Resiliency to disasters means a locale can withstand an extreme natural event with a tolerable level of losses. It takes mitigation actions consistent with achieving that level of protection."[61] The common thread of resilience, sustainability, and mitigation is responsibility. When knitted together,

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[58] Wisner, "Disaster Risk Reduction in Megacities," 184.

[59] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

[60] Dennis S. Mileti, *Disasters by Design: A Reassessment of Natural Hazards in the United States* (Washington, DC: Joseph Henry Press, 1999), 4.

[61] Mileti, 5.

these ideas show how to operationalize resilience, a term that has practically replaced the buzzword *sustainability*.[62]

Vulnerability is a lack of access to resources in addition to living within a particular risk-prone area while resilience is access to resources and the capacity to deal with different levels of risk. Wisner defines vulnerability as "the absence or blockage of capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard," which provides a dichotomous relationship between vulnerability and resilience.[63] High vulnerability often corresponds with the lack of capacity in a community, and the connection between resilience, adaptive capacity, and vulnerability is a topic that has generated much research. Professor Virendra Proag from the University of Mauritius, in comparing vulnerability and resilience, argues that vulnerability is the amount of risk in society's economic, social, and physical aspects.[64] Thus, resilience, adaptive capacity, and ability are the opposite of vulnerability, so they are held in tension with vulnerability.

Cutter et al. acknowledge semantic diversity in disaster terminology and, using the foundation of myriad characterizations, define vulnerability as "the pre-event, inherent characteristics or qualities of social systems that create the potential for harm."[65] They also claim that resilience and vulnerability are often viewed as static and finite occurrences, making their measurement more easily accessible.[66] However, the literature suggests that resilience and vulnerability are dynamic courses of action that morph through learning as situations change them. The dynamic nature of both vulnerability and resilience that Cutter et al. point to illustrates their dichotomous and fluid relationship, and Wilson argues that as resilience grows, vulnerability decreases.[67]

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[62] Geoff A. Wilson, "Community Resilience, Globalization, and Transitional Pathways of Decision-making," *Geoforum* 43 (2012): 1218, http://dx.doi.org/10.1016/j.geoforum.2012.03.008.

[63] Wisner, "Disaster Risk Reduction in Megacities," 184.

[64] Virendra Proag, "The Concept of Vulnerability and Resilience," *Procedia Economics and Finance* 18 (2014): 375, https://doi.org/10.1016/S2212-5671(14)00952-6.

[65] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 559.

[66] Cutter et al., 559.

[67] Wilson, "Community Resilience, Globalization, and Transitional Pathways," 1221.

Cutter et al. claim that resilience connects to *adaptive capacity* or "the ability of the social system to re-organize, change, and learn in response to a threat."[68] This learning shows the dynamism of social and physical systems. How well a community or built environment adapts to changes following a disaster is a measure of its resilience.[69] Norris et al. claim, "Community resilience is a process of linking a network of adaptive capacities (resources with dynamic attributes) to adaptation after a disturbance or adversity."[70] If communities have a profusion of interconnected resources and elements that continue to thrive after a disaster, their resilience level is high.

Norris et al. maintain that resilience's strength is not only a means for quantification but also a way to examine relationships temporally between adaptive capacity and shocks or stresses.[71] These connections may show over time how much a system has adapted. Cutter et al. also consider links between resilience and adaptive capacity. They innovatively divide resilience into two traits: "inherent (functions well during non-crisis periods); and adaptive (flexibility in response during disasters) [which] can be applied to infrastructure, institutions, organizations, social systems, or economic systems."[72] Therefore, according to Cutter et al., if a community system is flexible and acclimated to change, it should perform better during a disruption.

If adaptative capacity is about moving forward, *recovery* looks back to what once was. Adaptive capacity or the community's ability to adapt to changes after a disaster helps measure recovery and, therefore, community resilience. The field of psychology frequently uses the term recovery, often in tandem with resilience. George Bonanno, professor of psychology at Columbia University, defines recovery as returning to where one started or

[68] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 559.

[69] Christopher G. Burton, "The Development of Metrics for Community Resilience to Natural Disasters" (PhD diss., University of South Carolina, 2012), 28.

[70] Norris et al., "Community Resilience as a Metaphor," 147.

[71] Norris et al., 146.

[72] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 601.

returning to homeostasis.[73] A community cannot "absorb" more than it can take on. The ability to adapt moves communities beyond where they were before the disaster to a new and different realm. That is the crucial difference between recovery and resilience: communities are inherently more resilient than others based on their innate ability to absorb and change.

B. SUMMARY

Defining resilience helps to illustrate what resilience can look like and how it is measured. As a boundary object, resilience acts as a communication and collaboration bridge between academic disciplines. The discourse around the evolving meaning of resilience provides a rich tapestry of what it is and how it can be implemented and measured. The resilience definitions started as broad abstractions and metaphors made more explicit when other terms helped explain the concept. The associative words and their measures—risk (and its reduction), mitigation, sustainability, vulnerability, capacity, and recovery—add mass to the term resilience. At the center of resilience is the ability to adapt, take on risk, sustain oneself and community, and recover. Terms that relate to resilience can buoy its meaning and provide a deeper context for its applicability. Furthermore, types of resilience add to its definition as they illustrate how resilience manifests, revealing observable aspects that move resilience into a space of greater accessibility.

[73] George A. Bonanno, "Loss, Trauma, and Human Resilience: Have We Underestimated the Human Capacity to Thrive after Extremely Aversive Events?" *American Psychologist* 59, no. 1 (2004): 20, https://doi.org/10.1037/0003-066X.59.1.20.

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III. RESILIENCE INDICATORS

Resilience indicators provide ways to break down and separate resilience definitions in the literature. Indicators also provide observable illustrations of how to operationalize resilience and the amount of resilience in a community. Scholars often write about resilience as a theoretical abstraction, so the concept does not fasten to specific, concrete, and executable actions, such as indicators. The four resilience indicators often cited in the literature are social, physical, and economic resilience and resilience governance. This chapter classifies the multitude of academic definitions using these dimensions. It then introduces frameworks to categorize the resilience indicators. These indicators are used within resilience frameworks to measure and track resilience in communities.

A. SOCIAL RESILIENCE

Social resilience, recognized as the preeminent driver of community resilience in the literature, is steeped in the notion of trust of community members, organizations, and the government. This trust is established through community networks and provides the vehicle to share resources. According to leadership experts Amy Edmondson, Andrew Marshall, and Sally Jewell, trust in the federal government among adults fell from 77 percent in 1964 to 20 percent in 2020—a historic low.[74] Edmondson, Marshall, and Jewell claim that the government is responsible for ensuring trust in its institutions.[75] More important, low trust in government can lower a community's resilience levels. Research from the social sciences that examines relationships, behavior, and culture has divided social resilience into categories that, when connected, create higher levels of trust and, therefore, community resilience.

[74] Amy Edmondson, Andrew Marshall, and Salley Jewell, "Leading in Government Demands the Stewardship of Public Trust," *MIT Sloan Management Review*, January 21, 2020, https://sloanreview-mit-edu.cdn.ampproject.org/c/s/sloanreview.mit.edu/article/leading-in-government-demands-the-stewardship-of-public-trust/amp.

[75] Edmondson, Marshall, and Jewell.

Social resilience is the most widely researched type of resilience and the most challenging to operationalize. Urban activist Jane Jacobs coined the phrase "social capital" in the early 1960s, a term she used to describe "loose neighborhood networks."[76] French sociologist and anthropologist Pierre Bourdieu focused on human relationships and social order when he wrote in the late 1980s that social capital "consists of resources based on connections and group membership."[77] These connections are crucial to attaining resilience.

Political scientist Robert Putnam's 1995 seminal work, *Bowling Alone*, continues with Jacobs's and Bourdieu's conceptualization and argues that social capital, also called social networks, is the essential resource of a connected society.[78] Putnam argues that social capital prompts an abundance of resources through connections within a community that an individual cannot easily acquire independently. Access to these resources, according to many scholars, helps to build community resilience. Wisner writes, "Social capital refers to the access to resources and information that households have by virtue of their noneconomic social relations with other people."[79] Thus, substantial social capital enables information-sharing because of social ties, which help communities access resources and build resilience.

These social ties can be thought of as nodes in a network. Carpenter maintains that social resilience "can be conceptualized as a web of nodes (individuals or groups) and ties (links between nodes)."[80] This definition marries up with Crowley and Elliott's definition

[76] Gert-Jan Hospers, "Jane Jacobs: Her Life and Work," *European Planning Studies* 14, no. 6 (2006): 726.

[77] Pierre Bourdieu, "What Makes a Social Class? On the Theoretical and Practical Existence of Groups," *Berkeley Journal of Sociology* 32 (1987): 4, http://www.jstor.org/stable/41035356.

[78] Robert D. Putnam, "Bowling Alone: America's Declining Social Capital," *Journal of Democracy* 6, no. 1 (1995): 66, https://doi.org/10.1007/978-1-349-62965-7_12.

[79] Wisner, "Disaster Risk Reduction in Megacities," 183.

[80] Ann Carpenter, "Social Ties, Space, and Resilience: Literature Review of Community Resilience to Disasters and Constituent Social and Built Environment Factors," Discussion Paper 02-13 (Atlanta: Federal Reserve Bank of Atlanta, 2013), 8.

of social resilience as a "complex web of social interactions."[81] Having links between the nodes is vital, as connections strengthen the system's integrity.

The nodes collectively build up a network that can take advantage of human and social capital. Wisner writes that human capital is "local knowledge of the built and natural environment and the skills, formally and informally acquired."[82] Substantial social capital in the form of networks, Cutter et al. assert, is essential to creating antecedent conditions that allow communities to prepare, respond, and recover quickly after a disaster.[83]

Crowley and Elliott break down social networks into three interconnected elements that are essential for resilience: they couch resilience as "a complex web of *social interactions*, *characteristics* and *capacities* that enable a community to live with the hazards they face" (emphasis added).[84] Social interactions are the regular encounters among the community, characteristics of a community provide cultural elements that connect community members, and capacities involve access to resources and the amount of resources the community can take on. Understanding a community's capacity helps pinpoint where to build up vulnerable areas and how to ask for and acquire resources that shore up that capacity.

According to Putnam, the two primary drivers of high social capital levels are civic engagement and trust.[85] Putman argues, "Networks of civic engagement foster sturdy norms of generalized reciprocity and encourage the emergence of social trust. Such networks facilitate coordination and communication, amplify reputations, and thus allow dilemmas of collective action to be resolved."[86] Trust and civic engagement are interdependent, as membership in community organizations promote more trust, and more

[81] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 209.

[82] Wisner, "Disaster Risk Reduction in Megacities," 183.

[83] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 604.

[84] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 209.

[85] Putnam, "Bowling Alone," 67.

[86] Putnam, 67.

trust in the community promotes more membership in organizations.[87] These collectively create higher levels of social capital and, therefore, social resilience.

Carpenter distinguishes two types of resilience—informal and formal—and argues that both are necessary in working toward recovery.[88] Many academics, including Wilson and Aldrich, break informal and formal social capital into three main types—bonding, bridging, and linking—that affect resilience and manifest through trust.[89] Informal social capital involves bonding and bridging while formal social capital entails linking. Formal resilience organizations come out of the government and non-governmental organization sectors while informal social networks like family, friends, and community members bring together resources at the community level. When resources and networks are more abundant, there is a higher level of resilience.[90]

1. Informal Social Capital: Bonding and Bridging

Bonding, or group cohesion, is the most common type of informal social capital in disaster scenarios. It includes trusted family and friend connections that were strong before the disaster struck.[91] Like Norris et al., Cutter, Burton, and Emrich have found that community connections and interest in community issues coalesce through the link to close and trusted family members and friends.[92]

Bridging concentrates on looser social ties "that span social groups, such as class or race."[93] A lower level of homophily, according to McPherson, Smith-Lovin, and Cook, "implies that distance in terms of social characteristics translates into network distance, the

[87] Putnam, 67.

[88] Carpenter, "Social Ties, Space, and Resilience," 6–7.

[89] Daniel P. Aldrich and Michelle A. Meyer, "Social Capital and Community Resilience," *American Behavioral Scientist* 59, no. 2 (2015): 258, https://doi.org/10.1177/0002764214550299.

[90] Carpenter, "Social Ties, Space, and Resilience," 6–7.

[91] Wilson, "Community Resilience, Globalization, and Transitional Pathways," 1222–23.

[92] Susan L. Cutter, Christopher G. Burton, and Christopher T. Emrich, "Disaster Resilience Indicators for Benchmarking Baseline Conditions," *Journal of Homeland Security and Emergency Management* 7, no. 1 (2010): 9, https://doi.org/10.2202/1547-7355.1732.

[93] Aldrich and Meyer, "Social Capital and Community Resilience," 258.

number of relationships through which a piece of information must travel to connect two individuals."[94] Thus, bridging networks span a wider swath of the community but inherently include the distance between individuals within the system. A simple illustration of bridging is neighbors checking on neighbors and providing lifesaving assistance.[95]

Capacity builds through informal social capital and influences the community's planning and preparedness for the next disaster. A secure connection between bonding and bridging, according to Carpenter, helps in the recovery phase. It is as important as the influx of government resources throughout the stages of a disaster.[96] Bonding and bridging may complement one another but work fundamentally at different levels and for different ends.[97]

2. Formal Social Capital: Linking

Linking is a more formal type of social capital that fosters vertical relationships, connecting residents and communities to power structures and government, built on trust and social norms.[98] This relationship between community-based and non-governmental organizations, Wisner claims, "provide a bridge between the formal agencies of disaster management in governments and urban dwellers, [whereby] institutions themselves form 'social capital.'"[99] Consequently, Wisner believes that the linking provided by non-governmental organizations, which he distinguishes as *civil society*, between government and the people, is the cornerstone to building social capital and communities' resilience.[100]

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[94] Miller McPherson, Lynn Smith-Lovin, and James M. Cook, "Birds of a Feather: Homophily in Social Networks," *Annual Review of Sociology* 27, no. 1 (2001): 416, https://doi.org/10.1146/annurev.soc.27.1.415.

[95] Aldrich and Meyer, "Social Capital and Community Resilience," 256.

[96] Carpenter, "Social Ties, Space, and Resilience," 6–7.

[97] Aldrich and Meyer, "Social Capital and Community Resilience," 261.

[98] Aldrich and Meyer, 259.

[99] Wisner, "Disaster Risk Reduction in Megacities," 183.

[100] Wisner, 184.

Carpenter cautions that speeding up recovery and helping communities bounce back or forward require government oversight, intervention, regulation, and financial support. These efforts must be in concert with "grassroots networks that empower citizens with lasting skills combined with greater ties to local formal networks."[101] In other words, bonding, bridging, and linking—combined—may enhance recovery. Aldrich agrees that social connections at all levels will move communities into recovery more quickly than if individuals work for their ends.[102]

B. PHYSICAL RESILIENCE

The literature suggests that physical resilience is the next most important driver in a community's resilience after the social variety.[103] Physical resilience describes how the built environment provides social resilience with the physical space to manifest through gathering and sharing resources. Cutter, Burton, and Emrich break resilience into a "sense of community, place attachment, and citizen participation."[104] Place attachments are liminal ecotones between physical and social resilience, as the built environment can help residents form a community as their "sense of place." Feeling connected to the built environment, its space, and a sense of community within the space is an impetus for re-creating these spaces after a disaster.

A resilient community needs structures that function during and after a disaster. Keith Porter from the University of Colorado Boulder makes the point that "if you can't go back into your building after an earthquake, it's a disposable building."[105] If buildings collapse after a disaster, social capital will not have a location to share resources

[101] Carpenter, "Social Ties, Space, and Resilience," 6–7.

[102] Aldrich and Meyer, "Social Capital and Community Resilience," 260.

[103] Joseph Mayunga, "Understanding and Applying the Concept of Community Disaster Resilience: A Capital-Based Approach" (Munich: Summer Academy for Social Vulnerability and Resilience Building, 2007), 8, https://www.u-cursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf.

[104] Cutter, Burton, and Emrich, "Disaster Resilience Indicators," 9.

[105] Rong-Gong Lin II, "California Earthquake Standard Designed to Save Lives but Not Buildings. There's a New Push to do Both," *Los Angeles Times*, March 15, 2018. https://www.latimes.com/local/lanow/la-me-ln-earthquake-legislation-nazarian-20180313-story.html.

collectively, so the community's resilience going forward will drop precipitously. This example illuminates the interdependence of social and physical resilience.

According to academic literature, one way to build resilience and social capital is to invest in and build community spaces used before disasters to create social capital and during and after disasters to protect human lives. Cagney et al. contend that built environments can encourage connection and increase social capital through "mixed-use urban space that encourages residents to pass one another as they engage in routine activities facilitat[ing] connectedness and trust, potentially providing a reservoir of assistance in time of need."[106] These spaces also provide locations to build social capital in peaceful, non-disaster settings. Trust, a keystone to social capital and resilience, can grow out of daily interactions before disaster events. Furthermore, if residents have spaces to gather before a disaster, they can bond without the strain of an emergency. Then, these public spaces can also become meeting locations following a disaster.[107]

Physical resilience is also an effort to ensure the built environment withstands risk at certain levels through mitigative practices. It may include DRR because it avoids building in certain areas due to vulnerability. According to Mileti, sustainable hazard mitigation is the umbrella under which social and physical resilience resides.[108] Communities must intentionally choose how their land is developed so that sustainable hazard mitigation is an outcome.[109] Government policy, land-use planning, design standards, regulations, and building codes that support safety and resistance from risks and vulnerabilities strengthen physical resilience.

Studying and understanding the stability of the built environment is also key to measuring levels of community resilience. Geoff Wilson, professor of human geography at the University of Plymouth in England, expands on the argument that resilience is part of the pre- and post-event disaster domain, championed by Cutter et al. and others, adding

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[106] Kathleen Cagney et al., "Social Resources and Community Resilience in the Wake of Superstorm Sandy," *PLoS ONE* 11, no. 8 (2016): 8, https://doi.org/10.1371/journal.pone.0160824.

[107] Carpenter, "Social Ties, Space, and Resilience," 2.

[108] Mileti, *Disasters by Design*, 4.

[109] Mileti, 4.

that one can assess the theory of resilience by examining how social systems change over time.[110] This definition of resilience is from a sociological perspective, and it offers a way to examine changes in systems related to other variables. Sociologist Havidán Rodríguez supports the assertions of Wilson and Cutter et al. that resilience is a temporal construct. He stresses that to understand a community's resilience levels, there must be an understanding of pre-disaster conditions in the community.[111] In the forward to *Handbook for Disaster Research*, he describes how difficulties resulting from disasters are generally not novel. Disasters exacerbate existing issues such as "poor land use, unenforced building codes, lack of attention to mitigating community risks, poverty, inadequate medical care, and substandard housing, among others."[112] Therefore, examining and juxtaposing antecedent challenges and social constructs renders a complete picture of a community's level of resilience.

The academic community in design, engineering, urban and land-use planning, and architecture has been working on DRR design for years to facilitate resilience in communities. Design and mindfulness of risk when building structures and infrastructure can foster resilience. David Godschalk, a preeminent urban-planning and built-environment scholar, writes that resilient cities "are constructed to be strong and flexible, rather than brittle and fragile. Their lifeline systems of roads, utilities, and other support facilities are designed to continue functioning in the face of rising water, high winds, shaking ground, and terrorist attacks."[113] These attributes make a city both physically vulnerable and resilient.

Built environments create physical spaces where social capital can develop and recovery can take place. Carpenter argues that the built environment can also serve as a

[110] Wilson, "Community Resilience, Globalization, and Transitional Pathways," 1220.

[111] William A. Anderson, Patrick A. Kennedy, and Everett Ressler, *Handbook of Disaster Research*, ed. Havidán Rodríguez, Enrico Louis Quarantelli, and Russell Rowe Dynes (New York: Springer, 2006), xvii.

[112] Anderson, Kennedy, and Ressler, xvii.

[113] David R. Godschalk, "Urban Hazard Mitigation: Creating Resilient Cities," *Natural Hazards Review* 4, no. 3 (2003): 137, https://doi.org/10.1061/(ASCE)1527-6988(2003)4:3(136).

"benchmark for recovery."[114] The private sector primarily owns the built environment in most areas, and thus, in places like Japan, the private sector undertakes reconstruction efforts.[115] The delay in businesses' reopening after a disaster due to reconstruction can ruin them.[116] As communities push the government to support the private sector's rebuilding in areas deemed essential places, the time it takes to rebuild gauges the success of recovery efforts. Post-disaster recovery research indicates that damage to owner-occupied residential properties is most prevalent in the built environment.[117] Carpenter details how rebuilding efforts in the United States typically focus on aid for owner-occupied, single-family homes, as well as lower-income residents who rent and may find relief only at Red Cross shelters.[118] She also points out that trends in rebuilding efforts show a hesitance to replace "large proportions of the affordable multifamily housing stock" in the long term.[119] Carpenter's research has found that a lack of rental properties significantly contributes to housing issues after disasters.[120]

C. RESILIENCE GOVERNANCE

The carrying out of resilience programs and projects falls under resilience governance, and how well communities adapt and recover is based on community, government, and individual resilience. The execution of governance directly affects the success of resilience programs. The UN claims that "good governance" must include eight significant attributes: "participatory, consensus oriented, accountable, transparent,

[114] Carpenter, "Social Ties, Space, and Resilience," 2.

[115] Lawrence J. Vale and Thomas J. Campanella, *The Resilient City: How Modern Cities Recover from Disaster* (Oxford: Oxford University Press, 2005), 213.

[116] Vale and Campanella, 214–15.

[117] Carpenter, "Social Ties, Space, and Resilience," 7.

[118] Carpenter, 7.

[119] Carpenter, 7.

[120] Carpenter, 7.

responsive, effective and efficient, equitable and inclusive and follows the rule of law."[121] Good governance, then, is crucial in supporting the operationalization of resilience.

Governance can also put limitations on resilience, as resilience does not "account for the power dynamics that are inherent in the way cities function and cope with disruptions."[122] Thus, because it does not overlap with how governments function, resilience does not consider central factors that may help a community become more resilient through government support and possibly leadership. Governance is also the mechanism whereby plans are developed, supported, and executed.

Linking formal social capital can help provide the foundation for resilience governance. Linking ties to formal power structures that often do not, ironically, *link* to communities in need. The UN defines governance as "the process of decision-making and the process by which decisions are implemented (or not implemented)."[123] The government undertakes "governance," and all those involved in governance outside government are considered "civil society."[124]

Carpenter views the formal resilience government network and resources as necessary but not the mechanism for complete resilience-building at the local level. According to Carpenter, a challenge with the formal structures is that "post-disaster, local governments frequently find it difficult to make use of disaster aid resources due to a lack of organizational capacity."[125] Her literature review points to the overwhelming support of strengthening federal and state regulations around government-led risk reduction. This type of governance would be through infrastructure insurance and land use at the local level.[126]

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[121] United Nations Economic and Social Commission for Asia and the Pacific, "What Is Good Governance?" (Bangkok: United Nations Economic and Social Commission for Asia and the Pacific, 2003), 1, https://www.unescap.org/sites/default/files/good-governance.pdf.

[122] Rockefeller Foundation and Arup International Development, *City Resilience Framework*, 3.

[123] United Nations Economic and Social Commission for Asia and the Pacific, "What Is Good Governance?," 1.

[124] United Nations Economic and Social Commission for Asia and the Pacific, 1.

[125] Carpenter, "Social Ties, Space, and Resilience," 7.

[126] Carpenter, 6–7.

The literature provides ways to build DRR through governance. Benadusi focuses on the need for education as a tool to build DRR through risk exposure awareness.[127] Similar to the notion of society's dominion over "a collection of resources," as introduced by Cutter et al., Benadusi shows the connection to empowering human decision-making based on data (risk exposure).[128] Regarding governance, she also explores how DRR has shifted away from state and national levels toward community and citizen levels, as top-down civil defense has been replaced with bottom-up community resilience.[129]

The academic community has debated the scope of resilience governance. Benadusi declares that both academics and practitioners have weighed whether such resilience is "a conservation oriented quality or . . . a transformative attitude capable of fostering change and modifying existing political and social disparities or, in other words, changing the factors that reproduce inequality in the local context."[130] Benadusi's analysis carries the argument beyond conserving an original state. She has coined the term "transformative resilience" as a way to move away from "reinforcing the status quo or, at best, fostering people's ability to adapt to crises without producing positive and substantial changes in social structures."[131] Like Benadusi, Manyena et al. find the value of resilience as a concept is less about being a vague "inspiring" message and more about the effectiveness of policy changes in building adaptive capacities.[132]

Writing about low levels of resilience in the governance context, Benadusi suggests resilience "could be used to compensate for shortfalls in institutional response, thus allowing individuals and families to bounce back after a disaster with little or no external

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[127] Mara Benadusi, "Pedagogies of the Unknown: Unpacking 'Culture' in Disaster Risk Reduction Education," *Journal of Contingencies and Crisis Management* 22, no. 3 (2014): 176.

[128] Benadusi, 176.

[129] Benadusi, 176.

[130] Benadusi, 180.

[131] Benadusi, 180.

[132] Bernard Manyena et al., "Disaster Resilience: A Bounce Back or Bounce Forward Ability?" *Local Environment: International Journal of Justice and Sustainability* 16, no. 5 (2011): 417, https://doi.org/10.1080/13549839.2011.583049.

assistance."[133] From this perspective, resilience focuses on the need for hyper-local or family-level resilience due to a lack of governmental response capabilities. These shortfalls might result from a lack of resilience governance and the inability to adapt to the disaster's repercussions.

Kathleen Cagney et al. suggest that to build resilience, government programs and policies must invest in neighborhood social infrastructure.[134] According to these scholars, community-level government support is the primary driver in building resilience. Local emergency management is often the body that helps inform resilience policies and programs and is a chief executor. Tierney, Lindell, and Perry lend comprehensive examples of good governance practices:

> Building local emergency response capacity thus appears to involve the ability to pursue a variety of bridging and boundary-spanning activities, such as maintaining frequent interdepartmental and interorganizational communications; establishing councils, boards, and mutual aid networks representing key organizational actors in the community; organizing joint activities such as communitywide disasters exercises; and attempting to make emergency operations centers vehicles for interorganizational coordination.[135]

These elements in the resilience governance sections of the cases in Chapter IV show how well each city governs resilience. The focus on coordination between groups is the key to robust local emergency management and resilience capacity. This coordination does not lead to automatic concord.

Not only is collaboration key to better governance, but the U.S. public, according to Tierney, Lindell, and Perry, "expects government to respond swiftly and effectively in emergencies and has little tolerance when those expectations are not met."[136] These exceedingly high expectations have pushed all levels of government to work to respond

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[133] Benadusi, "Pedagogies of the Unknown," 180.

[134] Cagney et al., "Social Resources and Community Resilience," 8.

[135] Kathleen J. Tierney, Michael K. Lindell, and Ronald W. Perry, eds. *Facing the Unexpected: Disaster Preparedness and Response in the United States* (Washington, DC: Joseph Henry Press, 2001), 176–77.

[136] Tierney, Lindell, and Perry, 152.

expeditiously and plan better. There is also a brighter light shown on government activity due to higher levels of expectation. This increase in more aggressive response may "originate in the need to avoid criticism for not being sufficiently proactive, to claim credit for response activities that are proceeding well, or (though those involved would never admit it) simply to grab headlines."[137] Therefore, the impetus for response and reactive measures at all government levels is partly because of political demands.

D. ECONOMIC RESILIENCE

The least-explored indicator is economic resilience, which often interweaves with resilience governance and physical resilience when funds are allocated and managed to do resilience work. If resilience is a part of or opposite to vulnerability, economic resilience, in this context, can be juxtaposed with resource scarcity. There are substantial financial investments and incentives tethered to DRR. These connections have become a part of the discourse around international DRR in the last two decades. Alexander writes, "The link between disaster reduction and economic development, obvious for very many years, only became a common topic of international debate in the 1990s, after decades in which development was simply halted, or set back, while the aftermaths of large disasters were addressed."[138] Alexander maintains that decision-makers should push DRR by redressing development that has not coincided with risk.

Economic development and government spending on resilience, emergency planning and management, and mitigation lead to higher resilience levels. Thung-Hong Lin, of Taiwan's Academia Sinica's Institute of Sociology, finds that one could calculate and measure a state's capacity or resilience by dividing government expenditures by the gross domestic product (GDP), which "is negatively associated with human losses caused by disaster."[139] Consequently, there is a correlation between higher government spending as a percentage of GDP (as a measure of state capacity) and fewer lives lost in natural

[137] Tierney, Lindell, and Perry, 155.

[138] Alexander, "Globalization of Disaster," 9.

[139] Thung-Hong Lin, "Governing Natural Disasters: State Capacity, Democracy, and Human Vulnerability," *Social Forces* 93, no. 3 (2014): 1268, https://doi.org/10.1093/sf/sou104.

disasters.[140] If the government is spending a higher percentage of its GDP, it may have the funds to shore up resilience, risk mitigation and reduction, preparedness, response, and recovery initiatives.

Tierney, Lindell, and Perry build on Lin's assertion: "Worldwide, it is clear that higher levels of affluence are associated with lower levels of disaster vulnerability, particularly in terms of lives lost in disasters."[141] Wealth or an abundance of supplies and resources in cities, government bodies, and organizations may help to grow DRR and resilience. Furthermore, as Cutter et al. claim, "Disaster impacts may be reduced through improved social and organizational factors such as increased wealth."[142] Wealth and resilience are positively correlated, and this idea links back to Cutter et al., who assert that high levels of community resilience are tied to resource access.[143] Personal economic resilience is not a topic covered extensively in the literature. Understanding the complexity of resilience by sharing resources in the social, physical, economic, and governance arenas is the nascent stage of cultivating knowledge of community resilience levels. These different resilience indicators add tangibility to the definition of resilience and show how resilience can build and become stronger. Looking at the specific cities' practices of resilience through this indicator framework is the next step in understanding how to operationalize resilience.

E. NIST RESILIENCE FRAMEWORK

This thesis uses NIST's 2016 Community Disaster Resilience Program framework to analyze the operationalization of resilience in the Kyoto City, Los Angeles, Vancouver, and Wellington case studies. Frameworks serve to provide a catalog of facets and benchmarks that, together, explain a theory, such as resilience. The two fundamental types of resilience, social and physical resilience, correspond well with the resilience indicators used in many U.S. and international frameworks. NIST's resilience framework includes an

[140] Lin, 1268.

[141] Tierney, Lindell, and Perry, *Facing the Unexpected*, 180.

[142] Cutter, Burton, and Emrich, "Disaster Resilience Indicators," 5.

[143] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 603.

emphasis on both social and physical resilience. Several key vulnerability frameworks—such as the 2003 vulnerability/sustainability framework by Turner et al., the 2004 pressure and release model by Wisner et al., and the 2007 capital-based approach by Mayunga—were eminent predecessors to models like NIST's framework.[144]

There is a temporal aspect of resilience that the NIST framework acknowledges in its definition of resilience. NIST correlates quicker recovery to higher resilience levels, much like the 2008 disaster resilience of place model.[145] Also, from the 2010 Multidisciplinary and National Center for Earthquake Engineering Research's resilience framework, NIST borrows the "four Rs"—robustness, redundancy, resourcefulness, and rapidity—as means to evaluate each system.[146]

The resilience literature analysis has illustrated the importance of governance; economic development, wealth, and resources; the built environment; and social dimensions and social capital in measuring resilience. The NIST framework incorporates these four resilience indicators:

1. Resilience governance: How resilience is managed/governed
2. Economic resilience: Economic development
    - General financial breakdown of the city
    - Cost/funding: How resilience work is funded at the local level
3. Physical resilience: Examples of resilience in the built environment
4. Social Resilience: Examples of social dimensions (resilience and social capital)[147]

[144] Cutter et al., 600–601.

[145] National Institute of Standards and Technology, *Community Resilience Planning Guide for Buildings and Infrastructure Systems*, vol. 1, NIST Special Publication 1190 (Washington, DC: Department of Commerce, 2016), 13, http://dx.doi.org/10.6028/NIST.SP.1190v1.

[146] Carpenter, "Social Ties, Space, and Resilience," 4.

[147] Cathleen A. Berrick, *Homeland Security: DHS's Progress and Challenges in Key Areas of Maritime, Aviation, and Cybersecurity*, GAO-10-106 (Washington, DC: Government Accountability Office, 2009), 8.

The case study analysis in Chapter IV uses these indicators to show how the four cities operationalize resilience. The indicators break down into observable components, which help to show operationalized resilience, not just the conceptual elements. These four indicators are all inextricably linked to the main driving force of resilience: access to resources. Indicators 1, 2, and 3, if high or strong, directly correlate to a higher level of access to resources, the critical driver in operationalizing resilience.

Indicators help to categorize resilience in the literature and add more accessible tactility to the abstract theory of resilience. The four resilience indicators are used in frameworks to measure resilience and show its operationalized form. Without resilience indicators and a framework to shore up the structure of analysis, cities cannot grasp how and where to build their resilience.

IV. PRACTITIONER RESILIENCE PROGRAMS AND PROJECTS IN FOUR CITIES

The purpose of this chapter is to explore how cities operationalize resilience, using case studies of urban environments to illuminate how resilience is governed and practiced. The four case studies comprise Kyoto City, Japan; Los Angeles, California; Vancouver, Canada; and Wellington, New Zealand, all of which participated in the Rockefeller Foundation's 100 Resilient Cities (100RC) initiative. The Rockefeller Foundation has funded crucial urban-planning projects to address various crises for many decades. The 100RC initiative was an international program launched by the Rockefeller Foundation in 2013 to grant funds to 32 cities in the world for resilience work.[148] The 100RC program used Arup International Development (Arup)'s city resilience framework to build the city resilience strategies and offer ways to build resilience in the selected cities.[149] The program's outcome is that each city has a resilience strategy and a Chief Resilience Officer tasked with managing the city's strategic resilience development.

Arup built the strategies on the ability of people working and residing in the cities to thrive after "stresses or shocks."[150] It focuses on the city as a whole, in a systems-based approach, instead of separate systems. The strategies look at both the impact of human behavior and the stresses to the physical environment in the realms of social, physical, and economic resilience.[151] The strategy's core focus is to provide an index to cities that gives them a sense of "what does and does not contribute to urban resilience."[152] Through discussions and research, Arup "found perspectives were siloed, shaped by experience and expertise in one or another aspect of resilience, disaster risk reduction, infrastructure resilience, climate change, national security or business continuity."[153] Arup built the

[148] Anzilotti, "Rockefeller Foundation."

[149] Rockefeller Foundation and Arup International Development, *City Resilience Framework*, 3.

[150] Rockefeller Foundation and Arup International Development, 3.

[151] Rockefeller Foundation and Arup International Development, 4.

[152] Rockefeller Foundation and Arup International Development, 1.

[153] Rockefeller Foundation and Arup International Development 1.

reality-based framework through thought leadership and capacity.[154] Thus, it addressed challenges in building and understanding resilience "by providing an accessible, evidence-based articulation of city resilience."[155] The firm reviewed findings of resilience research and mapped most of the stakeholders' perceptions to them.[156]

A unique factor of the city resilience strategies is the push toward resultant resilience "co-benefits," a term coined in academic literature of the 1990s meaning a win-win approach to addressing climate adaptation and development together.[157] Co-benefits can also mean "intended positive side effects of a policy from ancillary benefits or unintended positive side effects."[158] The notion of co-benefits is a central theme to current work about climate adaptation. As the Rockefeller Foundation states, "Instead of focusing on individual hazards we have focused on actions that will build qualities such as flexibility, robustness, integration, resourcefulness, inclusivity and continuous learning into all of the city systems—our regulation, communities, infrastructure, and knowledge networks."[159] Thus, the resilience strategies focus on DRR, not a specific hazard response. There is a focus on aligning and supporting networks of networks.

The cases were analyzed using NIST's 2016 Community Disaster Resilience Program framework, which identifies and observes specific actions at the heart of resilience operationalization. NIST is also a more recent framework that builds on lessons learned from its predecessors. Each case study begins with information about the city's risks to help differentiate and contextualize its strategy for resilience programs and initiatives. Then, it outlines the city's population size and general demographic make-up, as these attributes affect its resilience strategy.

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[154] Rockefeller Foundation and Arup International Development, 1.

[155] Rockefeller Foundation and Arup International Development, 3.

[156] Rockefeller Foundation and Arup International Development, 4.

[157] Akiko Miyatsuka and Eric Zusman, "What Are Co-benefits?," Fact Sheet No. 1 (Hayama, Japan: Institute for Global Environmental Strategies, 2009), 5, https://www.iges.or.jp/en/publication_documents/pub/nonpeer/en/2393/acp_factsheet_1_what_co-benefits.pdf.

[158] Miyatsuka and Zusman, 5.

[159] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy* (New York: Rockefeller Foundation, 2017), 11, https://wellington.govt.nz/wellington-city/resilient-wellington/wellington-resilience-strategy.

The case studies use NIST's four resilience indicators—resilience governance, economic resilience, physical resilience, and social resilience—to supply thematic analysis sections. Elements found in the cases that are not explicit parts of the NIST framework are labeled "framework extensions." In the following chapter, a cross-case analysis uncovers shared themes and creative resilience operationalization programs that differentiate the cities.

A. KYOTO CITY, KYOTO PREFECTURE, JAPAN

Kyoto City is located in one of the most earthquake-prone regions in the world.[160] Kyoto City is the inland capital city of Kyoto Prefecture, which comprises 11 wards that subdivide the city by government ordinance.[161] Kyoto City is in a valley, part of a large basin surrounded by mountains in the west, north, and eastern region.[162] Three rivers run through this inland city.[163] In 2018, Kyoto City had a population of 1.47 million, but that population is shrinking, made up of homogenous and aging people.[164] Kyoto Prefecture had a population of 2.59 million in 2018.[165]

Resilient Kyoto has made the aging population one of the center points of its strategy. *Resilient Kyoto* highlights "increasing social isolation due to the break-down of community cohesion" as a significant challenge.[166] The strategy provides creative

[160] International Research Institute of Disaster Science, *HFA IRIDeS Review Report: Focusing on 2011 Great East Japan Earthquake* (Sendai, Japan: International Research Institute of Disaster Science, 2014), 1, http://irides.tohoku.ac.jp/media/files/HFA_IRIDeS_ReviewReport_Web_20140612(1).pdf.

[161] Takanobu Kosugi, Yoshiyuki Shimoda, and Takayuki Tashiro, "Neighborhood Influences on the Diffusion of Residential Photovoltaic Systems in Kyoto City, Japan," *Environmental Economics and Policy Studies* 21, no. 4 (2019): 480.

[162] Kimisato Oda et al., "Urban Agriculture as a Sustainability Transition Strategy for Shrinking Cities? Land Use Change Trajectory as an Obstacle in Kyoto City, Japan," *Sustainability* 10, no. 4 (2018): 3, https://doi.org/10.3390/su10041048.

[163] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto* (New York: Rockefeller Foundation, 2019), 6, https://resilientcitiesnetwork.org/downloadable_resources/Network/Kyoto-Resilience-Strategy-English.pdf.

[164] "Japan: Kyōto," City Population, accessed January 28, 2021, https://www.citypopulation.de/en/japan/cities/kyoto/.

[165] "Population of Kyoto Prefecture in Japan from 1920 to 2018," Statista, accessed January 28, 2021, https://www.statista.com/statistics/608402/japan-population-kyoto/.

[166] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 8.

solutions to safeguard the aging population from being forgotten by ensuring that senior citizens can contribute to Kyoto's culture and society by remaining in the workforce and volunteer organizations. The strategy encourages social networking and pulling those who live alone out of isolation through senior social events and in-home care provisions and assistance.[167]

Initiative 1 of *Resilient Kyoto* involves "addressing [the] declining local population."[168] The initiative promotes community engagement by devising innovative solutions around a declining population. Mitigation measures could include "increasing birthrate, preventing population outflow and welcoming more people to live in Kyoto. Solutions could also include adaptation measures to the reality of a smaller and aging population."[169] The strategy does not include specific ways to accomplish these measures, as the plan pushes these ideas to the community level for solutions.

1. Resilience Governance

Kyoto City's Chief Resilience Officer, Hiroyuki Fujita, writes in March 2019's *Resilient Kyoto*, "This is not just a strategy, it's our effort to create a roadmap to a future sustainable society."[170] In the strategy, the mayor touts the city's long, rich history. It has weathered quite a bit over the last 1,000 years. The strategy highlights the concerning dyad of an aging and shrinking population experiencing a rise in disasters.[171] A "whole of government" committee leads the strategy's implementation and an annual internal review.[172] Some of *Resilient Kyoto*'s unique governance resilience features include goals around environmental stewardship and sustainability and climate adaptation, including work around increasing sea levels. There is also a considerable focus on co-benefits peppered throughout the strategy, which tie to the governance of resilience.

[167] Rockefeller Foundation 100 Resilient Cities, 24.

[168] Rockefeller Foundation 100 Resilient Cities, 18.

[169] Rockefeller Foundation 100 Resilient Cities, 18.

[170] Rockefeller Foundation 100 Resilient Cities, 3.

[171] Rockefeller Foundation 100 Resilient Cities, 1.

[172] Rockefeller Foundation 100 Resilient Cities, 12.

A mayor governs Kyoto City, and the national government mandates that municipalities in Japan administer DRR policies.[173] Japan's federal government dictates many of the particulars and funds the bulk of this work.[174] Kyoto has a fire and disaster management agency, but publicly accessible information about the agency is limited.[175]

a. Framework Extension: Support Volunteers

Much of the local emergency management in Kyoto City, like other cities in Japan, is coordinated and led at the local level by volunteer groups called *shobodan*—"highly developed social infrastructure of citizens' organizations at the neighborhood level that serve various functions such as firefighting, first aid, hazard mitigation, and education about earthquakes."[176] Some of the shobodan are over 200 years old, which contributes to their high level of development.[177] As of the early 1990s, local groups that addressed hazard mitigation at the neighborhood level, called *machizukuri kyo gikai*, covered approximately 37 percent of households in cities.[178] There is also a robust Japanese Red Cross that acknowledges and supports local expertise in emergency management.[179]

Throughout Japan, cities seem to understand how active these local groups are in planning, mitigation, and preparedness work. Government bodies advocate for them instead of competing or not supporting them.[180] Although this is a reliable marker of substantial social capital, the volunteer groups find bringing in younger members a

[173] "Past Calamities Revisited in Regional Collaborations," *Japan Times*, November 8, 2019, https://www.japantimes.co.jp/news/2019/11/08/national/past-calamities-revisited-regional-collaborations/#.XgTxO0dKgmQ.

[174] "Past Calamities Revisited in Regional Collaborations."

[175] "Japan to Tighten Gasoline Sale Rules After Kyoto Arson Attack," Kyodo News, October 26, 2019, https://english.kyodonews.net/news/2019/10/a3a4a2e5ab11-japan-to-tighten-gasoline-sale-rules-after-kyoto-arson-attack.html.

[176] Wisner, "Disaster Risk Reduction in Megacities," 191.

[177] Wisner, 191.

[178] Wisner, 191.

[179] Wisner, 191.

[180] Wisner, 191.

challenge.[181] As volunteerism propels disaster mitigation and response at the local level in Japan, *Resilient Kyoto* gives prominence to the need to support volunteers and their agencies. Volunteer fire brigades are commonplace in Kyoto, and Initiative 6–2-3 aims to develop these organizations through training and recruitment.[182] It is unclear how this will be accomplished and by whom. The focus area of the recruitment is on young people and women.[183]

2. Economic Resilience: Economic Development

The 2019 *Resilient Kyoto* cites a "declining local economy" as a roadblock in building resilience, and this feeling of economic stagnation is all over Japan.[184] As its resilience strategy is new, it is challenging to understand how Kyoto has operationalized strengthening its economy. *Resilient Kyoto* includes local economic resilience initiatives and goals. Initiative 5 involves developing the local economy and anticipating future trends.[185] Creative and novel approaches to local economic development, including land-use proposals to support local businesses, are keystones of this initiative.[186] Goal 1.2 of the strategy is to provide "economic security for local businesses and workers [by] working together for mutual prosperity."[187] This goal centers on business continuity in Kyoto through staff retention and increased job security.[188] The action plan includes engaging employees, employers, and labor unions to promote "intergenerational communication and understanding, giving a voice to vulnerable workers and engaging with the tourism and food production sectors."[189] The results include a more stable workforce, which will

[181] Wisner, 191.

[182] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 36.

[183] Rockefeller Foundation 100 Resilient Cities, 36.

[184] Rockefeller Foundation 100 Resilient Cities, 8.

[185] Rockefeller Foundation 100 Resilient Cities, 18.

[186] Rockefeller Foundation 100 Resilient Cities, 18.

[187] Rockefeller Foundation 100 Resilient Cities, 21.

[188] Rockefeller Foundation 100 Resilient Cities, 21.

[189] Rockefeller Foundation 100 Resilient Cities, 21.

hopefully curb population decline.[190] A stated co-benefit is "intergenerational cohesion building."[191]

Another element of building economic resilience in Kyoto is a focus on the younger generation. The program plans to connect young people with small- to medium-size businesses to increase Kyoto's younger populations and increase local economic resilience.[192] Kyoto will also build financial resilience by focusing on startup companies and small businesses to create more job diversity in the business sector and more economic opportunities for business owners and employees.[193]

Elements of Japan's economy are essential in appreciating the local economic resilience of Kyoto City as national commercial drivers and trends impact and often trickle down to localities. In 2020, Japan contributed 6 percent of global GDP and was the third-largest economy.[194] The government of Japan spent an estimated 19.6 percent of GDP in 2017.[195]

3. Physical Resilience: Built Environment

Mounting difficulty in economic resilience is also seen in the built environment as Kyoto is quite interconnected. Locally, there is a lack of commercial land available, so *Resilient Kyoto* claims that the government will make vacant public land available for commercial use.[196] Initiative 6, "Bringing a Resilience Lens to Town Planning," encompasses this type of land use.[197] Issues beyond land use, such as traffic and local

[190] Rockefeller Foundation 100 Resilient Cities, 21.

[191] Rockefeller Foundation 100 Resilient Cities, 21.

[192] Rockefeller Foundation 100 Resilient Cities, 22.

[193] Rockefeller Foundation 100 Resilient Cities, 28.

[194] Prableen Bajpai, "The 5 Largest Economies in the World and Their Growth in 2020," Nasdaq, January 22, 2020, https://www.nasdaq.com/articles/the-5-largest-economies-in-the-world-and-their-growth-in-2020-2020-01-22.

[195] "The World Factbook: Japan," Central Intelligence Agency, last modified February 16, 2021, https://www.cia.gov/the-world-factbook/countries/japan/.

[196] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 28.

[197] Rockefeller Foundation 100 Resilient Cities, 19.

community revitalization, are the core elements of Initiative 6. Local government agencies' engagement helps complete this work.[198] There is also mention in the strategy of public transportation campaigns and a committee to investigate how to incorporate automated vehicles.[199]

Another physical resilience initiative in the strategy is the use of community-led disaster preparedness in "traditional housing areas."[200] Kyoto's vulnerable areas include row houses on narrow streets, and Initiative 6–1-1 promotes work with businesses and community members to identify evacuation routes for vulnerable areas.[201] Infrastructure maintenance is an issue in Kyoto, and 6–1-2 is about "using technology to connect citizens and city government for infrastructural maintenance" through smartphone applications that collaboratively connect community members directly to local government agencies. A co-benefit of the app is an increase in community pride and participation in the management of infrastructure.[202]

There are lofty seismic retrofit goals in *Resilient Kyoto*. These include retrofitting and adding physical resilience mitigative measures to water, sewer, road, bridge and tunnel network, and stormwater management.[203] There are also goals around "disaster proofing" evacuation centers through a mandate of certain levels of disaster supplies.[204] The strategy includes information on seismic retrofitting of private buildings and homes with public campaigns through subsidies.[205]

[198] Rockefeller Foundation 100 Resilient Cities, 19.

[199] Rockefeller Foundation 100 Resilient Cities, 31.

[200] Rockefeller Foundation 100 Resilient Cities, 35.

[201] Rockefeller Foundation 100 Resilient Cities, 35.

[202] Rockefeller Foundation 100 Resilient Cities, 35.

[203] Rockefeller Foundation 100 Resilient Cities, 36–37.

[204] Rockefeller Foundation 100 Resilient Cities, 36.

[205] Rockefeller Foundation 100 Resilient Cities, 35.

a. Framework Extension: Food Security Resilience

Food security is a piece of the resilience pyramid in Kyoto. Initiative 4-2-3, "Kyoto's Fresh Food Network—Connecting Growers, Sellers and Consumers for Food Safety and Security," ensures the fresh food industry is resilient.[206] Kyoto's central wholesale food market serves as the hub for collaboration between "fresh food suppliers, growers and consumers to promote food safety, freshness, and diversity. This includes upgrades to the market facilities and collaborative events to attract and educate consumers."[207] This initiative promotes wholesale fresh food sector diversification, which builds food security resilience.[208]

4. Social Resilience: Social Capital

Like much of the literature, *Resilient Kyoto* focuses on the importance of social capital in building resilience, claiming the City of Kyoto's "greatest assets include experience, culture and social cohesion."[209] Social resilience in *Resilient Kyoto* centers on what it calls "personal resilience." Initiative 2 of the strategy entails citizens' commitment to resilience and guides public outreach on the approach between generations. It also includes a "personal pledge to implementing the strategy through their own actions and lifestyle" as a way to build personal resilience.[210] These public pledges link to social pressure and prosocial behavior.[211] They also result in social rewards upon completion and encourage other community members to follow their lead.[212]

The strategy includes projects that address the social isolation of those living in condominiums through government engagement with real estate companies to recruit

[206] Rockefeller Foundation 100 Resilient Cities, 30.

[207] Rockefeller Foundation 100 Resilient Cities, 30.

[208] Rockefeller Foundation 100 Resilient Cities, 30.

[209] Rockefeller Foundation 100 Resilient Cities, 7.

[210] Rockefeller Foundation 100 Resilient Cities, 18.

[211] "From Awareness to Action: Public Pledging," *Community Connect Labs* (blog), August 28, 2019, https://www.communityconnectlabs.com/post/from-awareness-to-action-public-pledging.

[212] "From Awareness to Action."

residents to sit on community development programs with the local government.[213] It also includes the provision of grants for community-led projects. The pillar also leverages technology or community members as a means to link to the government through an already established program called "Treasure Bank."[214] One way that *Resilient Kyoto* links formal and informal social capital is through the goal of "strengthening collaboration mechanisms for social services."[215] This initiative is about connecting various governmental, non-governmental, school, university, and private-sector entities in a collaborative manner to "amplify the results of these diverse social services."[216] This linking is key to building social capital and community resilience.

Bonding, bridging, and linking social capital are parts of the strategy. As Tierney, Lindell, and Perry write, "Culturally, members of Japanese society tend to feel a much greater sense of social obligation to their families and to secondary groups to which they belong, such as schools and employers, than they do to strangers."[217] Thus, the prevalence of bonding social capital may limit other types of connections following a disaster.

a. Framework Extension: Focus on Cultural Co-Benefits

Benadusi and others talk about the importance of culture in building and sustaining resilience. Initiative 4 of *Resilient Kyoto* brings "a cultural lens to resilience," highlighting actions that can connect culture and resilience. This initiative will build a framework to ensure that resilience work includes history, language, crafts, philosophy, and religion. The framework will add "the value of Kyoto's unique culture and approach to resilience-building."[218] This co-benefit will encourage resilience work in a culturally competent manner.

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[213] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 23.

[214] Rockefeller Foundation 100 Resilient Cities, 23.

[215] Rockefeller Foundation 100 Resilient Cities, 25.

[216] Rockefeller Foundation 100 Resilient Cities, 25.

[217] Tierney, Lindell, and Perry, *Facing the Unexpected*, 214.

[218] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 18.

b. Framework Extension: Building Up Tourism and the Population through Cultural Exchange

The homogeneity of Japan and Kyoto have hampered their ability to grow. *Resilient Kyoto*'s Initiative 2–2-2, "Fostering a Multi-Culturality," outlines steps to inspire foreign-born individuals to work and live in Kyoto. Some of the programs are meant to provide multilingual access to services and multicultural exchanges.[219] The strategy speaks to sharing traditional arts and culture through cross-generations and locals working together to define their culture.[220] Co-benefits for arts programs and tourism should provide financial gain.[221]

c. Framework Extension: Education through Disaster Drills, Curriculum, Media, and Commemoration

Education builds a culture of preparedness. Disaster tools can help build a culture of resilience through education. Kyoto Prefecture and City have worked hard to educate their populations. In 2011, experts praised public education campaigns in Japan for saving many lives during and after the earthquake.[222] Alerts and warnings through cell-phone text messaging, radio and television media, social media, warning sirens, and community and family learning are some of the ways to provide disaster education.[223] Earthquake preparedness drills and instruction begin as early as kindergarten in Japan.[224]

In April 2016, Kyoto Prefecture created a hazard map online called the Multi-hazard Information Providing System.[225] Residents can use the system for disaster drills, evacuation routes, and other disaster elements on one hazard map.[226] Another tool

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[219] Rockefeller Foundation 100 Resilient Cities, 24.

[220] Rockefeller Foundation 100 Resilient Cities, 26.

[221] Rockefeller Foundation 100 Resilient Cities, 26.

[222] James Glanz and Norimitsu Onishi, "Japan's Strict Building Codes Saved Lives," *New York Times*, March 11, 2011, https://www.nytimes.com/2011/03/12/world/asia/12codes.html.

[223] Preston, *Disaster Education*, 3.

[224] Alan Greenblatt, "Japanese Preparedness Likely Saved Thousands," National Public Radio, June 13, 2011, https://www.npr.org/2011/03/11/134468071/japanese-preparedness-likely-saved-thousands.

[225] "Past Calamities Revisited in Regional Collaborations."

[226] "Past Calamities Revisited in Regional Collaborations."

is the media and the ability to leverage it. Formal and informal (social) media have led disaster education into a space of collective information-sharing, which contrasts starkly with previous didactic methods.[227] During the 2011 Tōhoku earthquake and tsunami, "broadcast media adopted a reflexive approach to social media by reporting on what was being reported by users of Twitter. In turn, Twitter users 'Tweeted' their own interpretations of what was being broadcast in the media."[228] The cumulative ability of crowdsourcing far surpasses the scale and scope of government agencies. Therefore, the media and government can leverage these methods of education and information-sharing to build resilience.

d. Framework Extension: Personal Resilience Indicator—Focus on Physical and Mental Health

Resilient Kyoto focuses on the mental and physical health of its residents as a means to build resilience. Initiative 2–3-2 strives to "promote public health through empowering individuals with information and motivation to lead a healthy lifestyle. Co-benefits will include support concerning mental health issues such as anxiety, depression, and social isolation."[229] This emphasis on health supports the personal resilience focus of *Resilient Kyoto*. Notably, personal resilience is not an indicator extension but a new indicator.

5. Summary

Kyoto provides an optimal aperture to view resilience in the disaster context due to the sheer number of disasters it has faced and the preparedness culture that has resulted. Expanding the notion of resilience beyond earthquake-resistant buildings to mental health and food security serves as a progressive addition to the global resilience conversation. However, Kyoto is only one city and does not represent the panoply of community and urban resilience.

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[227] Preston, *Disaster Education*, 1.

[228] Preston, 1.

[229] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 25.

B. LOS ANGELES, CALIFORNIA, UNITED STATES

Los Angeles is one of many cities in the United States and worldwide facing escalating crises such as homelessness and affordable housing. Through 100RC, in 2013, Los Angeles began to build *Resilient Los Angeles* to tackle these and other issues. *Resilient Los Angeles* includes eight goals and 96 initiatives and is the most comprehensive of the four cities' resilience strategies. The 2018 issued report focuses on building resilience for the most vulnerable people and communities in Los Angeles. The plan mentions vulnerable populations, including the homeless, previously incarcerated, and low-income residents.[230] It also focuses on social equity, which is a unique part of the plan.[231]

Resilient Los Angeles'*s* targets include leadership and engagement, disaster preparedness and recovery, economic security, climate adaptation, and infrastructure modernization.[232] These themes are in the literature and map to the NIST framework at the governance, social, economic, and physical resilience indicator levels.

The city of Los Angeles sits on the Pacific Ring of Fire, which contains many faults and causes roughly 10,000 earthquakes a year in the southern part of California, many of them too minor to perceive.[233] The most significant seismic fault in Los Angeles is the strike-slip San Andreas Fault, a prominent "boundary between the Pacific Plate and the North American Plate, . . . vulnerable to the 'big one,' a potentially large and damaging event after the San Francisco earthquake in 1906."[234] Thus, the San Andreas Fault's geology lends it to additional "big" earthquakes.

The following noteworthy earthquakes have affected the Los Angeles area:

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[230] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles* (New York: Rockefeller Foundation, March 2018), 8, https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf.

[231] Rockefeller Foundation 100 Resilient Cities, 13.

[232] Rockefeller Foundation 100 Resilient Cities, 13.

[233] "Earthquake Hazards: Education," United States Geological Survey, accessed November 3, 2019, https://www.usgs.gov/natural-hazards/earthquake-hazards/education.

[234] "San Andreas Fault Set for the 'Big One' (Update)," Science X, June 21, 2006, https://phys.org/news/2006-06-san-andreas-fault-big.html.

- 1933 Long Beach 6.2 earthquake[235]
- 1971 San Fernando 6.7 earthquake[236]
- 1987 Whittier Narrows 5.9 earthquake[237]
- 1994 Northridge 6.7 earthquake[238]

Each earthquake resulted in damage to the built environment and injuries to the population.

The most recent Los Angeles seismic event, the 6.7 magnitude Northridge earthquake, caused the deaths of at least 57 people and economic losses of $49 billion and $20 billion in property and infrastructural damage.[239] In comparison to projected earthquakes in the Bay Area in Northern California, "A magnitude 7.8 on the San Andreas Fault in Southern California could be even more catastrophic, causing 1,800 deaths and 50,000 injuries."[240] These casualties would undoubtedly cause significant strain on the medical system. Other risks to the city of Los Angeles include floods, wildfires, tsunamis, and droughts.[241]

Los Angeles is the largest city in California, the most populous state in the United States.[242] The population of Los Angeles represents 10 percent of California's total

[235] Egill Hauksson and Susanna Gross, "Source Parameters of the 1933 Long Beach Earthquake," *Bulletin of the Seismological Society of America* 81, no. 1 (1991): 81, https://authors.library.caltech.edu/37028/1/81.full.pdf.

[236] "Today in Earthquake History: San Fernando 1971," *Seismo Blog*, February 9, 2017, https://seismo.berkeley.edu/blog/2017/02/09/today-in-earthquake-history-san-fernando-1971.html.

[237] E. Etheredge and R. Porcella, *Strong-Motion Data from the Whittier Narrows Aftershock of October 4, 1987*, Report No. 88-38 (Washington, DC: United States Geological Survey, 1988), 1, https://pubs.usgs.gov/of/1988/0038/report.pdf.

[238] "M 6.7 - 1km NNW of Reseda, CA," United States Geological Survey, accessed August 24, 2019, https://earthquake.usgs.gov/earthquakes/eventpage/ci3144585/executive.

[239] Rong-Gong Lin II, "This is What a Devastating Earthquake in California Would Look Like: Christchurch, New Zealand, Shattered by a 2011 Earthquake, Offers an Urgent Lesson for California," *Los Angeles Times*, December 12, 2019, https://www.latimes.com/california/story/2019-12-12/aftershocks-christchurch-new-zealand-earthquake-what-california-can-learn.

[240] "Southern San Andreas Shakeout Scenario," Southern California Earthquake Center, accessed January 28, 2021, https://www.shakeout.org/california/scenario/.

[241] Wisner, "Disaster Risk Reduction in Megacities," 184.

[242] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 11.

population, and in 2018 it was 3,990,456.[243] However, the Los Angeles metropolitan region "includes 160 municipal governments and accounts for roughly one-half of California's entire population."[244] Wisner writes, "In the five-county region within a radius of 60 miles (96 km) of the City of Los Angeles are 26 full-blown 'edge cities.'"[245] Demographers and scholars have varying opinions on what Los Angeles comprises. In 2003, Wisner wrote that five Southern California counties spread across 34,000 square miles, with 15 million residents, composed Los Angeles.[246] The City of Los Angeles proper encompasses "502.7 square miles (468.7 square miles of which is land and 34.0 square miles of water)."[247]

Over the last 70 years, the Los Angeles metropolitan region has grown exponentially.[248] Such continued growth has been seen across the United States in coastal metropolitan areas.[249] Moves to urban areas have created more diversity in cities. In Los Angeles from 2014 to 2018, 59.3 percent of residents over the age of five spoke languages other than English.[250] Research in 2003 suggests that although greater Los Angeles is very diverse, the population is "highly stratified by income and by race."[251] There are 47.3 million visitors to Los Angeles each year, and 37.8 percent of its population was not born in the United States.[252]

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[243] "QuickFacts: Los Angeles City, California," United States Census Bureau, accessed August 24, 2019, https://www.census.gov/quickfacts/losangelescitycalifornia.

[244] Ben G. Wisner, "Urban Social Vulnerability to Disaster in Greater Los Angeles," in *Sustainable Cities: Encyclopedia of Life Support Systems* (Paris: United Nations Educational, Scientific and Cultural Organization, 2003), 91.

[245] Wisner, 91.

[246] Wisner, 91.

[247] "LA Sanitation & Environment Leads U.S. in Protecting Biodiversity & Measuring Urban Ecosystem Health," *Planning Report*, February 2020, https://www.planningreport.com/2020/02/27/la-sanitation-environment-leads-us-protecting-biodiversity-measuring-urban-ecosystem.

[248] Wisner, "Urban Social Vulnerability," 91.

[249] Federal Emergency Management Agency, *2014–2018 Strategic Plan* (Washington, DC: Federal Emergency Management Agency), 4, https://www.hsdl.org/?view&did=757282.

[250] United States Census Bureau, "QuickFacts: Los Angeles City, California."

[251] Wisner, "Urban Social Vulnerability," 91.

[252] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 11.

1. Resilience Governance

Governing in the United States connects to core American values, including American exceptionalism, individualism, and local control. Structurally, the federal and state governments in the country push disaster work to the local level with the idea that local emergency management will know the best way to respond to local needs.[253] Locals are nominally at the helm during disasters with support from states and then the federal government. If the response and recovery are beyond the locality's capacity, state and federal entities may take a more active role.

State agencies support local governments in California, but large cities are often leaders in local resilience work due to their access to resources. Los Angeles is a well-resourced city with a mayor–council–commission form of government.[254] The mayor and 15 City Council members serve four-year terms through local elections.[255] The mayor appoints the general manager of the Emergency Management Department (EMD).[256] Like many large cities and well-funded emergency management departments, the Los Angeles EMD includes planning, training and exercise, preparedness, operations, and administration divisions.[257] The City of Los Angeles' EMD is in Los Angeles County, which also has its own Office of Emergency Services, and by state law, the City of Los Angeles must go through the county to receive state support. In the 1990s, California required all counties and cities to partake in mutual aid agreements and codified that cities must go through counties to access the California Governor's Office of Emergency Services in the Standardized Emergency Management System.[258]

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[253] Tierney, Lindell, and Perry, *Facing the Unexpected*, 68.

[254] "Form of Government," City of Los Angeles, access August 24, 2019, https://www.lacity.org/government/popular-information/form-government.

[255] City of Los Angeles.

[256] "About EMD," Los Angeles Emergency Management Division, August 24, 2019, https://emergency.lacity.org/about-emd.

[257] Los Angeles Emergency Management Division.

[258] Wisner, "Urban Social Vulnerability," 93.

Like many of the 100 Resilient Cities in the United States, the Los Angeles EMD does not lead resilience planning through a resilience division. Instead, it resides in a mayor's Office of Resilience, run by a Chief Resilience Officer (CRO).[259] EMDs do not always orchestrate recovery planning and execution holistically. It is a monumental, protracted, and expensive task, often executed by the mayor's office and department head committees run by a CRO. In March 2018, Los Angeles Mayor Eric Garcetti signed an executive directive obligating 28 city departments to assign a CRO.[260] It is unclear how these CROs collaborate and how non-governmental and private-sector entities are engaged in this work.

Resilient Los Angeles looks specifically at how the many CROs and other resilience leadership within the city fabric should be diverse and representative of the communities served. A governance piece of *Resilient Los Angeles* promotes more diversity in leadership positions through policy development that supports this effort.[261] This diversity push can link to higher levels of trust, the keystone to building resilience.

2. Economic Resilience: Economic Development

"Economic Security" is a section of *Resilient Los Angeles*. The median household income in Los Angeles in 2018 was $51,538, and a staggering 22 percent of its 3,990,456 population—877,900 people—were living in poverty.[262] The strategy lays out five goals to help build economic resilience in Los Angeles. The first goal pushes a 2021 deadline to build 100,000 new housing units and ensure that existing affordable housing units remain in place.[263] Another goal is to reduce the homeless population by half by 2022.[264] From

[259] "Mayor's Office of Resilience," City of Los Angeles, accessed August 24, 2019, https://www.lamayor.org/Resilience.

[260] "Mayor Eric Garcetti Announces Plan for a Resilient Los Angeles," City of Los Angeles, accessed August 24, 2019, https://www.lamayor.org/mayor-eric-garcetti-announces-plan-resilient-los-angeles.

[261] City of Los Angeles.

[262] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 13.

[263] Rockefeller Foundation 100 Resilient Cities, 13.

[264] Rockefeller Foundation 100 Resilient Cities, 13.

2016 to 2017, homelessness increased by 20 percent, to 34,189 unhoused individuals.[265] The strategy aims to address homelessness through mobile services and partnerships between government and agencies that provide services to the homeless population.[266]

Resilient Los Angeles ties life expectancy to vulnerability and, by 2028, wishes to increase life expectancy for vulnerable areas of Los Angeles.[267] The strategy also encourages the development, by 2028, of hubs of resilience in vulnerable neighborhoods.[268] Neighborhood resilience hubs are located within existing community organizations and provide physical space for community members to gather and share resources before, during, and after a disaster.[269]

Both the state of California and the City of Los Angeles have robust economies. In 2018, the Bureau of Economic Analysis gauged Los Angeles County's economic strength by its output: "$710.9 billion GDP—equivalent to Saudi Arabia—accounting for 3.8 percent of the U.S. total."[270] Between 2001 and 2018, Los Angeles County added $395.2 billion to the U.S. GDP.[271] The Los Angeles region had a GDP of $1 trillion in 2018.[272] In 2018, California's GDP was $2.7 trillion, an increase of 4 percent from 2017 and the highest of any state.[273] The state also retains 13 percent of the country's GDP.[274] California continues to be an economic leader in the United States with the largest

[265] Rockefeller Foundation 100 Resilient Cities, 7.

[266] Rockefeller Foundation 100 Resilient Cities, 79.

[267] Rockefeller Foundation 100 Resilient Cities, 13.

[268] Rockefeller Foundation 100 Resilient Cities, 13.

[269] Rockefeller Foundation 100 Resilient Cities, 59.

[270] Andre Tartar and Reade Pickert, "One-Third of the U.S. Economy Is Jammed into Just 31 Counties. L.A. Is the Biggest," *Los Angeles Times*, December 19, 2019, https://www.latimes.com/business/story/2019-12-19/los-angeles-largest-economy.

[271] Tartar and Pickert.

[272] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 11.

[273] Tartar and Pickert, "One-Third of the U.S. Economy."

[274] "About Cal OES," California Governor's Office of Emergency Services, accessed August 24, 2019, https://www.caloes.ca.gov/cal-oes-divisions/about-cal-oes.

population and economy and is the world's fifth-largest economy, right after Japan.[275] In 2017, government spending in the United States was 38 percent of GDP.[276] This percentage is a constant trend and holds with an average of 37.08 percent from 1970 to 2017.[277]

Although Los Angeles' economic make-up is quite strong, the eight goals and 96 initiatives in *Resilient Los Angeles* also include the need for funding streams. Local and state government initiate disaster and resilience work through federal grants—bonds to shore up and retrofit infrastructure—and sometimes part of general fund portions of operating budgets. Voters have passed measures to improve Los Angeles' infrastructure, such as its public transportation, which the strategy highlights. Some of the strategy projects were already in operation in 2018, and the city had already allocated funding. Public–private partnerships that may not have existed in 2018 will pay for most of the *Resilient Los Angeles* projects. There is wording throughout the document that suggests the evaluation of potential funding options.

Los Angeles relies on federal and state grants for resilience and emergency management work. A significant funding stream comes from the federal Urban Areas Security Initiative (UASI). The City of Los Angeles (as well as five other jurisdictions) is part of the Los Angeles County/Long Beach UASI, which was awarded over $56 million in 2018.[278] The national UASI program awards $615 million annually to 32 areas across

[275] Associated Press, "California Is Now the World's Fifth-Largest Economy, Surpassing United Kingdom," *Los Angeles Times*, May 3, 2018, https://www.latimes.com/business/la-fi-california-economy-gdp-20180504-story.html.

[276] "United States Government Spending to GDP," Trading Economics, accessed August 24, 2019, https://tradingeconomics.com/united-states/government-spending-to-gdp.

[277] Trading Economics.

[278] Sachi A. Hamai, "Accept 2018 Urban Area Security Initiative Grant Funds (All Districts) (3 Votes)" (official memorandum, Los Angeles: County of Los Angeles Chief Executive Office, July 30, 2019), http://file.lacounty.gov/SDSInter/bos/supdocs/138173.pdf.

the United States deemed at high risk of terrorist attacks.[279] The Los Angeles County/Long Beach UASI receives the most funding proportionally in the nation.[280]

a. Framework Extension: Personal Economic Resilience

In the form of low debt and high savings, personal economic resilience is the marker of individual resilience, which can aggregate into community resilience. U.S. median incomes have remained unchanged since the early 1990s, while top earners have increased their incomes three times.[281] From 2014 to 2018, the median value of owner-occupied housing units in Los Angeles was $599,700, and the median gross rent was $1,376, making both homeownership and renting untenable for many.[282] In 2018, 62 percent of the Los Angeles population were renters.[283]

Resilient Los Angeles squarely tackles economic resilience in the frame of personal economic resilience and provides tangible ways to build such resilience through financial literacy. The strategy states, "A 2016 survey revealed that nearly 70 percent of Americans have less than $1,000 in their savings accounts and 34 percent have no savings at all."[284] *Resilient Los Angeles* touts a "capital project pipeline that creates living-wage jobs" in Los Angeles and updates the aging infrastructure.[285]

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[279] "DHS Announces Funding Opportunity for Fiscal Year 2020 Preparedness Grants," Department of Homeland Security, February 14, 2020, https://www.dhs.gov/news/2020/02/14/dhs-announces-funding-opportunity-fiscal-year-2020-preparedness-grants#:~:text=States%20are%20required%20to%20dedicate,threat%2C%20high%2Ddensity%20areas.

[280] Eric Garcetti, "Urban Areas Security Initiative FY 2016 Grant, Office of Homeland Security: Notification of Submission of a Grant Application and Request for Adoption of Governing Body Resolution" (official memorandum, Los Angeles: City of Los Angeles, June 29, 2016), http://clkrep.lacity.org/onlinedocs/2016/16-0777_rpt_MAYOR_06-30-2016.pdf.

[281] Jonathan Kay, "The Key to Canada's Economic Advantage over the United States? Less Income Inequality," *National Post*, December 13, 2012, https://nationalpost.com/opinion/jonathan-kay-the-key-to-canadas-economic-advantage-over-the-united-states-less-income-inequality.

[282] United States Census Bureau, "QuickFacts: Los Angeles City, California."

[283] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 13.

[284] Rockefeller Foundation 100 Resilient Cities, 43.

[285] Rockefeller Foundation 100 Resilient Cities, 42.

The strategy also includes a push for free Wi-Fi to grow community resilience and better ways to reintegrate previously incarcerated individuals back into society.[286] From 2014 to 2018, 80.7 percent of Los Angeles households had broadband internet subscriptions, yet free Wi-Fi for the additional 20 percent would strengthen connectivity to find jobs and services and, therefore, increase both social and economic resilience.[287] There is also a push to build partnerships that help employ younger members of the Los Angeles community, and *Resilient Los Angeles* highlights both economic prosperity and social equity work.[288]

b. Framework Extension: Increasing the Number of People Insured

Regarding insurance, *Resilient Los Angeles* discloses that "the City will work with local, state, and federal partners to increase the number of properties covered under earthquake insurance."[289] Through insurance data, the city will find neighborhoods with lower coverage and start educational pilot programs in those neighborhoods.[290]

c. Framework Extension: Supply Chain Resilience

Goal 85 of *Resilient Los Angeles* is to "fortify critical lifeline infrastructure and supply chains through continued assessments, coordination, and investments."[291] The strategy speaks to the interdependencies of supply chains and critical lifelines through a regional effort with federal, state, and county partners.[292] The first step is to identify risks and possible reduction methods.[293] Many cities and regions across the United States have

[286] Rockefeller Foundation 100 Resilient Cities, 42.

[287] United States Census Bureau, "QuickFacts: Los Angeles City, California."

[288] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 47.

[289] Rockefeller Foundation 100 Resilient Cities, 32

[290] Rockefeller Foundation 100 Resilient Cities, 33.

[291] Rockefeller Foundation 100 Resilient Cities, 138.

[292] Rockefeller Foundation 100 Resilient Cities, 138.

[293] Rockefeller Foundation 100 Resilient Cities, 138.

lifelines councils. Southern California Critical Lifelines Workgroup is the body that would do this work.[294]

Resilient Los Angeles highlights an economic resilience initiative undertaken by Los Angeles EMD in partnership with the Federal Emergency Management Agency (FEMA): the City of Los Angeles Supply Chain Resilience Initiative. The program became a national model and focused on the critical sectors of fuel, food, medical goods, pharmaceuticals, water, and transportation.[295] The report highlights the industries' resilience roles and how to support their quick recovery following a disaster.[296]

3. Physical Resilience: Built Environment

Not only is the United States vulnerable to many risks and densely populated in areas, but the infrastructure is also aging. Thus, the need for updated physical resilience work is not new in Los Angeles. The physical resilience work laid out in *Resilient Los Angeles* builds on projects and programs undertaken well before the strategy was drafted, such as Rebuild L.A., from the 1970s–1990s. Following the tremendous success of Rebuild L.A., with its $300 million earmarked for rebuilding efforts, little else was invested in the struggling community's built environment.[297] *Resilient Los Angeles* focuses on shoring up 30 years of neglect to the built environment.

In December 2014, Mayor Garcetti's Seismic Safety Task Force produced the *Resilience by Design* report in concert with the 100RC *Resilient Los Angeles* work. The report focuses on "three priority areas for resilience investments: structural integrity of buildings, public water infrastructure integrity, and telecommunications infrastructure reliability."[298] The City of Los Angeles wrote *Resilience by Design*'s recommendations

[294] Rockefeller Foundation 100 Resilient Cities, 138.

[295] "Supply Chain Resilience Initiative," Los Angeles Emergency Management Division, accessed August 24, 2019, https://emergency.lacity.org/supply-chain.

[296] Los Angeles Emergency Management Division.

[297] Vale and Campanella, *The Resilient City*, 304.

[298] Berrick, *Homeland Security*, 7–8.

and building code updates.[299] City agencies and the U.S. Geological Survey worked to regulate private telecommunication infrastructure without that group building the report.

As part of *Resilience by Design*, Mayor Garcetti hired Dr. Lucy Jones, a seismologist and former risk-reduction advisor for the U.S. Geological Survey, as his science advisor for seismic safety.[300] Jones's role included developing an action plan through vulnerability research with experts from communities, the government, the private sector, and academia.[301] *Resilient Los Angeles* has the reestablishment of the Seismic Safety Task Force as one of its goals.[302]

In 2016, there was another physical resilience report in Los Angeles. The U.S. Green Building Council's Los Angeles Chapter drafted *Building Resilience Los Angeles: A Primer for Facilities*. This work includes the goals of building coalitions, risk evaluation processes, and community engagement. Further, the report promotes implementing solutions that benefit the whole community, case studies of resilience work in the Los Angeles region, a template for other parts of the state and country, and a platform for support of peer-to-peer performance benchmarking and networking.[303]

NIST's 2015 *Community Resilience Planning Guide*, which enumerates steps to build a guide, including team formation, setting goals and objectives, developing a plan, and implementing and maintaining the program, underpins *Building Resilience*.[304] This strategy has a clear trajectory, which may enable its success.[305] NIST's *Community*

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[299] Berrick, 7–8.

[300] Mayoral Seismic Task Force, *Resilience by Design* (Los Angeles: Mayoral Seismic Task Force, December 2014), 3, https://www.lamayor.org/sites/g/files/wph446/f/article/files/Resilience%20by%20Design%20(1).pdf.

[301] Mayoral Seismic Task Force, 3.

[302] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 105.

[303] U.S. Green Building Council–Los Angeles, *Building Resilience Los Angeles: A Primer for Facilities* (Los Angeles: U.S. Green Building Council–Los Angeles, 2016), ii, https://static1.squarespace.com/static/57dc2456e58c62e05fee0316/t/58177cb7725e25ba06357b20/1477934275541/10-24-2016_BuildingResiliency-LA.pdf.

[304] U.S. Green Building Council–Los Angeles, iii.

[305] "Community Resilience Planning Guide," National Institute of Standards and Technology, last modified November 5, 2020, https://www.nist.gov/topics/community-resilience/planning-guide.

Resilience Planning Guide, like its resilience framework, examines how social dimensions and the built environment can be clustered to support one another.[306]

In 2017, Mayor Garcetti's office issued another physical resilience initiative called Building Forward LA, which includes national and local organizational partnerships in a six-month design and research process.[307] Building Forward LA's goal is to update the city's building policies and procedures by creating a prioritization framework with stakeholder engagement and input gathered from various fields.[308] The initiative includes all types of buildings and pushes design, engineering, and construction innovation.[309] The framework embraces ways to make existing policies less "difficult, time consuming or costly to implement" for those who work to make the built environment more resilient.[310]

a. Framework Extension: Port Resilience

Resilient Los Angeles includes information about zero-emission technology as a way to increase the Port of Los Angeles' resilience, and the Port's *2018–2022 Strategic Plan* provides a vulnerability study, which looks at its adaptive capacity and vulnerability.[311] A risk and vulnerability report is the output of the *Strategic Plan* with specific recommendations. It contains four objectives that map to the NIST framework around improving the built environment and infrastructure, economic resilience in the form of supply chain resilience, and social resilience in pushing "strong relationships with stakeholders."[312]

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[306] National Institute of Standards and Technology.

[307] "Building Forward LA," City of Los Angeles, accessed August 24, 2019, https://www.lamayor.org/BuildingForwardLA.

[308] City of Los Angeles.

[309] City of Los Angeles.

[310] City of Los Angeles.

[311] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 127.

[312] Port of Los Angeles, *2018–2022 Strategic Plan* (San Pedro, CA: Los Angeles Harbor Department, 2018), 3, https://kentico.portoflosangeles.org/getmedia/6ac20c8e-f574-44a8-b28e-da8683b41cf6/Strategic-Plan-2018-2022.

The Port of Los Angeles is a revenue-generating enterprise department of the City of Los Angeles that is supported in part by taxes.[313] As one of the world's busiest ports, it is crucial to the economic viability of Los Angeles and beyond.[314] The port's footprint includes 43 miles of waterfront and 7,500 acres of water and land.[315] The Port of Los Angeles is also the "leading gateway for international trade in North America and has ranked as the number one container port in the United States each year since 2000."[316] The port moved more cargo that year than any other port in the Western Hemisphere.[317] The physical resilience of ports is crucial to the economic resilience of Los Angeles communities and others. Furthermore, individual city departments need strategic resilience plans because city and state resilience strategies may not specifically address their needs. These department plans should be cross-walked to find interdependencies.

4. Social Resilience: Social Capital

Social resilience is a keystone in *Resilient Los Angeles*, and two main elements are education and volunteerism. Goal 1 of the strategy is to "educate and engage Angelinos around risk reduction and preparedness so they can be self-sufficient for at least seven to 14 days after a significant shock."[318] The strategy states that this will be accomplished through public outreach campaigns and providing grants for community-led projects.[319] The strategy pushes social resilience throughout by increasing partnerships with governmental and non-governmental organizations, which creates a bridge between formal and informal social networks.

Many cities build emergency response volunteers through their Community Emergency Response Team (CERT) programs, and *Resilient Los Angeles* lauds their

[313] "About the Port of Los Angeles," Port of Los Angeles, accessed December 4, 2020, https://www.portoflosangeles.org/about.

[314] Port of Los Angeles.

[315] Port of Los Angeles.

[316] Port of Los Angeles.

[317] Port of Los Angeles.

[318] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 31.

[319] Rockefeller Foundation 100 Resilient Cities, 65.

efforts in Los Angeles. The Los Angeles Fire Department started the first CERT program in 1986 after visiting Japan and learning how volunteer groups there execute much of the local response following disasters.[320] In 2003, Los Angeles had trained more than 20,000 CERT members. Still, Wisner writes, "Very few of these are low income, minority or immigrant residents who could share such skills with their neighbors in impoverished areas like South Central LA and Hispanic areas of East LA."[321] Leaving out members of the population hampers the city government's ability to muster support for resilience-building initiatives. Relationships between diverse economic and ethnic groups are already challenging for government bodies to navigate appropriately.[322] Such a dynamic exacerbates the challenge of connecting formal social capital, occupied by those in power, and Los Angeles residents, who hold the key to building community resilience.[323]

The literature suggests that government and community organizations need to link formal and informal social capital. As mentioned, Los Angeles is full of diverse neighborhoods, businesses, non-profit organizations, industry, government, communities, and faith-based organizations. Local emergency management in 2002, however, had no non-governmental organizations on councils at the local government level, which could have provided a bridge between formal and informal social capital.[324] Los Angeles has done an excellent job since then to incorporate non-governmental organizations into their planning.

5. Summary

Los Angeles is a city that faces obstacles, which it has tried to shift into opportunities. There are numerous city- and state-based resilience projects in both the social and physical realms that tie in and support *Resilient Los Angeles.* Some unique

[320] "Community Emergency Response Team (CERT)," Los Angeles Fire Department, accessed December 4, 2020, https://www.lafd.org/join/volunteer/cert.

[321] Wisner, "Urban Social Vulnerability," 92.

[322] Wisner, 92.

[323] Aldrich and Meyer, "Social Capital and Community Resilience," 258.

[324] Wisner, "Disaster Risk Reduction in Megacities," 191.

factors of the plan focus on social equity and personal resilience. It looks at how vulnerable populations include low-income residents, formerly incarcerated individuals, and the growing homeless population. Shoring up these communities through free Wi-Fi and programs aimed at growing employment levels for these groups focuses on how personal resilience will result in higher community resilience. There is also the unique individual resilience indicator of life expectancy, and the plan mentions ways to increase life expectancy for vulnerable areas of Los Angeles.[325] Its focus on linking social capital, whereby the government works directly to aid those with lower social capital and, therefore, resilience, makes *Resilient Los Angeles* full of attractive resilience-building prospects.

C. VANCOUVER, BRITISH COLUMBIA, CANADA

The City of Vancouver's *Resilient Vancouver* follows a time horizon to 2050, which is unique.[326] Like the other city resilience strategies, *Resilient Vancouver* builds on existing strategies.[327] The plan lists specific and measurable goals. One goal is for DRR and more robust recovery mandates.[328] Much of this DRR work is and will be orchestrated by the Pathways to Disaster Risk Reduction Project, a steering committee comprising various stakeholders.[329]

Resilient Vancouver launched the Resilient Neighbourhoods Program, a significant effort of the strategy, in June 2019. The program's goals include building community capacity, ensuring the community has a voice in built environment projects, and addressing

[325] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 13.

[326] "Resilient Vancouver," City of Vancouver, accessed September 13, 2019, https://vancouver.ca/people-programs/resilient-neighbourhoods-program.aspx.

[327] City of Vancouver.

[328] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver* (New York: Rockefeller Foundation, June 2019), 70, https://vancouver.ca/files/cov/resilient-vancouver-strategy.pdf.

[329] Rockefeller Foundation 100 Resilient Cities, 73.

chronic issues, or vulnerabilities, in communities.[330] A toolkit provides guidance, as well as grants to help finance community-based projects.[331]

The Rockefeller Foundation chose Vancouver as one of the cities needing a resilience framework due to its earthquake-risk profile, flooding, fires, and growing concerns around sea-level rise and the succeeding steps of climate adaptation. It is a coastal seaport city in western Canada, located in the Lower Mainland region of British Columbia.[332] Since 1998, 80 percent of federal assistance payments have gone to Canada's most recurrent and expensive natural disasters—flooding.[333] Other risks include earthquakes, hail, landslides and snow avalanches, tornadoes, tsunamis and storm surges, volcanic eruptions, and winter storms.[334]

Vancouver is the most populous city in the British Columbia province.[335] In 2011, the census recorded a population of 603,502, and that number increased almost 10 percent to 631,486 in the 2016 census.[336] Greater Vancouver is the third-most populous metropolitan area in Canada, with a 2016 census of 2,463,431.[337] Vancouver is the most densely populated area of Canada and "the fifth-most densely populated city with over

[330] City of Vancouver, "Resilient Vancouver."

[331] City of Vancouver.

[332] "Census Profile, 2016 Census: Lower Mainland–Southwest [Economic Region], British Columbia and British Columbia [Province]," Statistics Canada, last modified August 9, 2019, https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=ER&Code1=5920&Geo2=PR&Code2=59&Data=Count&SearchText=British%20Columbia&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=59.

[333] Public Safety and Emergency Preparedness Canada, "Government of Canada Contributes to Resilient Communities in British Columbia," Cision, November 16, 2018, https://www.newswire.ca/news-releases/government-of-canada-contributes-to-resilient-communities-in-british-columbia-700694651.html.

[334] "Natural Disasters: County Profile Series," Inland Marine Underwriters Association, accessed September 13, 2019, https://www.imua.org/Files/reports/Natural%20Disasters%20-%20Country%20Profile%20Series%20-%20Canada.html.

[335] "Population and Dwelling Count Highlight Tables, 2011 Census," Statistics Canada, October 2, 2020, https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/hlt-fst/pd-pl/Table-Tableau.cfm?LANG=Eng&T=307&SR=1&S=10&O=D.

[336] Statistics Canada.

[337] Canadian Press, "Population of Metro Vancouver Outpaced National Growth Rate," *Vancouver Sun*, February 8, 2017, https://vancouversun.com/news/local-news/new-census-data-population-of-metropolitan-area-of-vancouver-outpaced-national-growth-rate.

250,000 residents in North America, behind New York City, Guadalajara, San Francisco, and Mexico City, according to the 2011 census."[338]

From 2005 to 2010, the Group of Eight (G8) included nations with the most advanced economies: Japan, the United States, Canada, the United Kingdom, Italy, Germany, France, and Russia.[339] Canada had the highest growth in population, about 1.1 percent, and migratory increases were the main driver.[340] Canada anticipates that its population growth will level off but stay higher than other G8 countries.[341] The country's 2011 National Household Survey suggests that 20.6 percent of the population was not born in Canada.[342]

One of the main stressors or drivers for *Resilient Vancouver* is the aging population's growth with little economic resilience.[343] By 2041, residents 65 and older are expected to increase by an alarming 92 percent, with only a 10 percent increase of people younger than that demographic in the same timeframe. This escalation has already strained the government's social service system and will continue to do so.[344]

1. Resilience Governance

Resilient Vancouver gives one of the four cities' more specific ways to govern resilience by offering the approach to share tools that root resilience projects and concepts in community-based organizations and city government.[345] This "embedding" of resilience is an original piece of the strategy's Phase 3, "Implementation and Integration (2019–21)."[346] The theme of "embedding" resilience continues with ensuring the city

[338] Canadian Press.

[339] Statistics Canada, *Canadian Demographics at a Glance*, 2nd ed. (Ottawa: Minister of Industry, 2016), 5, https://www150.statcan.gc.ca/n1/en/pub/91-003-x/91-003-x2014001-eng.pdf?st=ilauwXSI 5.

[340] Statistics Canada, 5.

[341] Statistics Canada, 5.

[342] Statistics Canada, 34.

[343] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 30.

[344] Rockefeller Foundation 100 Resilient Cities, 30.

[345] Rockefeller Foundation 100 Resilient Cities, 20.

[346] Rockefeller Foundation 100 Resilient Cities, 21.

planning and strategies include risk-reduction data and research.[347] Governance is the act of not just developing policy but also implementing it.

Phases 1 and 2 were also steps in resilience governance. Phase 1, "Preliminary Resilience Assessment (2017–18)," was about stakeholder engagement, gap analysis, and resilience work inventories. Phase 2, "Engagement, Research and Action (2018–19)," then focused on convening working groups of diverse stakeholders, leveraging funds for physical and social resilience projects, delegating earthquake-specific tasks, and refining strategic goals, objectives, and actions.[348] The action piece presents the means of operationalizing resilience goals and objectives.

Governance is also about coordination, collaboration, and resource and policy alignment.[349] As *Resilient Vancouver* claims, "Resilience, Sustainability, Emergency Management, and Risk Management teams can streamline risk reduction and adaptation efforts and resources through City-coordinated decision-making and planning processes for our greatest hazards."[350] This method of coordination aligns with the *Sendai Framework*.[351] Cities do receive some support from the Canadian government in resilience work. Canada, though, has one of the most decentralized governments in the world, second only to Switzerland.[352] This decentralization has pushed control to the provinces and municipalities within them. Thus, the policies of the provinces and cities are customized, unique, and pertinent.

The city of Vancouver places emergency management under a public safety umbrella with fire and rescue services. The Vancouver Emergency Management Agency writes emergency plans, coordinates emergency alerts and warnings, and trains volunteers

[347] Rockefeller Foundation 100 Resilient Cities, 21.

[348] Rockefeller Foundation 100 Resilient Cities, 21.

[349] Rockefeller Foundation 100 Resilient Cities, 70.

[350] Rockefeller Foundation 100 Resilient Cities, 70.

[351] Rockefeller Foundation 100 Resilient Cities, 70.

[352] Andrew Parkin, "Most Canadians Don't Want a Province-First Approach to Climate Change," *Policy Options*, July 16, 2019, https://policyoptions.irpp.org/magazines/july-2019/most-canadians-dont-want-a-province-first-approach-to-climate-change/#:~:text=Canada%20is%20already%20the%20developed,government%20of%20any%20comparable%20country.

through the Vancouver Volunteer Corps.[353] The Corps comprises four areas: emergency communications through VECTOR for amateur radio capability; Emergency Social Services for shelter volunteer support; the Neighbourhood Emergency Assistance Team, which offers support to first responders during a disaster; and the Neighbourhood Emergency Preparedness Program, whereby volunteers teach preparedness to community members.[354] The city's website includes an overview of the risks that Vancouver experiences as well.

Twenty-one municipalities, one Treaty First Nation, and one electoral area make up Metro Vancouver. This multitude of stakeholders necessitates a regional emergency management coordination body. The Integrated Partnership for Regional Emergency Management in Metro Vancouver oversees Metro Vancouver and the province of British Columbia.[355] With a decentralized national government, the provincial and local governments must work closely on resilience work.

a. Framework Extension: Equity Framework

A piece that stands out in the Vancouver report is the need to recognize intersectionality through the development of an "equity framework." The framework aims to address hardships caused by social and economic disparity and defines intersectionality as "a way of seeing how a group of people or social problem is affected by mutually reinforcing systems that work together to create inequity and social exclusion."[356] The equity framework helps to operationalize equity through steps to implement intersectional policy and planning strategies.[357] Bolstering this framework, the beginning of the report

[353] "Volunteer to Help in an Emergency," City of Vancouver, accessed September 13, 2019, https://vancouver.ca/home-property-development/how-you-can-help-in-an-emergency.aspx.

[354] City of Vancouver.

[355] "About Us," Integrated Partnership for Regional Emergency Management in Metro Vancouver, 2015, http://www.iprem.ca/about/Pages/default.aspx.

[356] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 32.

[357] Rockefeller Foundation 100 Resilient Cities, 32.

acknowledges that the First Nations' people have been Canada's community resilience teachers and ambassadors for generations.[358]

2. Economic Resilience: Economic Development

Vancouver has the fastest growing economy in Canada, even though 44 percent of residents do not make a living wage.[359] British Columbia has the highest level of income inequality of all the Canadian provinces.[360] *Resilient Vancouver* explains that low wages and debt deter the local population from staying in Vancouver because the city ranks among the highest costs of living in North America. Moreover, those who choose to remain in Vancouver have more debt than residents of any other city in Canada.[361] *Resilient Vancouver* details the related stressors of food insecurity and poverty that affect the population of Vancouver.[362] One suggestion to combat this lack of economic resilience entails participatory budgeting, which involves community members in government budget processes to ensure that the local government meets community needs.[363]

As a decentralized national government system, much of the funding for resilience projects is initiated and planned for at the provincial and local levels. The federal government, however, does provide mitigation grant funds and contributes to communities for recovery when significant disasters strike. Nationally, Canada spends 20.98 percent of its GDP on government.[364] As with the United States and other countries, Canada's economy cyclically ebbs into recessions and flows into greater prosperity. The country's

[358] Rockefeller Foundation 100 Resilient Cities, 4.

[359] Rockefeller Foundation 100 Resilient Cities, 11.

[360] Craig Alexander and Francis Fong, *Income and Income Inequality—A Tale of Two Countries* (TD Economics, 2012), 4, https://www.td.com/document/PDF/economics/special/ff1212_income.pdf.

[361] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 30.

[362] Rockefeller Foundation 100 Resilient Cities, 30.

[363] Rockefeller Foundation 100 Resilient Cities, 54.

[364] "Canada: Government Spending, Percent of GDP," Global Economy, accessed September 13, 2019, https://www.theglobaleconomy.com/Canada/government_size/#:~:text=Canada%3A%20Government%20spending%20as%20percent%20of%20GDP&text=The%20latest%20value%20from%202018%20is%2020.98%20percent.

median household income, though, has been higher than that of the United States, and there has been steady growth for both lower- and higher-income earners.[365]

a. Framework Extension: Insurance

Resilient Vancouver highlights the stark statistic that fewer than 50 percent of Vancouver residents have earthquake insurance and that most renters have no insurance.[366] The strategy does not outline how to ensure more individuals but instead focuses on the city's working with risk, insurance, government, and other regional stakeholders to invest in infrastructure.[367]

Insurance is an issue across Canada, as in many countries, due to the amount of flooding and other disasters. In 2017, The Insurance Bureau of Canada insured $4.9 billion in damage, which passed "the previous annual record of $3.2 billion set in 2013—and . . . the annual economic cost of disasters around the world has increased five-fold since the 1980s."[368] Surpassing the record by $1.7 billion indicates a need to strengthen DRR work—as disaster costs continue to rise—and improve mitigation efforts. Another shocking element that should push more DRR work through indemnification is that 80 percent of local government-owned infrastructure in the Vancouver region carries no insurance.[369] This statistic, coupled with rising personal debt, poverty, and income inequality, shows that Vancouver and Canada are on the edge of a precipice of low economic resilience.

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[365] Craig Anthony, "10 Countries with the Most Natural Resources," Investopedia, June 25, 2019, https://www.investopedia.com/articles/markets-economy/090516/10-countries-most-natural-resources.asp.

[366] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 34.

[367] Rockefeller Foundation 100 Resilient Cities, 87.

[368] Public Safety and Emergency Preparedness Canada, "Canada Contributes to Resilient Communities."

[369] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 36.

3. Physical Resilience: Built Environment

Local built-environment resilience work in Vancouver is substantial and includes a resilient buildings initiative.[370] *Resilient Vancouver* includes goals about strengthening the supply chain, building codes, and critical infrastructure.[371] As social capital and resilience often need physical space in the built environment to grow, *Resilient Vancouver* provisions a community hub model called Neighbourhood Resilience Labs.[372] These labs, locations to test community-based ideas and concepts, were in the exploration phase at the strategy's publication date.[373]

Resilient Vancouver does an excellent job of articulating how to govern physical resilience. The plan advances physical resilience governance through the goal of "develop [ing] a city-wide framework for critical infrastructure management and decision-making."[374] The framework at the time of publication did not exist; however, acknowledging this need for guidance on physical resilience governance is a promising first step.

Another built-environment governance project aims to "create and test a Resilient Neighbourhood Design Framework" that links resilience objectives to design efforts.[375] The City Design Studio, global experts, and Vancouver city departments will develop this framework, aiming to provide planners with a tool to "evaluate the co-benefits and trade-offs of different design approaches on a wide range of objectives—from disaster risk reduction to walkable communities" with consultation from the community.[376]

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[370] "Resilient Buildings," City of Vancouver, accessed September 13, 2019, https://vancouver.ca/people-programs/resilient-buildings.aspx.

[371] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 36.

[372] Rockefeller Foundation 100 Resilient Cities, 54.

[373] Rockefeller Foundation 100 Resilient Cities, 54.

[374] Rockefeller Foundation 100 Resilient Cities, 82.

[375] Rockefeller Foundation 100 Resilient Cities, 76.

[376] Rockefeller Foundation 100 Resilient Cities, 76.

Another governance objective tied to the built environment is a cross-departmental Resilient Buildings governance model, which exists but still needs formalization.[377] The model's primary goal is to construct resilient buildings and upgrade existing ones. The Resilient Building Committee comprises "staff responsible for policy related to housing, affordability, green buildings, seismic safety, heritage and accessibility . . . work [ing] together to identify co-benefits, promote innovation, explore incentives and set targets that balance and support multiple priorities."[378] The source of funding for this project is unclear.

Critical infrastructure and lifelines will be mapped and prioritized for resilience-building projects.[379] Mapping will help first responders better understand where to focus resource needs during disaster response and recovery. Some private sector–owned lifelines may be hesitant to share where their infrastructure is on a map due to fear of competitors and the public understanding their vulnerabilities. This prioritization work, if successful, could influence capital planning projects and policy.[380] The last part of this initiative includes the need for external funding.[381]

4. Social Resilience: Social Capital

Vancouver's growing senior population lends itself to increased isolation. A survey completed during Phase 1 indicates that "50 per cent of Vancouverites are unable to identify four people they could confide in, and only 54 per cent reported a strong sense of community. Almost 40 per cent of households in Vancouver consist of a single person."[382] This isolation is an indicator of low social resilience.

Social resilience is built in Vancouver through Neighbourhood Emergency Assistance Teams that offer first responders support during a disaster and the

[377] Rockefeller Foundation 100 Resilient Cities, 60.

[378] Rockefeller Foundation 100 Resilient Cities, 60.

[379] Rockefeller Foundation 100 Resilient Cities, 82.

[380] Rockefeller Foundation 100 Resilient Cities, 82.

[381] Rockefeller Foundation 100 Resilient Cities, 82.

[382] Rockefeller Foundation 100 Resilient Cities, 31.

Neighbourhood Emergency Preparedness Program, whereby volunteers teach preparedness to community members.[383] Education is a driving force behind *Resilient Vancouver.* The strategy proposes a neighborhood-scale digital tool that provides community members with risk information and risk-reduction actions to take to improve preparedness.[384]

An exciting piece of *Resilient Vancouver* not often seen in the academic literature, except around the built environment and sometimes economic resilience, entails examples of social resilience. As social resilience creates connections aimed at building community networks, specific examples of social resilience are often difficult to articulate or seen as esoteric. One of the most robust ways to see social resilience is in the number of connections that make up a community; family, friends, and community groups are a few examples.

At the beginning of the *Resilient Vancouver* initiative, residents and community members were asked to provide resilience examples. Some of their responses included

- The ongoing fight for Indigenous rights and freedoms and reconciliation
- Community-led response and advocacy around the ongoing opioid crisis
- City response to the refugee crisis and support for new immigrants
- Community coming together to clean up after the Stanley Cup Riots
- Embracing LGBTQ and two-spirited human rights
- Successful lobby by Chinatown and Strathcona residents to stop the freeway.[385]

Although these examples are not specific or particularly actionable, they are a start.

a. Framework Extension: Women and Resilience

In the vein of *Resilient Vancouver*'s equity framework, the strategy makes explicit mention of women and their "unique and often undervalued role in disaster resilience and recovery."[386] The strategy argues that women take on more responsibilities of caretaking

[383] City of Vancouver, "Volunteer to Help in an Emergency."

[384] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 59.

[385] Rockefeller Foundation 100 Resilient Cities, 17.

[386] Rockefeller Foundation 100 Resilient Cities, 67.

for their families, those in shelters, children, and vulnerable populations.[387] *Resilient Vancouver* claims that infrastructural development gets a disproportionate amount of resources, while women are leaders in psychological and social recovery for their community and family.[388] The report also asserts that girls and women are not as likely to survive disasters.[389] Enarson suggests that mortality rates, as well as injury and illness, are higher for women and girls than men and boys following disasters. She attributes this high rate to disproportionate economic losses—especially for women who are economically less secure—through both lost wages and less access to post-disaster aid; heightened responsibilities at home and work and within the community; more frequent reports of stress symptoms following disasters; and an uptick in domestic and sexual violence against women and girls during and following disasters.[390] *Resilient Vancouver* also mentions that sexual and domestic violence increases after disasters and that emergency shelters are often not safe for women.[391] The strategy centers on ensuring women are at the decision-making table around resilience work.

5. Summary

Resilient Vancouver offers ways to operationalize and evaluate the efficacy of the plan, providing tools and processes embedded in the existing programs and projects of city and community organizations.[392] This focus on governance, tied to specific actions and metrics, may enable a more effective implementation of *Resilient Vancouver*. Personal economic resilience is also a cornerstone of the plan. The plan's equity framework also highlights the role of women and girls in disasters and the need to ensure they are supported to grow the city's resilience.

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[387] Rockefeller Foundation 100 Resilient Cities, 67.

[388] Rockefeller Foundation 100 Resilient Cities, 67.

[389] Rockefeller Foundation 100 Resilient Cities, 67.

[390] Elaine Enarson, "Gender Issues in Natural Disasters: Talking Points and Research Needs," *Crisis, Women and Other Gender Concerns* (2002): 6, https://www.academia.edu/943593/Gender_issues_in_natural_disasters_Talking_points_and_research_needs.

[391] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 67.

[392] Rockefeller Foundation 100 Resilient Cities, 21.

D. CITY OF WELLINGTON, WELLINGTON REGION, NEW ZEALAND

Work for the *Wellington Resilience Strategy* started in 2014, with a kickoff workshop in which participants offered 600 proposals to increase Wellington's resilience. The completed March 2017 strategy lists 30 resilience projects that the city hopes to accomplish and includes the region's contextual elements.[393] The 30 projects take account of the lead agency, key partners, actions, and co-benefits, and the strategy provides a lens for accountability and concrete ways to operationalize the project through action-oriented results.

The strategies all include "'power initiatives' that generate the most benefits across multiple resilience drivers, engage a broad range of people, and generate equitable outcomes in the short and long term."[394] The top three goals of the projects in the *Wellington Resilience Strategy* are as follows: "that people are connected, empowered and feel part of a community; decision making is integrated and well informed; and our homes [and] natural and built environment are healthy and robust."[395] The strategy, conceived of by 200 community members, council staff, researchers, infrastructure managers, and others from across the region, imagines a 35-year horizon they call a "resilience story" that follows a fictional family.[396] The plan focuses on many hazards, including recovery following earthquakes and sea-level rise, both of which affect a large part of New Zealand.[397]

Disaster researchers have studied New Zealand extensively as it has had large earthquakes recently. The most notable recent earthquake in New Zealand occurred in February 2011 in Christchurch, a large city on the South Island.[398] The 6.2 magnitude

[393] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 6.

[394] Rockefeller Foundation 100 Resilient Cities, 11.

[395] Rockefeller Foundation 100 Resilient Cities, 6.

[396] Rockefeller Foundation 100 Resilient Cities, 6.

[397] Rockefeller Foundation 100 Resilient Cities, 6.

[398] Lin, "Christchurch, New Zealand, Shattered by a 2011 Earthquake."

earthquake killed 185 people, and the community is still dealing with recovery.[399] Much of the research on the Christchurch earthquake concentrates on the challenges of recovery.

The Wellington region is home to 471,315 residents, 70.6 percent of whom are New Zealand born.[400] The city of Wellington is the capital of New Zealand and is the country's second-most populous urban area, with 418,500 residents.[401] Wellington is the most populated area in the southern North Island and is the world's southernmost capital of a sovereign state.[402] North and South Island and hundreds of smaller islands make up the country of New Zealand.[403] The city of Wellington is home to a diverse population: "13 percent Māori, 8 percent Pasifika and 8 percent Asian, with more than 80 ethnic groups and dozens of languages spoken on the streets."[404] Thus, Wellington's diversity is considerable for a city that is not exceptionally large.

1. Resilience Governance

New Zealand is a sovereign island nation without state or provincial governments, and a parliamentary government runs it centrally.[405] Thus, a central and local government make up the two layers of New Zealand's government.[406] The central government determines the path forward for the country at large, while district, city, or regional councils run local governments.[407] The central government is in charge of "housing, welfare, education, health, justice, immigration, the police, energy, the national road and rail

[399] Lin, "Christchurch, New Zealand, Shattered by a 2011 Earthquake."

[400] "Community Profile," Greater Wellington Regional Council, accessed October 5, 2019, https://profile.idnz.co.nz/greater-wellington/population.

[401] "Home Page," Statistics New Zealand, accessed October 5, 2019, https://www.stats.govt.nz/.

[402] Craig Glenday, ed., *Guinness World Records 2009* (Vancouver: Jim Pattison Group, 2008), 277.

[403] "Geography - Physical Features," Statistics New Zealand, accessed February 22, 2021, https://web.archive.org/web/20130408074526/http://www2.stats.govt.nz/domino/external/web/nzstories.nsf/092edeb76ed5aa6bcc256afe0081d84e/54e50d25aff60a7bcc256b1e007adcb6?OpenDocument.

[404] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 6.

[405] Statistics New Zealand, "Geography."

[406] "Central Government," New Zealand Immigration, accessed October 5, 2019, https://www.newzealandnow.govt.nz/living-in-nz/history-government/central-government.

[407] New Zealand Immigration.

systems, defence, foreign policy and public finances."[408] Local governments, on the other hand, "provide local services like water, rubbish collection and disposal, sewage treatment, parks, reserves, street lighting, roads, local public transport and libraries."[409] Local governments also levy property taxes and process regulatory contents for buildings and the environment.[410] Regional councils and territorial authorities (city councils and districts) make up the two local government levels.[411] The regional councils may be responsible for public transportation, parks, water and air quality, flood control, and other environmental resource management responsibilities.[412] Territorial leaderships are in charge of economic development, city planning, libraries, roads, water, and sewer.[413] Districts and city councils may combine to form a unitary council.[414]

The *Wellington Resilience Strategy* centers on governance. The strategy states, "If the robustness and integration of knowledge, planning and governance in Wellington isn't improved, the consequences could be socially and economically significant."[415] The Wellington City Council heads up emergency management work in the city, running the Emergency Operations Center (EOC) and pushing residents to the Wellington Region Emergency Management Office (WREMO) website for hazard updates, alerts, and warnings.[416] The regional level houses most of the emergency management functions.

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[408] New Zealand Immigration.

[409] New Zealand Immigration.

[410] New Zealand Immigration.

[411] "Local Government," New Zealand Immigration, accessed October 5, 2019, https://www.newzealandnow.govt.nz/living-in-nz/history-government/local-government.

[412] New Zealand Immigration.

[413] New Zealand Immigration.

[414] New Zealand Immigration.

[415] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 14.

[416] "Emergency Management," Wellington City Council, accessed October 5, 2019, https://wellington.govt.nz/about-wellington/emergency-management; "Emergencies in Wellington," Wellington City Council, accessed October 5, 2019, https://wellington.govt.nz/about-wellington/emergency-management/emergencies-in-wellington.

a. Framework Extension: Emergency Management Regional Coordination

With only national and local government structures, regional work around resilience needed a place to reside formally, so the *Wellington Resilience Strategy* mentions this requirement and its trajectory. The nine Wellington regional councils aggregated their civil defence emergency management functions in 2012, which resulted in WREMO. It comprises a small staff who works to share resources across the region, with one-third of staff and resources dedicated to resilience-building. WREMO, in partnership with the Joint Centre for Disaster Research, founded the International Centre of Excellence for Community Resilience to bridge the gap between academic and practitioner research.[417]

b. Framework Extension: Program/Project Evaluation and Implementation Plan

A unique feature of the *Wellington Resilience Strategy* is its focus on continued program evaluation. The plan supports the formal body for resilience goal-monitoring that developed the strategy, the Resilient Wellington Steering Group.[418] Group members assess the stability of budgets, timelines, barriers, and outcomes as a means of robust project management while championing resilience and lending a public-facing piece of the strategy.[419] The group reports updates and recommendations to the city and various councils annually.[420] The CRO manages strategy implementation, laid out in the implementation plan, which outlines project assignments, time frames, and resources needed to guarantee project completion.[421]

[417] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 49.

[418] Rockefeller Foundation 100 Resilient Cities, 66.

[419] Rockefeller Foundation 100 Resilient Cities, 66.

[420] Rockefeller Foundation 100 Resilient Cities, 66.

[421] Rockefeller Foundation 100 Resilient Cities, 66, 104.

c. Framework Extension: Recovery Framework

Recovery frameworks help to guide recovery efforts. The *Wellington Resilience Strategy* mandates a pre-disaster recovery framework that covers all types of resilience.[422] A cross-section of stakeholders will develop the plan, and it will link to other projects.[423]

2. Economic Resilience: Economic Development

The central city area of Wellington currently provides 77 percent of the total GDP for Wellington city, 48 percent for the Wellington region, and 8 percent of the national GDP.[424] Between 1982 and 2011, New Zealand's GPD had grown 35 percent, with half of it going to 10 percent of the working population.[425] New Zealand has a relatively low unemployment rate of 4.2 percent, which adds to its economic resilience.[426] In 2019, government spending as a percent of GDP was 39.97 percent.[427]

Programme 1.3 of the *Wellington Resilience Strategy* calls out economic resilience. Its goal is to "increase economic resilience of central city and outside hubs."[428] The document describes this objective vaguely. The national government supplies grants to support resilience work: the Ministry of Civil Defense and Emergency Management's 2018–2022 business plan mentions a resilience fund that "supports emergency preparedness and improved community resilience through funding."[429] However, a permanent allocated fund not subject to approval will help New Zealand more sufficiently and efficiently underwrite resilience work before and after disasters. This project will

[422] Rockefeller Foundation 100 Resilient Cities, 99.

[423] Rockefeller Foundation 100 Resilient Cities, 99.

[424] Rockefeller Foundation 100 Resilient Cities, 56.

[425] "The Economy of New Zealand," International Living, accessed October 5, 2019, https://internationalliving.com/countries/new-zealand/the-economy-in-new-zealand/.

[426] Statistics New Zealand, "Home Page."

[427] "New Zealand: Ratio of Government Expenditure to Gross Domestic Product (GDP) from 2015 to 2025," Statista, accessed January 28, 2021, https://www.statista.com/statistics/436523/ratio-of-government-expenditure-to-gross-domestic-product-gdp-in-new-zealand/#:~:text=The%20statistic%20shows%20the%20ratio,the%20country's%20gross%20domestic%20product.

[428] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 23.

[429] Rockefeller Foundation 100 Resilient Cities, 7.

produce recommendations on how to decrease central city vulnerability and build economic prospects.[430] There is also a push for economic redundancy and diversification.[431]

Business continuity planning is another element to build economic resilience by investing more in the existing business continuity program for 1,000 small-to-medium enterprises.[432]

a. Framework Extension: Economic Resilience through Insurance

New Zealand has a unique insurance coverage scheme, which heightens its level of economic resilience. According to Motu Economic and Public Policy Research in Wellington, New Zealand boasts one of the most highly insured populations in the world, with nearly 90 percent of home-owning residents possessing insurance for their properties.[433] Moreover, under the Earthquake Commission Act, all policy holders must be provided coverage for damage to land from storms and floods.[434] Insurance helps put some of the burden of living in high-risk areas on the homeowner. Although insurance rates are high, the *Wellington Resilience Strategy* includes an insurance literacy campaign that helps businesses and homeowners make smart decisions about insurance coverage.[435] The first step is to complete a survey to assess insurance knowledge in Wellington and residents' access to insurance.[436]

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[430] Rockefeller Foundation 100 Resilient Cities, 57.

[431] Rockefeller Foundation 100 Resilient Cities, 57.

[432] Rockefeller Foundation 100 Resilient Cities, 58.

[433] David A. Fleming et al., *Public Insurance and Climate Change (Part One): Past Trends in Weather-Related Insurance in New Zealand* (Wellington, NZ: Motu Economic and Public Policy Research, 2018), 5 https://docs.niwa.co.nz/library/public/MotuWP18-09.pdf.

[434] Fleming et al., 7.

[435] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 87.

[436] Rockefeller Foundation 100 Resilient Cities, 87.

3. Physical Resilience: Built Environment

The *Wellington Resilience Strategy*'s focus on robust physical resilience centers on studies, research, cost–benefit analyses, and gap analyses. The strategy offers disparate information on the built environment in stating that "the energy, transport, water and telecommunications infrastructure that serves our communities, our Government and our business sectors are centralised and vulnerable."[437] This understating of vulnerability is essential, but the inability to describe lifeline interdependencies does not capture the vulnerability of critical lifelines.

The strategy highlights physical resilience in Goal 3, which aims to make "homes and natural and built environments . . . healthy and robust."[438] Corresponding Programme 3.1, "Homes and telecommunication," lists three projects: "Support[ing] flexible energy supply, . . . support[ing] widespread adoption of electric vehicles, . . . [and] leverag[ing] transportation investment to improve Wellington's resilience."[439] The critical lifelines of energy and transportation are crucial to resilience in the built environment. The inclusion of electric vehicles points to sustainable resilience practices that may reduce the risk of environmental degradation.

Enforcement and regulatory tools are other elements of the strategy that support physical resilience. The Wellington Lifelines Group (WeLG) will introduce these tools through an initial organizational assessment of options "to mitigate future liabilities of liquefaction, flooding, sea level rise and other hazards, and to build resilience into our city's decision making."[440] Amendments to land-use provisions in the district plan include residential home-securing requirements and emergency water-storing mandates.[441] There

[437] Rockefeller Foundation 100 Resilient Cities, 14.

[438] Rockefeller Foundation 100 Resilient Cities, 23.

[439] Rockefeller Foundation 100 Resilient Cities, 23.

[440] Rockefeller Foundation 100 Resilient Cities, 64.

[441] Rockefeller Foundation 100 Resilient Cities, 64.

will also be exploratory work around the economic impacts of regulatory vis-à-vis non-regulatory tactics.[442]

The *Wellington Resilience Strategy* also highlights the need to share lifeline and critical infrastructure vulnerabilities with city leaders through the WeLG to prioritize projects and policies.[443] This project will include cost–benefit analyses using the existing Measuring the Economics of Resilient Infrastructure Tool.[444]

A post-earthquake housing study is another project in the strategy. WREMO will lead this project so that policymakers can better understand housing limitations and gain strategies to provide temporary housing to those affected in various scenarios, including those facing homelessness and climate refugees.[445]

A cultural development resilience piece is about heritage sites and their protection. The *Wellington Resilience Strategy* asks that disaster risk management plans are developed for heritage sites to ensure their security as they serve as a critical cultural commodity.[446]

a. Framework Extension: Sustainable Food Networks

Sustainable food networks are another piece of the economic and social resilience of the strategy. This project will leverage existing programs and build new ones to ensure food security for Wellington residents, especially after a disaster. The project will "identify partnership opportunities with groups targeting child obesity, type 2 diabetes, families in need, marae [places of worship], mental health, seniors, refugees, and prisons to develop new community gardening projects."[447] These combined efforts will build food security and resilience.

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[442] Rockefeller Foundation 100 Resilient Cities, 64.

[443] Rockefeller Foundation 100 Resilient Cities, 65.

[444] Rockefeller Foundation 100 Resilient Cities, 65.

[445] Rockefeller Foundation 100 Resilient Cities, 79.

[446] Rockefeller Foundation 100 Resilient Cities, 54.

[447] Rockefeller Foundation 100 Resilient Cities, 53.

b. Framework Extension: Open Space

Open space is at a premium in most cities. One strategic project is to assess the amount of open space in Wellington city and propose new projects that build social resilience, such as urban farms and gardens, community dojos, parks, and cultural venues.[448] Victoria University of Wellington's School of Architecture and Design has begun to identify space for issuing healthcare and education, economic continuity, and post-disaster housing. The government, multidisciplinary, and community-led project team will build on this work.[449] Another social resilience tie to the project lies in the provision of space for volunteers.[450] The physical structures built will house emergency supplies, equipment, water, and back-up power.[451]

c. Framework Extension: Retrofitting on Transportation Routes

In 2016, a national policy passed that mandates retrofitting of earthquake-prone buildings.[452] Through the strategy, Wellington will work to prioritize upgrades to buildings that sit on critical transportation routes. There is an earmark for critical facilities as the next type for retrofitting.[453]

d. Framework Extension: Electric Vehicles

The vulnerability of supply chains, especially fuel, is outlined in the *Wellington Resilience Strategy*. One solution is to adopt more electric vehicles as the city's fleet needs replacement.[454] The project encourages work regionally to institute a more expansive

[448] Rockefeller Foundation 100 Resilient Cities, 52.

[449] Rockefeller Foundation 100 Resilient Cities, 52.

[450] Rockefeller Foundation 100 Resilient Cities, 52.

[451] Rockefeller Foundation 100 Resilient Cities, 52.

[452] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 79.

[453] Rockefeller Foundation 100 Resilient Cities, 79.

[454] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 101.

charging network.[455] Co-benefits of an increase in electric vehicles include reduced air and noise pollution with resulting health benefits.[456]

e. Framework Extension: Resilient Transportation

Resilient transportation infrastructure is critical for the movement of supplies, equipment, first responders, and survivors. An advisory project outlined in the strategy and headed by the city leadership will champion the New Zealand Transport Agency's existing Wellington city projects.[457] These include projects that curb congestion, improve bicycle ways, and shore up port resilience.[458]

f. Framework Extension: Working Remotely

A unique piece of the *Wellington Resilience Strategy* involves remote working. The strategy stresses the need for "large-scale remote working" following a significant seismic event. The project will engage telecommunications asset owners to better understand the capabilities following a massive earthquake. The co-benefits are that fewer employees will need to commute on a congested transportation system, more part-time work might help parents cover childcare needs, and mobility-constrained and older community members can still participate actively in the workforce.[459] Remote working may help build social resilience, too.

4. Social Resilience: Social Capital

An ambitious goal of the *Wellington Resilience Strategy* is to "help communities build resilience." The strategy encourages the expansion of the existing city and regional projects. These projects include funding for community organizations, especially those that the plan deems unofficial. Two leadership streams—WREMO and the City Council, which

[455] Rockefeller Foundation 100 Resilient Cities, 101.

[456] Rockefeller Foundation 100 Resilient Cities, 101.

[457] Rockefeller Foundation 100 Resilient Cities, 103.

[458] Rockefeller Foundation 100 Resilient Cities, 103.

[459] Rockefeller Foundation 100 Resilient Cities, 89.

leads emergency management at the city level, will run these initiatives.[460] The Wellington regional government leads various disaster community volunteer programs, and the city has its own Wellington Emergency Response Team.[461] The City Council will continue to amplify work on the social networking site Next Door to promote community events, while ensuring that community planning efforts include co-design approaches, place-based initiatives, and participation.[462]

There is also an active social capital link in the sub-programmatic elements of the *Wellington Resilience Strategy* under Goal 1, which ensures people are connected, empowered, and feel part of a community. Goal 1 maintains that "everyone thrives" when the community is "prepared for an aging population" and "reduce[s] homelessness."[463] Other elements include helping "communities build resilience" and "develop[ing] sustainable food networks."[464] The strategy consists of food networks—as food insecurity lowers resilience—but this and other goals and programs are vague.

a. Framework Extension: Provisions for the Aging Population

Provisions for the aging population are another attribute of the *Wellington Resilience Strategy*. The city of Wellington will plan its "transport, housing, health system and social spaces to enable [the] aging population to fully participate and contribute to the economic and social life of [the] city."[465] A cross-section of community members, non-governmental organizations, architects and designers, and others will convene at a symposium to "include examples from other 100RC cities and the WHO Global Network of Age Friendly Cities and Communities."[466] Spatial mapping of senior services already in the community combined with a research project will help to build what the strategy

[460] Rockefeller Foundation 100 Resilient Cities, 50.

[461] "Become a Volunteer," Wellington City Council, accessed October 5, 2019. https://wellington.govt.nz/about-wellington/emergency-management/volunteering.

[462] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 50.

[463] Rockefeller Foundation 100 Resilient Cities, 23.

[464] Rockefeller Foundation 100 Resilient Cities, 23.

[465] Rockefeller Foundation 100 Resilient Cities, 45.

[466] Rockefeller Foundation 100 Resilient Cities, 45.

calls "a loneliness index."[467] This data will help policymakers understand how to better prepare for an increasing aged community. Co-benefits include senior citizens' having a higher adaptive capacity to disasters and support among neighbors.[468]

b. Framework Extension: Provisions for the Homeless Population

Homelessness is an issue that Wellington will reduce by expanding existing projects, such as Action Te Mahana. Because the Māori are represented disproportionally in the homeless population, Action Te Mahana was built with Māori involvement to include broader cultural viewpoints. This program includes funding to train frontline staff to work directly with the homeless population in a culturally competent manner.[469]

c. Framework Extension: Regional Efforts to Build Social Capital

WREMO will head up resilience planning at the regional level including training and exercises. Leaders at the regional level will be trained on how to lead their communities during crises through a community leadership module.[470] They will also "improve access to household resilience items," such as water tanks, "grab&go bags," and tools to support urban agriculture, so that Wellingtonians are self-sufficient for seven days following a catastrophic earthquake.[471] WREMO will explore public–private partnerships to help acquire these products.[472] The City Council's and WREMO's efforts will be linked and connected to broader planning frameworks.[473] In aggregate, these public-facing programs will build community trust in government and reduce inequality of access to resources.[474]

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[467] Rockefeller Foundation 100 Resilient Cities, 45.

[468] Rockefeller Foundation 100 Resilient Cities, 45.

[469] Rockefeller Foundation 100 Resilient Cities, 47.

[470] Rockefeller Foundation 100 Resilient Cities, 50.

[471] Rockefeller Foundation 100 Resilient Cities, 44.

[472] Rockefeller Foundation 100 Resilient Cities, 44.

[473] Rockefeller Foundation 100 Resilient Cities, 50.

[474] Rockefeller Foundation 100 Resilient Cities, 44.

WREMO organizes "community emergency hubs," which had previously been called "civil defence centres."[475] These predetermined hubs are locations where the community can come together "to do what it can to help each other—people helping people with what they have available."[476] Thus, they provide physical space for community members to share resources and "empower and promote a community-led response to the challenges communities will face during a disaster."[477] After the Christchurch earthquake, communities organically initiated hubs through small initiatives to give back to their neighborhoods. They have provided physical space for the community to "come together for company, to share their stories about their experience, find out information, offer assistance to those who need it, and look for assistance."[478] Community members, not the government, run hubs. Community centers, schools, and other spaces where community members gather are often hub locations.[479] WREMO manages the logistical relationships with the sites and can access them for the community.[480] They are not emergency assistance centres, formerly welfare centres, where government agencies offer direct support, but the government gives radios to hubs to communicate with EOCs.[481] WREMO provides a *Community Emergency Hub Guide* and free training on how to run an effective hub.[482]

5. Summary

The "power initiatives" of the *Wellington Resilience Strategy* strive to encourage buy-in from diverse groups to build equitable outcomes. The story-telling aspect of the fictional family in the strategy is unique and allows stakeholders to interpret and

[475] "Community Emergency Hubs," Wellington Region Emergency Management Office, accessed October 5, 2019, https://wremo.nz/about-us/initiatives/hubs/.

[476] Wellington Region Emergency Management Office.

[477] Wellington Region Emergency Management Office.

[478] Wellington Region Emergency Management Office.

[479] Wellington Region Emergency Management Office.

[480] Wellington Region Emergency Management Office.

[481] Wellington Region Emergency Management Office.

[482] Wellington Region Emergency Management Office.

personalize it. The three goals—a connected, empowered community, well-informed decision-making, and a healthy natural and built environment—align with the other cities' strategies and focus on the community more than the individual. Building 35 years into the future with a fictional family helps the strategy feel creative and personal. Some solutions that support families' spending more time together include remote work, electric vehicles, and enhanced public transportation.

E. CONCLUSION

All the cases present varied and rich examples of how to operationalize resilience. The four strategies have more in common than not. They all pull civil society closer to a collective community whereby community members, governments, non-profit organizations, and private-sector entities have a stake in resilience. Resilience becomes a goal through which actions are taken at the city level to propel the community toward higher resilience levels. The next chapter dissects the cases to reveal commonalities and uniqueness in resilience operationalization.

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V. CROSS-CASE ANALYSIS AND SUMMARY OF NIST INDICATOR EXTENSIONS

This section compares the approaches that each city has taken to operationalize resilience and identifies common themes. This analysis examines resilience operationalization and what may be useful to study further. An array of often-interdependent indicators shows ways of operationalizing resilience. The strategies are all anchored to the notion that strategic development workgroups first need to empathize with and understand communities before building strategies to help build resilience.

The cities' resilience strategies also tie each goal to specific shocks and stresses. Shocks are "sudden-onset events, such as earthquakes, floods, and extreme weather . . . [while] stresses are conditions that weaken the urban fabric of a city on a daily or reoccurring basis, such as racism, social isolation and poverty."[483] Furthermore, all city resilience plans and strategies connect with sea-level rise, climate change, and climate adaptation. The strategies all exemplify well-conceived plans that led to an understanding of local conditions and contexts that provide barriers to achieving resilience.

A. RESILIENCE GOVERNANCE

Each of the four strategies took years to develop, illustrating that building resilience takes time and thoughtfulness. Academic intuitions and various disciplines were parties to the cities' resilience strategies, and all cities used interdisciplinary academic research, problem-solving, and lessons learned from other cities worldwide to build their strategies.

Each city's resilience strategy ambitiously lays out resilience goals and initiatives. The Los Angeles strategy is the longest, at 178 pages, but all the strategies include comprehensive suggestions on how to make resilience a reality. Moreover, they all aim to align resilience goals and public expectations. This association is seen most starkly in the governance of resilience indicator.

[483] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 29.

Three of the four strategies include integrating ideas and funding from the whole community in a bottom-up manner. Kyoto's strategy is the anomaly as a whole-of-government committee implements the strategy and conducts an annual internal review.[484] This top-down approach is unique, as Kyoto City relies on non-governmental volunteer groups to carry out resilience work, yet Japan's government structure is centralized, contributing to the "whole of government" moniker. The cases also focus on resilience outcomes that move communities forward, not merely returning them to a pre-disaster state.[485]

1. Resilience Governance Should Include Accountability

A metric for successful resilience is not apparent in the literature or the case studies. Measuring resilience is further hampered without a body or source to implement resilience, and the consequence is that resilience operationalization cannot come to fruition. However, writing down planning elements around resilience operationalization is one step. *Resilient Vancouver* attempts to bring accountability into the strategy by assigning departments and agencies to specific objectives and actions.[486] Following up on a project's progress with processes that ensure leaders are accountable for action or inaction is vital. Without mechanisms to track progress, resilience projects will be simply lofty ideas documented in strategies.

2. Resilience Covers All Emergency Management Phases

Each case includes projects that hit all phases of the emergency management cycle: mitigation, preparedness, prevention, protection, response, and recovery. Resilience, in the literature, covers all the phases.[487] At the intersection of all phases, emergency management's notion of resilience will be strengthened and hopefully less conceptual.

[484] Rockefeller Foundation 100 Resilient Cities, 29.

[485] Cutter et al., "A Place-Based Model for Understanding Community Resilience," 600.

[486] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 92.

[487] Longstaff et al., "Building Resilient Communities," 2.

Different players who lead the various phases will operationalize resilience inside their phase and find interdependencies and coordination areas across other phases.

3. Recovery Planning Is Important

Los Angeles outlines the need for recovery planning. In Japan, the national government pays for workgroups made up of academics, government offices, and consultants to draft post-disaster recovery plans at the local level for one year following a disaster.[488] Los Angeles has developed a city recovery plan, and the California Governor's Office of Emergency Services and FEMA financially and physically support recovery efforts at the local level. The other three cities only allude to the importance of recovery planning in the context of recent disasters.

4. Co-opt Existing Programs and Projects into Resilience Strategies

Many of the resilience projects in the four cities' resilience strategies already existed. Because community risk is not often adequately mitigated before a disaster and more significant systemic societal issues, such as insufficient housing, poverty, and inadequate medical care, cripple cities, programs exist to address these ills.[489] Co-opting existing programs saves resources that might be put into new programs and amplifies and helps fund existing programs under the banner of resilience, creating more traction and needed attention. Kyoto tied its strategies to the broader United Nations' 17 sustainability development goals. This tie can provide an example of a cohesive string between local, regional, state, federal, and global projects.[490]

5. Community Members Are Needed at All Phases of Resilience Planning and Governance

All the plans include diverse stakeholders at different phases of the strategies' planning horizons. How government emergency managers and others plan is as important as the plans themselves. Whole-community approaches to planning, whereby

[488] International Research Institute of Disaster Science, *HFA IRIDeS Review Report*, 35.

[489] Anderson, Kennedy, and Ressler, *Handbook of Disaster Research*, xvii.

[490] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 3.

non-governmental, community, and faith-based organizations and private-sector partners are integral parts of the planning process, have become more commonplace.

6. Risk and Preparedness Education Builds DRR

All four cases include information about the importance of risk education and programs to reach the community. Training builds a preparedness culture "to collect and disseminate relevant knowledge and information about hazards, vulnerabilities and capacities."[491] Understanding communities' risks empower data-driven decision-making.[492]

Disaster education is crucial to resilience as it can help build a culture of preparedness and community resilience through public awareness. Benadusi defines the wide-ranging pedagogical elements in disaster education beyond the school curriculum and public information to "family and community learning, adult education and popular culture (what we might consider to be 'public pedagogies')."[493] Supposing the public has a comprehensive understanding of what risks their communities face and ways to mitigate, reduce, respond, and recover from them, they may take more proactive approaches to build resilience. Benadusi remarks, "Disaster risk reduction policies make heavy use of education for spreading a 'culture' of resilience at community level."[494] This tie of DRR to education is a marker in efforts that foster a culture of resilience.

Benadusi also looks at the oft-utilized term "building" when referencing how to reach a culture of resilience. She writes, "'Building a culture of resilience,' 'building a culture of risk,' [and] 'building a culture of safety' . . . [and] verbs such as 'strengthening,' 'teaching,' 'improving,' 'inspiring,' 'promoting,' and 'fostering' are also frequently

[491] Kyung-Hun Ha et al., "A Novel Approach towards Skill-Based Search and Services of Open Educational Resources," in *Metadata and Semantic Research: Proceedings of the 5th International Conference, MTSR 2011*, ed. Elenda García-Barriocanal et al. (Berlin: Springer, 2011), 321.

[492] Benadusi, "Pedagogies of the Unknown," 176.

[493] Benadusi, 174.

[494] Benadusi, 174.

used."[495] These terms imply that someone is doing the "teaching, fostering, etc."[496] Still, Benadusi asks, "Who is the legitimate owner of this culture and who is entitled to spread it? And, what does this culture mean for the people who are the targets of such educational interventions?"[497] This connection of formal (government) and informal (community-level) social capital is a concept addressed in the next section. Information networks may be the best at sharing resources and education, as the level of trust in these networks is higher than in formal ones.

Kyoto and other cities in Japan partake in national disaster drills frequently. Of the four cities, Kyoto does the best job of executing and learning from disaster drills. Practicing for disasters through exercises can help people learn and change behavior. Preston writes about the many ways that emergency "rehearsal" can benefit a community. He claims that "rehearsal is used to routinise and familiarize individuals and families with preordained rules of behaviour. This is not only to lock in behaviours so that they become engrained into an individual's habits but also to attempt to remove affective or cognitive processes that may prevent action from being undertaken."[498] Thus, building muscle memory and cognitive skills enable people to act and respond more effectively before, during, and following disasters. Experiential learning from disaster drill lessons also allows people to observe possible areas for improvement.[499]

Crowley and Elliott write that in Japan, "well rehearsed emergency drills and a predisposition to trust and obey official orders have created a collectively prepared community."[500] Choice architecture through nudging community members to participate in drills in Japan is successful due to cultural constructs that push communities to follow the government and their neighbors' actions. Los Angeles' and Vancouver's culture of preparedness pales in comparison to Kyoto's because these cities have not had disasters

[495] Benadusi, 178.

[496] Benadusi, 178.

[497] Benadusi, 178.

[498] Preston, *Disaster Education*, 5.

[499] Preston, 5.

[500] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 213.

that affect a large portion of the country at one time and lack such a strong culture of preparedness. In contrast, due to the recent frequency of catastrophic disasters in New Zealand, preparedness in Wellington has strengthened.

National preparation days in cities throughout Japan also build a collective culture of preparedness and practice. These events, often commemorating catastrophic disasters, both ensure that disaster events do not leave the collective consciousness and bind communities together through tradition, customs, and ceremonies. Tradition is a form of practice and may provide a space for holding a community together. At the same time, culture can be particular to specific groups and divide and distance communities comprising various cultures. Coming together around shared experiences or disasters that have affected the places where people live, through annual commemorative events, is the glue that binds community cultures that find coalescing difficult.

It is challenging for city leaders to lead resilience efforts when resilience is hard to define effectively. WREMO's community leadership module illustrates one way to help guide leaders through resilience work. The module shows local leaders how to navigate their communities during stressful times to adapt under change management leadership.[501] The other strategies do not mention this type of education beyond the mentorship their CROs receive from the Rockefeller Foundation.

7. Regional Coordination and Collaboration Build Resilience

New Zealand does not have provincial or state governments and is thus "more compact and straightforward."[502] The Wellington region filled this void by creating an emergency management collaboration to address the absence of leadership. In contrast, Kyoto City is under a more top-down government structure starting at the national level and moving down to the prefecture and then to the local level. Metropolitan-wide planning is vital in Japan and leads to a "high degree of intersectoral and inter-city coordination."[503]

[501] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 50.

[502] Statistics New Zealand, "Geography."

[503] Wisner, "Disaster Risk Reduction in Megacities," 189–90.

Metropolitan government structures can use data from the national government, such as Japan's National Land Agency, to drive innovation and economic interests locally.[504]

The Los Angeles metropolitan area, unlike urban regions in Japan, New Zealand, and Canada, does not have overarching "legally established, strong, and well-financed metropolitan government structures that embrace a large portion of the megacity."[505] Moreover, sprawling Los Angeles County comprises many cities that work autonomously.

8. Expand the Number of Chief Resilience Officers throughout Government and Non-governmental Agencies

All of the cities have one CRO. In 2018, Los Angeles Mayor Eric Garcetti mandated that 28 city departments assign CROs.[506] This unique model may build Los Angeles' resilience as the four NIST resilience indicators may reside in a cross-section of local government agencies. Thus, the CROs from public works, ports, engineering, building inspections, water, and other lifelines, as well as architecture and capital planning departments, can work to build physical resilience.

B. ECONOMIC RESILIENCE

The cases all highlight economic resilience at the individual and government levels as methods to grow resilience. Economic resilience rarely gets traction in the literature, but all of the strategies tie to public, private, and non-profit partnerships. Moreover, while funding for resilience projects in each city is not transparent, every strategy speaks to leveraging existing programs and partnerships.

1. A Higher Government Percent of GDP Spending Leads to Higher Levels of Resilience

Lin's work to measure a state's capacity or resilience by dividing government expenditures by percentage of the GDP helped to analyze each city's resilience levels. Examining the correlation between higher government spending as a percentage of GDP

[504] Wisner, 189–90.

[505] Wisner, 189–90.

[506] City of Los Angeles, "Garcetti Announces Plan."

(as a measure of state capacity) and fewer lives lost in disasters is vital.[507] Governments that spend a higher percentage of their GDP could use these funds to enhance government-sponsored resilience work.

According to the global and intergovernmental Organisation for Economic Co-operation and Development, in 2013, the global average of government expenditures of GDP was 41.9 percent.[508] The United States and New Zealand are close to this mark, with 38 percent and 40.1 percent, respectively. Japan is quite a bit lower, at 19.6 percent, as is Canada at 20.98 percent.

2. Being Insured Helps to Grow Resilience

The importance of insurance in building community economic resilience is highlighted in all the strategies and is seen a bit in the academic literature studied. Californians and Los Angelinos have low levels of earthquake insurance. After the 1994 Northridge earthquake, 93 percent of homeowner insurance companies limited or negated earthquake insurance policies.[509] In 1996, this calamitous change precipitated the California State Legislature to form the California Earthquake Authority (CEA), a group of 21 insurance companies that provide earthquake insurance.[510] Only 10 percent of Californians have earthquake insurance, and 16 percent of Los Angelinos do. By contrast, 95 percent of New Zealand's residents have earthquake insurance.[511] CEA was an attempt to bring insurance prices down. In New Zealand, local governments have collaborated with the central government to provide public education about insurance and promote lower rates.[512] As the Insurance Bureau of Canada states,

> The economic cost of disasters around the world has increased five-fold since the 1980s. Flooding damage has accounted for 80 percent of federal

[507] Lin, "Governing Natural Disasters," 1289.

[508] "Government at a Glance 2015: New Zealand," Organisation for Economic Co-operation and Development, 2015, 1, https://www.oecd.org/gov/New-Zealand.pdf.

[509] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 32.

[510] Rockefeller Foundation 100 Resilient Cities, 32.

[511] Rockefeller Foundation 100 Resilient Cities, 32.

[512] Rockefeller Foundation 100 Resilient Cities, 148.

> disaster assistance payments over the past 20 years. Studies have demonstrated that there is a 6:1 return on investment when flood mitigation measures include both structural and non-structural investments.[513]

Thus, Canada, like New Zealand, has pushed residents and businesses to purchase insurance.

3. Include Economically Vulnerable Populations

Each plan identifies and works to create solutions for vulnerable populations. Los Angeles' strategy defines them as "homeless, previously incarcerated, and low-income residents and Vancouver and Wellington's strategies include the first and last of these."[514] Kyoto's strategy focuses reasonably on the aged but little on other vulnerable populations.

C. PHYSICAL RESILIENCE

Multi-stakeholder engagement produced each city's strategy. In the process, there was a community gauge to understand expectations about physical resilience better. This participatory effort enabled physical resilience projects to include specific information from the community, not just from those involved in constructing the built environment.

According to the academic literature, a way to build resilience and social capital is to invest in and build community spaces used before disasters. Gathering spaces create social capital during and after disasters and a location to protect human lives. When communities push the government to support private-sector rebuilding in areas deemed essential places, the time it takes to rebuild gauges the recovery efforts' success.

1. Stand up Lifelines Councils

Los Angeles and Wellington both have a lifelines council, which the strategies call out. They include members of the private and public sectors. These councils coordinate around lifelines projects and initiatives. The importance of coordinating among critical

[513] Public Safety and Emergency Preparedness Canada, "Canada Contributes to Resilient Communities."

[514] Rockefeller Foundation 100 Resilient Cities, *Resilient Los Angeles*, 8.

lifelines is also a part of a broader U.S. construct to harmonize critical infrastructure emergency planning and disaster response.[515]

2. Focus on Hazard Mitigation and DRR, Not Just Response

Experts assert that for every dollar spent on mitigation, there is a six-dollar return on investment.[516] As a country, Canada has invested in the National Disaster Mitigation Program since 2015 and has funded hundreds of projects from coast to coast.[517] For example, because flooding is a significant issue in Canada, the federal government funded $7.75 million in risk assessment, flood mapping, impact studies, and mitigation projects—61 projects in Ontario alone—in 2019.[518]

FEMA provides funding through public assistance grants for the built environment. These grants can cover, at a minimum, 75 percent of the costs to rebuild a building to its previous state.[519] FEMA will ultimately construct a new building if the repair costs are more than half of that to replace the structure.[520] Hazard mitigation funds are included in public assistance grants as well to help minimize damage in the future.[521] *Resilient Vancouver* and *Resilient Los Angeles* highlight the need to strengthen critical infrastructure, as the literature highlights this point about physical resilience.[522]

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[515] Cybersecurity and Infrastructure Security Agency, *A Guide to Critical Infrastructure Security and Resilience* (Washington, DC: Department of Homeland Security, 2019), 16, https://www.cisa.gov/sites/default/files/publications/Guide-Critical-Infrastructure-Security-Resilience-110819-508v2.pdf.

[516] "Emergency Management," Government of British Columbia, accessed October 7, 2019, https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/emergency-management-bc/bc-disaster-mitigation.

[517] "Federal Support for 61 Ontario Flood Mitigation Projects," Public Safety Canada, July 25, 2019, https://www.canada.ca/en/public-safety-canada/news/2019/07/federal-support-for-61-ontario-flood-mitigation-projects.html.

[518] Public Safety Canada.

[519] Kevin Sack and John Schwartz, "As Storms Keep Coming, FEMA Spends Billions in 'Cycle' of Damage and Repair," *New York Times*, October 8, 2018, https://www.nytimes.com/2018/10/08/us/fema-disaster-recovery-climate-change.html.

[520] Sack and Schwartz.

[521] Sack and Schwartz.

[522] Rockefeller Foundation 100 Resilient Cities, *Resilient Vancouver*, 36.

3. Building Codes Can Build Resilience

Building codes in New Zealand, the United States, and Canada are the same or quite similar.[523] The building codes enforced in Japan are more stringent than those in the other three countries, as is the use of "isolation pads and energy dissipation units to dampen the ground's shaking during an earthquake."[524] According to Glanz and Ohishi, U.S. building codes and standards focus on collapse prevention "while in Japan—with many more earthquakes—the goal is to prevent any major damage to the buildings because of the swaying."[525] Japan also focuses on building back to an original state, while the other strategies look to improve buildings beyond what they once were. Each plan focuses on streamlining code enforcement.

Post-disaster recovery research indicates that damage to owner-occupied residential property is most prevalent in the built environment.[526] In Kobe, the traditional wooden houses collapsed and killed many people, while in Northridge, a few buildings collapsed and many survived the earthquake.[527]

The research does not focus on the need for resilience plans to include specific redevelopment efforts that span planning in the next 10 years to the end of the century, yet each resilience strategy lays out such a timeline.

4. Support and Build Resilient Transportation

Vancouver's strategy includes reliable and equitable transportation as a keystone, and Los Angeles' approach emphasizes reliable transportation nodes that reach those most economically vulnerable and in need of transportation to places of work.

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[523] Jill Cowen, "They Call Her 'the Beyoncé of Earthquakes': An Interview With Lucy Jones," *New York Times*, July 10, 2019, https://www.nytimes.com/2019/07/10/us/california-earthquake-lucy-jones.html.

[524] Glanz and Ohishi, "Japan's Strict Building Codes Saved Lives."

[525] Glanz and Ohishi.

[526] Carpenter, "Social Ties, Space, and Resilience," 7.

[527] Tierney, *Social Roots of Risk*, 14.

5. Focus on Personal Physical Resilience, Including Food Security Resilience

Food security is an issue presented in all the cities' resilience strategies although the literature does not explicitly mention food insecurity as a marker of low resilience in a community.

D. SOCIAL RESILIENCE

The literature suggests that social resilience is the bedrock of community resilience, and all the strategies focus on building social capital within the four cities. Each strategy also highlights difficult elements that deplete social resilience, such as social isolation, the dramatic increase in aging populations, high levels of income disparity, and a lack of diversity in representing the communities served.

1. Grow Resilience Culture

Culture forms when people assemble, and the cases address culture through the cities' resilience strategies. Alexander looks at culture in the context of disasters in a few ways and argues that disasters produce cultures and subcultures. In the anthropological context, academics can examine how communities react to catastrophes using cultural frames.[528] This notion of culture inherently contains plastic facets created or morphed during and after disasters. These cultural aspects can also exist before disasters and help determine the success of local response and recovery execution.

Benadusi looks at culture in relation to resilience. She writes that the "resilience paradigm" is less about rote learning of what to do during a disaster than about "more intangible and difficult to define cultural capacity. The frequent use of terms such as *readiness*, *resourcefulness*, and *watchfulness* gives a clear idea of this open-endedness."[529] Benadusi defines resilience as a cultural resource, arguing, like others, that resilience is about absorptive capacity but also that "possible futures are determined by this cultural

[528] Alexander, "Globalization of Disaster," 8–9.

[529] Benadusi, "Pedagogies of the Unknown," 179.

resource of permanent adaptation as the only strategy for survival."[530] Adaptation is not a crystal ball of what is to come but is more about relationships. Furthermore, resilience relies on access to resources, some of which are cultural. Similar to Benadusi's ideas around cultural capacity's intangibility, Vale and Campanella tie urban resilience to culture. They write, "Urban resilience is thus anchored in the resilience of an intangible urban culture as well as remnants of the physical urban past."[531] Therefore, both the physical construction of a city and urban culture hold resilience in place.

The strategies grow resilience culture through programs that preserve national or local culture and mention the cultural element of social obligation to family and other groups. Wellington's and Vancouver's strategies also highlight the need to learn from and preserve indigenous culture, suggesting that indigenous populations are often exemplars of resilience through generations of adaptation to their surroundings. Wellington and Vancouver use examples from indigenous or First Nations people throughout their strategies.

All the strategies include efforts to build a resilience culture. Canada pushes federally driven legislative frameworks with the hopeful objective of "an integrated and resilient 'whole-of-government' approach to emergency management planning, which includes better prevention/mitigation of, preparedness for, response to, and recovery from emergencies."[532] Both U.S. and Canadian crisis management has pushed institutional cultures to support a provisional and united "crisis culture" (or "culture of preparedness").[533] The actualization of the "whole of community," "whole of society" concept can help accomplish this cohesion.

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[530] Benadusi, 179.

[531] Vale and Campanella, *The Resilient City*, 232.

[532] Public Safety Canada, *Federal Policy for Emergency Management: Building a Safe and Resilient Canada* (Ottawa: Public Safety Canada, 2009), 1, https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/plc-mrgnc-mngmnt/plc-mrgnc-mngmnt-eng.pdf.

[533] Public Safety Canada, 1.

Crowley and Elliott write that it is easier to build a culture of preparedness in Japan due to cultural elements and a "predisposition to trust and obey officials."[534] Wisner writes about how challenging it is in Los Angeles to earn the public's trust "with the phenomenon of 'private opulence and public squalor,'" thus pitting issues like dramatic income inequality against the ability to build a culture of preparedness.[535]

2. Diversity Builds Resilience

Three of the four strategies address diversity or heterogeneity. Kyoto's strategy does not address heterogeneity, except with regards to age. Los Angeles, in contrast, is a highly stratified community by race and income level. Wellington and Vancouver are quite culturally diverse. The value of diverse local knowledge or that of non-experts is essential to forging ahead with resilience's operationalization.

Diversity and inclusion are elements highlighted in Los Angeles' and Vancouver's resilience strategies. Both encourage work to ensure that political entities and other government power structures include diverse community members in decision-making capacities. Vancouver has built an equity framework to ensure these needs come to fruition. Diversity is also a big piece of governance structures. *Resilient Los Angeles* includes language about including diverse stakeholders in positions of authority in the city government.

3. Focus on Thwarting Social Isolation

Social isolation is highlighted in all the cases as a societal ill to remedy. The opposite of social capital, as seen in supportive community structures, is unconnected isolation. According to Carpenter, the population living on the margins of social networks, not tied to groups or support systems, is increasing and is measured by the decline of participation in informal networks.[536] One example of such weak social capital and resilience was during the 1995 Chicago heat wave, when nearly 800 people died.

[534] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 213.

[535] Wisner, "Urban Social Vulnerability," 92.

[536] Carpenter, "Social Ties, Space, and Resilience," 8.

According to New York University Professor Eric Klinenberg, who led a social capital study of the heat wave, the government failed to issue a heat emergency, contact isolated seniors to warn them, and provide transportation to cooling centers.[537] Emergency planning and response did not account for many of the challenges of vulnerable Chicagoans. Had there been representation in planning workgroups from these vulnerable groups, the planning could have better addressed the communities' specific needs. The Chicago heat wave emphasized the need to reach isolated individuals, and the literature and the strategies continually highlight the key to resilience is social connection.

4. How Disasters Change People and Communities Needs to Be Addressed

Several studies have analyzed New Zealand's response after the 2011 Christchurch earthquake, and the Wellington strategy cites lessons learned from Christchurch's recovery. Recovery, as the research suggests, is getting back to where a community was before the disaster. In Christchurch, regional emergency management official James Thompson soulfully remarked on recovery: "We always used to say, 'Recovery is getting back to normal life.' The thing is, after an event like this, normal life has changed, and it's never going to be the same again."[538] He continued: "So you recover into a new normal, or a new way of living. And that change will stay with people forever."[539] Thus, the metaphor of bouncing back is not apt in this situation.

Another example of how recovery in the literature differs from case studies is through the observation of New Zealand resident Ann Brower.[540] Brower survived the 1994 Northridge earthquake in California and the 2011 Christchurch quake in New Zealand.[541] "'Life was never meant to stay the same,' Brower said. 'Recovery—that's where you're going back to where you were. You never fully recover from an earthquake.

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[537] Eric Klinenberg, "Denaturalizing Disaster: A Social Autopsy of the 1995 Chicago Heat Wave," *Theory and Society* 28 (April 1999): 257, https://doi.org/10.1023/A:1006995507723.

[538] Lin, "Christchurch, New Zealand, Shattered by a 2011 Earthquake."

[539] Lin.

[540] Lin.

[541] Lin.

But that's not necessarily a bad thing.'"[542] Thus, from first-hand experience, Bower believes there cannot be a full realization of recovery but does not think such a state is suboptimal. Communities can move into a "new normal" that is unlike their state before the disaster.

Resilient Kyoto also focuses on the mental and physical health of its residents to build resilience. Initiative 2.3.2 strives to "promote public health through empowering individuals with information and motivation to lead a healthy lifestyle. Co-benefits will include support concerning mental health issues such as anxiety, depression, and social isolation."[543] These aims align with the personal resilience focus of *Resilient Kyoto*.

5. Focus on Younger Generations' Resilience.

All of the cities discuss how to help younger generations build resilience. Los Angeles offers employment programs for younger Los Angelinos while Kyoto connects young people with the private sector.

E. SUMMARY

The case studies showcase operationalized resilience elements that might not be included in the often-esoteric academic definitions of resilience or among NIST's four resilience indicators. These real-world examples of resilience in practice help show how specific cities operationalize resilience and provide a springboard for identifying resilience in general. Resilience is a boundary object in the academic community as well as in the practitioner world. Its plasticity creates space for issues often left on the margin. Not being hemmed in by narrow definitions of resilience allows it to be composed of often limitless expanses. As case studies add practicality to conceptual ideas, these case studies have also helped define resilience. The case studies add to the resilience tapestry through the addition of dimensions previously unseen or unnoticed.

[542] Lin.

[543] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 25.

At the intersection of theory and practice lie recommendations for the next steps in the resilience journey. The final chapter explores how operationalized resilience can improve from information gleaned in the case studies. It also sheds light on what could be next for resilience.

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VI. CONCLUSIONS AND RECOMMENDATIONS

This chapter revisits the research questions and offers recommendations, based on the findings, to improve the definition of resilience, as well as best practices for resilience operationalization. It concludes with thoughts about what is next for resilience.

A. HOW CAN THE OPERATIONALIZATION OF RESILIENCE BE IMPROVED?

1. How is resilience defined in the literature?

An extensive literature review revealed that *resilience* is a boundary object defined differently in diverse disciplines. Areas of concord and uniqueness in various disciplines' definitions add to the richness and sometimes ambiguity of resilience's description. The literature review also showed that resilience is more concretely understood when broken down into four resilience indicators: governance and economic, physical, and social resilience. Social resilience is the indicator most often written about, followed by physical resilience. There is little research on resilience governance or economic resilience.

2. How do practitioners operationalize resilience in cities?

The analysis from the four case studies on Kyoto, Los Angeles, Vancouver, and Wellington shows how these four cities operationalize resilience. Their strategic projects, programs, and city policies—categorized by resilience indicators—lend specific resilience examples, including actionable ways to build resilience. The resilience recommendations all center on the imperative that government bodies include community groups and members in decision-making efforts. Moreover, all strategies highlight the need to democratize and expand government services and programs to build resilience.

The strategies also emphasize numerous inherent facets of a city. Vale and Campanella write that a city is more than a geographic location peppered with structures; it comprises "complex phenomenon of political decisions, economic powers, social structures, cultural experiences, and legal heritage. As long as these intangible elements survive, the physical destruction of the city and even the deaths of large numbers of people

do not cause the death of the city."[544] These elements marry up well with the resilience indicators utilized by NIST. Interestingly, Vale and Campanella believe that after the physical destruction of a city following a disaster, urban resilience is illustrated by pride in the culture, location, and ruins left, which are often more powerful than the recollection of the disaster.[545]

3. What opportunities exist to operationalize academic research and/or study existing practices?

This research aimed to determine how resilience's operationalization can be improved—starting with understanding how resilience is defined and categorized through indicators. The NIST framework, which advances specific resilience indicators or categories, helped to contextualize the four case studies and organize each city's resilience strategies.

Urban areas and megacities continue to grow. Thus, overlaying the complexity of the inputs needed in a megacity, such as outsized amounts of food, water, and energy, create compounded wasteful outputs that can intensify issues in a disaster scenario.[546] As the access to resources is essential to resilience, the vast amount needed in cities will continue to confound policymakers.

B. SYNTHESIS: WAYS TO CLARIFY RESILIENCE'S DEFINITION

The following sub-sections suggest some ways to improve the study of resilience.

1. Include resilience governance in the composite of resilience definitions.

In defining resilience, the literature speaks little about governance strategies. Because resilience is about repairing systems and creating useful changes through leadership and community ties, governance is the prime way to operationalize resilience. The case studies highlight that resilience is about access to food, clean water, jobs, housing, and policymakers. Therefore, governance can provide the venue for resilience ecosystems

[544] Vale and Campanella, *The Resilient City*, 232.

[545] Vale and Campanella, 232.

[546] Wisner, "Disaster Risk Reduction in Megacities," 182.

to reside collectively and interdependently. Communities and other stakeholders judge resilience leaders by their ability to grow relationships and make decisions with diverse stakeholders, so these leaders have the difficult job of creating social trust across groups with diverse needs. With a firm hold on resilience governance, leaders will have a more-explicit, less-ambiguous framework to categorize and execute resilience.

Governance shows how to coordinate the operationalization of resilience. Civil servants and policymakers help to govern resilience, and "strong, politically oriented social networks improve the commitment of public servants and the capacity of a community."[547] Notably, disaster scholars agree that local communities are essential when building disaster plans, as these communities are generally structured under elected government bodies, meant to represent the populace. In sum, the governance of resilience is a finite way to operationalize other resilience indicators.

2. Push "resilience" into the space of interdisciplinary and transdisciplinary problem-solving, and use resilience taxonomy to understand the components.

Resilience is a boundary object that floats between disciplines yet stays tethered to central tenets, or *ecotones*, which are the places where different communities can connect and integrate. Resilience systems and structures need to be interdisciplinary and possibly transdisciplinary—as the nexus between design, policy, and social science requires that resilience be visualized and its means explained. If the academic study of resilience is more interdisciplinary or transdisciplinary, the solutions to resilience problems, on both the conceptual and operational side, may find more integrated and, possibly, sustainable approaches.[548] Resilience can, thus, extend beyond the current boundaries of its definition.

One way to define resilience as a term with clearer markers of its operationalization is to create a clear taxonomic classification structure. Such an organization would

[547] Carpenter, "Social Ties, Space, and Resilience," 5.

[548] "Definitions," Harvard Transdisciplinary Research in Energetics and Cancer Center, accessed April 15, 2020, https://www.hsph.harvard.edu/trec/about-us/definitions/#targetText=Transdisciplinary%20Research%20is%20defined%20as,to%20address%20a%20common%20problem.

structurally place resilience indicators—physical, social, economic, and personal resilience and resilience governance—into categories with possible subgroups tied to different kinds of capital that surround them. As capital designates these indicators in the context of prosperity, they become resources that can be owned and shared. Human ecology—the study of human relationships with the environment—could be the cross-disciplinary ecotone where resilience taxonomy resides.

C. EXPANDING AND IMPROVING INDICATORS TO MEASURE RESILIENCE

If indicators break resilience into aggregate pieces, broken down taxonomically, this recommendation provides a path down which resilience projects may go. Indicators provide form and guard rails for resilience definitions and projects, as well as goals and targets to improve and measure resilience through social impact. Without measuring resilience or having a resilience goal grounded by an indicator of the level of resilience, it is challenging to see and understand resilience beyond its conceptual definition. Indicators are not stagnant; they need to be revisited, updated, and repeatedly integrated into resilience preparedness efforts.

Some of the observable resilience-governance elements of NIST's framework indicators include how governments design and implement resilience policy. GDP spending and money set aside for resilience-building projects demonstrates economic resilience while land-use legislation and codes show operationalized physical resilience in the built environment. Social resilience is a bit broader and more challenging to observe in practice because it often encompasses vague elements of social capital and social structures that support or detract from resilience. Some observable characteristics include the governments' involving various community members in decision-making and supporting non-governmental community and faith-based organizations that help build social capital, among other ways that bridge connections.

1. Include a Social Mitigation/Quality-of-Life/Personal Resilience Indicator

Mitigation is a durable centerpiece of the definition of resilience in the academic literature. Physical mitigation is prevalent whereas social mitigation is not. Social mitigation is an endeavor to reduce social vulnerability and increase access to resources and emergency planning efforts in communities. If academics clearly articulated a social mitigation return on investment (ROI) akin to that for hazard mitigation, practitioners might operationalize resilience more easily. This social ROI could tie to social costs such as social services, unemployment, and childcare. A social mitigation or quality-of-life indicator would show social resilience operationalization by quantifying dollars spent in mitigation. This indicator would make social resilience more actionable and concrete.

Another challenge around social vulnerability and mitigation, like resilience, appears in the observation phase. Tate argues, "Social vulnerability is not a directly observable phenomenon: there exists no device with which to measure it."[549] He agrees with other authors that access to resources can measure resilience and, therefore, vulnerability.[550] Nevertheless, in 2012, Tate found inadequate research of the efficacy of social vulnerability indices.[551] In the absence of understanding the strength of social vulnerability indices, insubstantial indices have delivered hazard-mitigation planning information and, thus, precipitated faulty decision-making.[552] The social vulnerability indices might not help build an understanding of the exact levels or close approximations of resilience and vulnerability. If results do not portray the reality in a community, then the provision of appropriate resources may not come to fruition. Indeed, both the nadir and pinnacle of resilience must be understood to find ways to observe it well.

Some of the literature includes personal resilience, but the primary focus is on community resilience. Preston argues that preparedness work focuses not on civic or

[549] Eric Tate, "Social Vulnerability Indices: A Comparative Assessment Using Uncertainty and Sensitivity Analysis," *Natural Hazards* 63, no. 2 (2012): 326.

[550] Tate, 328.

[551] Tate, 326.

[552] Tate, 326.

national disaster efforts but on individuals and families.[553] Carpenter concurs and breaks down the community element at the individual level: "A community's adaptability to change or adaptive capacity is strongly related to resilience; collectively, individuals can influence resilience by affecting and responding to change in the system."[554] The individuals who make up a community affect resilience levels through their singular ability to adapt. Resilience as a concept would benefit in following suit. *Resilient Kyoto* provides an example of how accountability through personal pledges to implement the strategy has helped shore up personal resilience work through social pressure and rewards.[555] Community members can lead by example, and personal responsibility builds resilience. Without personal economic, physical, and mental health resilience, the community's resilience will suffer.

2. Evaluate Resilience Programs for Accountability Purposes, and Tie Resilience Indicators to Benchmarks

None of the cases' strategies point to a specific benchmark or set of benchmarks for resilience. Practitioners and academics need to find ways to give value to qualitative and observable data to show high or robust resilience levels. Establishing a resilience value will create a baseline that becomes a goal. Next, practitioners can devise a benchmark for resilience outcomes, and a cross-sectional group can determine one at the local level through strategies. Those who govern resilience will then have a roadmap.

The hallmark of a good program is to see change over time. Resilience operationalization analysis, strategy updates, transitions, and new directions will ensure resilience improvements. The case studies' resilience strategies are static; they do not include appendices that mark progress after the strategies' publication. Audits and program evaluations can help mark the progress of resilience projects and their social impact.

Accountability applies to the built environment as well. Mileti writes that local governments often develop building codes; "however, investigations after disasters have

[553] Preston, *Disaster Education*, 1.

[554] Carpenter, "Social Ties, Space, and Resilience," 2.

[555] Rockefeller Foundation 100 Resilient Cities, *Resilient Kyoto*, 18.

revealed shortcomings in construction techniques and code enforcement. Codes, standards, and practices for all hazards must be reevaluated in light of the goal of sustainable mitigation, and communities must improve adherence to them."[556] Thus, without code enforcement, physical resilience operationalization is impossible.

3. Measure Whole-Community Resilience ROI and Inventories

Practitioners need to measure the resilience of communities, non-governmental organizations, and the private sector, too, as resilience is not just a government function. Determining the ROI for resilience, as with hazard mitigation, may add value by providing numbers with context. An ROI will help to evaluate and audit resilience programs. Furthermore, an appraisal of benchmarks, or ROIs, offers a clear understanding of the meeting of resilience initiatives or indicators. In the absence of understanding the level of resilience in a community, it is impossible to guess the level of operationalized resilience.

Quantifying community interactions and characteristics will lead to a better understanding of a community's capacity. Cutter, Burton, and Emrich quantify these elements "through proxies such as the number of religious adherents (per 10,000 people), the number of civic and social advocacy organizations (per 10,000 people), and the percentage of the population employed in creative class occupations."[557] These numbers can help communities measure their capacity.

Like Cutter and colleagues, Aldrich and Meyer identify participation in political, non-profit, religious, and civic organizations; the number of registered voters; and voter participation as crucial components to building substantial social capital.[558] However, they also look at the actions these groups can take to build social capital and trust. Aldrich and Meyer found that social networking events, such as "parades, fairs, and block parties along with moderator-led discussions of topics such as the environment and school choice," built

[556] Mileti, *Disasters by Design*, 8.

[557] Cutter, Burton, and Emrich, "Disaster Resilience Indicators," 9.

[558] Aldrich and Meyer, "Social Capital and Community Resilience," 258.

trust—sometimes through their transparent sharing of information—and, hence, social capital in communities.[559]

Another way to measure resilience is by gauging preparedness through inventories of supplies and equipment.[560] Whole-community partnerships can determine resilience inventories and then help measure resilience. In sum, quantifying resilience in a community through inventories can indicate operationalized resilience.

4. Develop Tools to Visualize Resilience

Policymakers must have specific examples of resilience to point to as opposed to abstractions that can dilute information into conceptual frameworks—examining why and clearly illustrating how particular outcomes befell particular communities will also inform planning efforts to operationalize resilience. A representation of a plan or theory in the form of an outline or model would help. Visual tools can simplify the conceptual nature of resilience. If the types of resilience could be clarified through indicators and models of healthy resilience, practitioners could better understand resilience. Furthermore, the community and policymakers need brief presentations for complex issues. Such models and visualizations should streamline decision-making around resilience operationalization.

D. RECOMMENDATIONS TO BETTER OPERATIONALIZE RESILIENCE

The case studies show how practitioners have operationalized resilience in four cities. The cities' resilience strategies provide roadmaps for improving resilience levels, focusing on what communities have done to become resilient and what they want to achieve in the future. Many of the strategies aggregate existing programs and projects under resilience indicator banners. Such research-guided policies show the intersection of knowledge and practice.

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[559] Aldrich and Meyer, 262.

[560] Jessica Jensen, *Preparedness: A Principled Approach to Return on Investment* (Falls Church, VA: International Association of Emergency Managers, 2011), i, https://www.ndsu.edu/fileadmin/emgt/IAEM_preparedness_principled_approach_81111.pdf.

As mentioned previously, operationalizing resilience requires robust implementation plans with accountability at the core. Without liability, resilience strategies are merely lofty goals, and the community will distrust resilience governance.

Resilience planning needs to focus on local issues, with regional, state, and national government levels included as these bodies have access to resources and expertise. Community members, faith-based organizations, businesses, non-governmental organizations, and community groups need to be at the table throughout the process, not just at the end, to vet strategies laid out by government officials without collective buy-in at the initial stages.

1. Recommendations for Resilience Governance

Governance is dynamic and hard to control. It morphs over time. Its challenges are exacerbated by the inextricable link to political and socio-economic factors. Governance is often unclear and contains many stakeholders. Arguably, the core American values of exceptionalism, individualism, and local control are getting in the way of a standardized resilience approach in the United States. Thus, the resulting system is built as a political compromise, and in some sense, it is arbitrary. American values have helped to drive local innovation as well as exceptionalism at the local and state level, but this bifurcated focus has overlooked intractable problems, such as low community resilience levels and climate change, that affect the whole nation. All disasters are local, but a collective effort to reduce risk and adapt to climate should not stop local jurisdictions from working toward solutions. Liberalism and representative democracies may be vital in dealing with other wicked problems like resilience, such as climate change.

Resilience policy can be a powerful tool in helping communities strengthen their resilience. Policies can show a community's identity as voters delegate those in elected office to represent them. Thus, policies can be seen as symbolic, as they illustrate a community's identity. The community must help build and implement resilience policies,

which can only occur by building its trust. According to Putnam, the two primary drivers of high social-capital levels are civic engagement and trust.[561]

Disaster planning, mitigation, and recovery work should not be piecemeal and infrequent. Legislation that preempts disasters instead of reacts and responds will help the operationalization of resilience. As Alexander writes, "Throughout the world, about 75 percent of legislation that aims to protect people against the effects of disaster is enacted in the wake of particular events, usually major disasters that stimulated demands for legal and organizational change."[562] Communities around the world live in the tempest-tossed state of globalization, which has helped spread disease; thus, flexibility is vital in response, but planning can pay dividends. While adapting after a disaster is part of resilience, if the focus is not on preparedness, prevention, and mitigation phases, an impediment of operationalized resilience through resilience governance is the outcome.

Updated disaster policy will help to ensure that communities feel supported in a way that reflects current frameworks and methodologies for calculating risk and measures to mitigate against it. Daylighting updates to disaster policy with the community will grow trust, social capital, and resilience. Tierney laments the use of large disasters to make massive policy updates:

> [Disasters] are also socially defined as representing major policy failures that need to be remedied. What then follows is a search for lessons learned and policy remedies. Here again, both the lessons of disasters and proposed solutions to disaster-related failures are socially constructed, and advocacy groups and policy entrepreneurs are typically active in suggesting solutions.[563]

Thus, solutions come after the large perceived "policy failures," not before them. Often these solutions are enforced top-down and paternalistically. This lack of collective effort stymies plans to operationalize resilience.

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[561] Putnam, "Bowling Alone," 66.

[562] Alexander, "Globalization of Disaster," 16.

[563] Tierney, *Social Roots of Risk*, 122.

The California Volunteers' 2019 *Building Disaster Resiliency* includes three ways to govern resilience better. The roadmap offers some concrete ways to operationalize social capital and resilience through governance. For example, its sixth opportunity area, "Democratize Disaster Learning and Resilience," provides salient examples for building community resilience more transparently and moving government and non-profit organization work out of silos into a more collaborative, trusting space. These resilience governance "good practices" and lessons learned include the following:

- Develop a trusted forum where all community members and sectors can openly share their learnings after a disaster
- Create a nonprofit hub or center to aggregate this learning and disseminate best-practices to the public
- Create and maintain a system for public engagement and resident input.[564]

The recommendations around resilience governance gleaned from the literature and case studies key into and expand on these three ideas.

a. Develop a Governance Framework for All Other Resilience Indicators, and Adopt a Standard, Adaptable Model of Resilience Governance

Governance should be an umbrella under which all the resilience indicators reside. A resilience governance framework should outline specific methods and measurable steps to govern the different indicators, including governing, legislating, and facilitating resilience work, with guideposts and guardrails determined in collaboration with the community. This framework would also provide a measurable means by which to enable resilience work.

The goal of Arup's *City Resilience Framework* was to remove silos, use thought leadership and evidence to drive decision-making, and make the framework accessible and relatively easy to follow and understand.[565] These tenets should guide a resilience governance framework.

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[564] California Volunteers, *Building Disaster Resiliency: A Roadmap for Investment & Innovation in California* (Sacramento: California Volunteers, 2019), 19, https://californiavolunteers.app.box.com/s/i1cl1py11r35hwpydgydky93j2gvjwyk.

[565] Rockefeller Foundation and Arup International Development, *City Resilience Framework*, 3.

Canada, European countries, and Asian countries reference the UN's *Sendai Framework for Disaster Risk Reduction* in their national resilience strategies, and Vancouver, Wellington, and Kyoto use Sendai locally. The United Nations Office for Disaster Risk Reduction creates risk profiles through the *Sendai Framework*, and such a collective international model helps nations understand where they need to build resilience projects and programs. Comparing resilience operationalization to other countries, states, and cities around the world helps to motivate policy and create a means of sharing information and ethical practices.

b. Grow Good Governance and Servant-Leadership through Training

If operationalized community resilience depends on the community's action, the servant-leadership philosophy needs to permeate all levels of government, with empathy and listening as the core principles.[566] Robert Greenleaf's seminal work, *The Power of Servant-Leadership*, rests on principles steeped in community building and stewardship as opposed to top-down business and government practices. He writes, "Servant-leadership advocates a group-oriented approach to analysis and decision making as a means of strengthening institutions and of improving society."[567] This type of leadership equates to resilience governance and leadership.

Leadership can be an inherent skillset, yet leadership training is often helpful as it provides tools and guidance. There is usually an expectation that leaders will quickly pivot in the time of crisis and move their communities toward resilience. This timeline is often unrealistic as leaders are often directly affected by disasters. Training leaders in all sectors how to lead resilience efforts is critical. Wellington is the only city studied that provides such training.[568]

Accountability is a means to build good governance. The UN's eight pillars of good governance are "participatory, consensus oriented, accountable, transparent, responsive,

[566] Robert K. Greenleaf, *The Power of Servant-Leadership: Essays* (San Francisco: Berrett-Koehler Publishers, 1998), 5.

[567] Greenleaf, 9.

[568] Rockefeller Foundation 100 Resilient Cities, *Wellington Resilience Strategy*, 50.

effective and efficient, equitable and inclusive and follows the rule of law."[569] These tenets, coupled with empathy, will enhance resilience governance as they provide a way to engage effectively and collaborate and partner equitably with community groups and members.

c. Adopt a Sustainable Hazard Mitigation Policy

Hazard mitigation planning in the built environment begins with identifying risks and then mapping out land use and procurement of property, structural engineering, and building code standards, which help mitigate the risks.[570] Godschalk wrote in 2003 that "the practice of traditional natural hazard mitigation has focused on wide sharing of information about risks and safety measures in order to build public commitment to, and participation in, mitigation programs."[571] Gathering risk data is the first step to creating mitigative structures and systems; sharing that information with the public and other stakeholders is how mitigation planning comes to fruition.

It is essential that the narrative changes around response and risk reduction. Mileti, wrote in 1999 that the United States "must shift to a policy of 'sustainable hazard mitigation.' This concept links wise management of natural resources with local economic and social resiliency, viewing hazard mitigation as an integral part of a much larger context."[572] Through mitigation work, resilience in communities grows. If this work is not sustainable or nourished through financial support and wise land-management practices, resilience operationalization will not be successful.

Mitigation seems like a straightforward endeavor, but governance and economic interests can muddy the water. For example, mitigation legislation is plentiful in California, but the state faces unwieldy challenges implementing "top-down" mitigative measures. Wisner attributes the problematic nature of execution to "extreme fragmentation,

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[569] United Nations Economic and Social Commission for Asia and the Pacific, "What Is Good Governance?," 1.

[570] Godschalk, "Urban Hazard Mitigation," 136.

[571] Godschalk, 139.

[572] Mileti, *Disasters by Design*, 2.

decentralization, and complexity of governmental structure and . . . the overwhelming influence of the real estate and financial sectors that have promoted little-regulated growth for nearly a century."[573] The result of such actions or inactions are fewer building regulations and, thus, less focus on mitigative DRR measures.

Governance and actualization of mitigation measures for the built environment are a challenge, but hazard mitigation as a construct can be limiting, too. Godschalk argues that with the best intentions, "hazard mitigation guidelines typically have not focused on or identified the unique needs and characteristics of cities under stress, as opposed to more generic hazard situations."[574] This absolute focus on hazard-specific scenarios—without an understanding of stressed systems' resource needs—advances myopic planning efforts.

d. Increase Diversity yo Widen the Scope of Resilience, and Plan Transparently with the Community

Stakeholder diversity is vital in building resilience strategies. Thought partners that challenge conventional thinking, paradigms, and assumptions will be more plentiful with a more diverse stakeholder group. There is a need for emergency managers (from all levels of government), quantitative and qualitative researchers, humanitarian organizations, non-profit organizations, and more to build out resilience programs, or there may be an absence of essential information and data. Without diversity, resilience operationalized may be myopic in scope and scale. These groups can also pitch ideas together to local governments. Planning collaboratively with diverse stakeholders can help build effective teams where disciplines converge and create together, instead of merely working together.

Transparent mitigation planning on the government side needs to be in concert with diverse community members to build resilience and trust. The democratization of access to information will help to build trust. If the key to operationalizing resilience depends on cooperation between communities, government, non-governmental organizations, and the private sector, trust must be established at the outset of resilience operationalization projects. Not only will plans be more holistic in their approach and include elements that

[573] Wisner, "Urban Social Vulnerability," 93.

[574] Godschalk, "Urban Hazard Mitigation," 136.

the government does not immediately identify as needs, but community involvement in planning will also help response and recovery efforts, as there will be more comfort and trust through relationships already established in the planning phases. Representation in planning workgroups of vulnerable groups also ensures that plans better address the community's specific needs.

Norris et al. have found that "to access social capital, one of the primary resources of any community, local people must be engaged meaningfully in every step of the mitigation process."[575] The mitigation process may not tie solely to the mitigation work of government agencies and private-sector entities. They claim that connections between various informal social networks and open communication are essential to local problem-solving and government aid integration into communities.[576]

Godschalk expands on the need for open communication as the mainspring to operationalizing resilience. In his vision of resilient cities, "governmental, nongovernmental, and private sector organizations are prepared with up-to-date information about hazard vulnerability and disaster resources, are linked with effective communication networks, and are experienced in working together."[577] Thus, the means of communication and the comfort of working together are as necessary as data sharing.

e. Grow Transparency and Trust by Sharing Data on One Platform

Access to data and the ability to share data in a clearinghouse setting can help operationalize resilience. Thus, all parties are privy to the same datasets in resilience planning, preparing, preventing, mitigation, responding, and recovering. Japan has a long history of sharing disaster data with the public and is arguably the most disaster-prepared nation globally.[578] Transparency is the key to trust, which is key to resilience and governance. Sharing data with the public links social capital to trust-building and growth in resilience.

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[575] Norris et al., "Community Resilience as a Metaphor," 143.

[576] Carpenter, "Social Ties, Space, and Resilience," 7.

[577] Godschalk, "Urban Hazard Mitigation," 137.

[578] International Research Institute of Disaster Science, *HFA IRIDeS Review Report*, 19.

A resilience project in the city of Vancouver pushed the need to "develop a web-based tool for communities to pool knowledge, avoid duplication, and optimize resources and expertise."[579] At the regional level, the United Nations International Strategy for Disaster Reduction shares this tool through the world conferences on DRR.[580] Clearinghouses of data that are free and accessible will enable more rigorous planning efforts.[581] Regional costs and benefits of resilience efforts analyzed through available tools will help with future investments as well.[582] If operationalized resilience work is not piecemeal but pushes to create lasting change with an eye toward the future, through data-driven decision-making, it will strengthen and endure. The flip side of sharing data is, of course, the issue of how to corral and address privacy when the government is more involved in this enterprise.

f. Support Non-governmental Organizations, and Help Them Grow Their Organizational Capacity

The totem of resilience is social cohesion, and often non-governmental community and faith-based organizations hold the space for this work. Non-governmental organizations are the link between formal (government) and informal (community members) social capital.[583] Non-governmental organizations are, according to Wisner, "the cornerstone to building social capital and resilience in communities."[584] In a *New York Times* interview, Dr. Lucy Jones stated that "the research on disasters shows that the communities that recover are the ones where people are connected to each other and care about each other. Most of the messages about earthquake preparedness are very isolating. We need to start working with community organizations."[585] To effectively communicate

[579] UR+ Vancouver, *Symposium Outcomes: Recommendations for Actionable Strategies* (Washington DC: Global Facility for Disaster Reduction and Recovery, 2017), 2, http://www.bccassn.com/media/UR+%20Vancouver-Outcomes.pdf.

[580] Chatterjee et al., "Bangkok to Sendai and Beyond," 177–78.

[581] UR+ Vancouver, *Symposium Outcomes*, 2.

[582] UR+ Vancouver, 2.

[583] Wisner, "Disaster Risk Reduction in Megacities," 184.

[584] Wisner, 184.

[585] Cowen, "An Interview with Lucy Jones."

with the public around resilience, the government must not be the only mouthpiece. Coalition building with non-governmental and faith-based community organizations will help push a collective message about how to build and sustain resilience.

Funding is often less reliable for community and faith-based organizations than for local governments that rely on taxes and state and federal support. Carpenter adds to Wisner's argument about the essential role of non-governmental agencies in building resilience, cautioning that the government must financially support and often regulate resilience. With only government bodies at the helm of resilience work at the local level, without community-led grassroots activities, resilience operationalization will not be realized.[586]

Efforts to grow organizational capacity before disasters for agencies and entities providing resilience programs will build organizational resilience. Carpenter claims that after a disaster, it is challenging for government bodies to utilize disaster funds at the local level because their organizations lack the capacity to accept the aid.[587] Resilience blooms and flourishes through community cohesion in partnership with government, not through government alone.

g. Create and Support Resilience Task Forces, Advisory Groups, and Policy Groups that draft Stronger Disaster Legislation and Update It Regularly

Diverse stakeholders from the community need to help build operationalized resilience programs. Such a group requires a formal structure that measures work progress. Los Angeles and Wellington have local and national lifelines councils, respectively. These councils create formal structures where private and government lifeline providers can collaborate, share, and build policy. They can also adopt good practices and implement corrective actions gleaned through lessons learned. The lifelines council construct should be expanded to become resilience councils in each community at the regional, state, or prefecture and national levels. The regional nature of resilience work in all the cases illuminates that disasters do not often recognize geographic boundaries. Working across

[586] Carpenter, "Social Ties, Space, and Resilience," 6–7.

[587] Carpenter, 6–7.

cities and under regional bodies helps build a larger reliance collaborative able to pool resources and more diverse expertise. Because resilience and adaptation work should not exist at a jurisdictional level, collaboration across sectors and government levels is critical to resilience operationalization. Such a concept requires regional committees because city boundaries do not confine disasters, and state or prefecture levels of government will provide interagency capacity support.

A structure that may work in resilience operationalization is a resilience task force overseen and supported by a resilience advisory group. CROs from a cross-section of various government, non-profit, and private-sector entities would make up the task force and policy group. This government and non-government body would link up formal and informal social capital. A larger CRO cadre model would borrow from the CROs of Los Angeles' 28 city departments, who oversee resilience work at the department level and come together as a collective to ensure resilience work in Los Angeles represents multiple needs.[588] Resilience working groups, governed by charters and work plans, would tackle specific projects at the task-force level. Subcommittees broken up by resilience indicators would lead these projects. The task force would meet quarterly to address benchmarks at the subcommittee level and brief the advisory group quarterly.

h. Find Ways to Work around Slow, Outdated, and Often Behemoth Bureaucratic Structures

If risk and disasters are socially constructed, society can intervene and shift the system, which will break down barriers to the operationalization of resilience. British anthropologist Mary Douglas, in writing about culture and classification systems, explains how change can emerge within the context of public goods—those shared by all. She writes,

> How a system of knowledge gets off the ground is the same as the problem of how any collective good is created. . . . Communities do not grow up into little institutions and these do not grow into big ones by any continuous

[588] City of Los Angeles, "Garcetti Announces Plan."

> process. For a convention to turn into a legitimate social institution it needs a parallel cognitive convention to sustain it.[589]

Thus, according to Douglas, collective judgment, reason, and learning in a connected society buttress society's rules. Douglas sees that because society creates social institutions, members of society can change them. Once these institutions change and become better representations of the communities served, a collective, more-trusting effort toward the operationalization of resilience will be an outcome.

A solution or way forward to change social institutions is what Alexander calls "adaptive governance," a form of resilience. He highlights that adaptive governance, also known as "adaptive co-management," is "a continuous problem-solving process" that must work in tandem with the adaptation in communities.[590] Modifying existing policies that currently impede achieving social resilience and resilience design strategies will help operationalize resilience.

2. Recommendations for Economic Resilience

Governance of resilience also includes how governments and others spend money, a quantitative indicator of operationalized resilience priorities. Funding for resilience projects needs the ability to morph as priorities change. Long-term contracts and planning efforts need room for investments and innovations. All levels of government emergency plans, strategic plans, policy guidance, policies (e.g., bills), insurance incentives, requests for proposals, lease requirements, and capital planning projects should add risk and adaptive strategies. Governance also needs to align the regulatory environment with the non-regularity. There is a strong need for resilience infrastructure projects to drive alignment at state and federal levels.

[589] Mary Douglas, *How Institutions Think* (Syracuse: Syracuse University Press, 1986), 46.

[590] Alexander, "Resilience and Disaster Risk Reduction," 2712.

a. Increase the Percentage of GDP on Government Spending, Grow Personal Economic Resilience, and Incentivize DRR Activities

National government spending as a percentage of GDP is a marker of resilience.[591] Without economic resilience at the national level, state and local resilience levels will not grow as fruitfully. The government can also help build personal economic resilience. During disasters that often cause financial upheaval, there is an opportunity to help individuals become more economically resilient. Without savings, individuals can spiral quickly into crippling debt. A closer link between the study of wealth, debt, and economic resilience from various disciplines may shed light on how individuals can become more financially resilient. FEMA developed an Emergency Financial First Aid Kit to build financial emergency preparedness.[592] Moreover, financial literacy should be taught in schools early and expanded upon as students move through the educational system.

An economic resilience action precipitated by implementing the Hyogo Framework for Action in Japan occurred when the Japanese government created the government-owned Development Bank of Japan. A 2011 analysis of the framework provided a specific example of economic development through the bank. To build resilience through financial means, the Development Bank of Japan "launched a new lending mechanism disaster reduction rating system for disaster countermeasures promotion projects, as an incentive for corporate disaster reduction activities."[593] Such financial investments in resilience and disaster countermeasures through incentives can help grow resilience in a community.

b. Offer Insurance Incentives and Risk Transfer

The cases and the literature illustrate that insurance gaps, the difference between insurable and insured items, can cause an undue financial burden on institutions and

[591] Lin, "Governing Natural Disasters," 1289.

[592] Public Safety Canada, *Advancing and Empowering Disaster Risk Reduction in Canada: Canada's Platform for Disaster Risk Reduction* (Vancouver: Public Safety Canada, 2018), https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/pltfrm-dsstr-rdctn-2018/index-en.aspx.

[593] Nagai Tomoya, *Japan: National Progress Report on the Implementation of the Hyogo Framework for Action (2009–2011)* (Tokyo: Cabinet Office, Government of Japan, 2011), 19, https://www.preventionweb.net/files/19650_jpn_NationalHFAprogress_2009-11.pdf.

individuals after a disaster, as insurance is a costly investment.[594] Reducing risk before events is paramount, and there must be more financial incentives for pre-disaster mitigation planning. Insurance incentives through risk transfer models and other ways may help increase the number of insured individuals and companies.

In 2018, FEMA leadership examined the high insurance gap in the United States—it has the largest globally—and called insurance "the best disaster recovery tool available."[595] Insurance is also a cumbersome process, and FEMA hopes to streamline inspection procedures for post-disaster damage assessments.[596] FEMA and national governments should look to New Zealand for best practices around insurance. The government-owned Earthquake Commission's homeowner insurance policy insures 90 percent of New Zealand's property.[597] There is already a strong insurance culture in the country, and locally, the *Wellington Resilience Strategy*'s insurance literacy campaign has helped guarantee the number of residents insured increases. An understanding of actuarial science, even at a conceptual or base level, buttresses decision-making around risk.

c. Engage and Partner with the Private Sector

All of the strategies incorporate the private sector. The United Nations Office for Disaster Risk Reduction work that Canada, New Zealand, and Japan support includes a national network called the Private Sector Alliance for Disaster-Resilient Societies, also known as ARISE.[598] These groups engage the private sector in DRR and continuity planning. Japan sends companies business continuity plans or continuity-of-operations plan surveys, which are means of tracking progress. The other cities do not hold the private sector as accountable as Japan does. Private-sector involvement in the operationalization of resilience is an area for future academic research.

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[594] Public Safety Canada, *Advancing and Empowering Disaster Risk Reduction in Canada*.

[595] Public Safety Canada.

[596] Public Safety Canada.

[597] Fleming et al., *Public Insurance and Climate Change*, 5.

[598] United Nations General Assembly, *Implementation of the Sendai Framework for Disaster Risk Reduction* (New York: United Nations, 2019), 17.

3. Recommendations for Physical Resilience

Globally, according to the UN, cities are physically expanding 1.5 times the amount of population growth.[599] This statistic points to the need for wise, sustainable urban planning and better transportation systems. These communities are also girding for an increase in the number of disasters.[600] Human decision-making around the built environment and infrastructure has been the impetus for DRR and physical resilience. Crowley and Elliott have written about the strategic positioning of city and suburban outgrowth locations to water supplies, opportunities for trade in routes and supply chains, and topographic and tectonic elements that support water movement and trade routes.[601] To that end, many cities are vulnerable to disasters based on their locations, and governance decisions made around where to build and rebuild do not always move forward with the community's resilience in mind.

a. Encourage Innovation

Regulations may impede innovation and the operationalization of resilience. Codes can ensure that design standards move forward by recognizing their place in the more extensive system. Continuing and building on design contests such as Resilience by Design and Rebuild by Design, which have promoted innovation in the realm of physical resilience, can foster creative solutions to issues around physical resilience. These competitions can offer latitude in creativity that planners may not experience due to government regulations and rules.

One would guess that the opportunity to rebuild after a disaster prompts innovative and creative solutions. Vale and Campanella write, "While urban disasters can bring about an opportunity for changes in the built environment, they do not appear to induce innovation per se."[602] Using the example of Japan and its frequent disasters, they argue

[599] "High-Level Political Forum Goals in Focus—Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable," United Nations Statistics Division, accessed August 24, 2019, https://unstats.un.org/sdgs/report/2018/goal-11/.

[600] United Nations Statistics Division.

[601] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 211.

[602] Vale and Campanella, *The Resilient City*, 213.

that "many times, the Japanese rebuilt their cities much the same as they were before, innovating only slightly on building codes or urban form."[603] Thus, repetition has not forged creativity. Innovation in architecture after a disaster results only when there is consensus between residents, the government planning entities, and the private sector.[604]

Building codes themselves do not lead to higher levels of resilience. Their practical application and the perceived efficacy of expropriation laws can guide the next steps in a building process. The governance of rebuilding is critical to resilience, not just the codes and regulations meant to provide construction guidance.

b. Change Behavior around Codes, Permits, and Regulations

Creating physical space for people to gather and socialize in antecedent conditions will grow social capital and resilience, saving lives during and following a disaster. The cases and the literature include information that drives decision-making about rebuilding after disasters. Risk-based standards that help communities respond to disruptions need to be defined, implemented, and ensured. Risk-ranking priority projects and advocating for their completion is critical as well. Japan's "build back better" mantra has helped the country's buildings better withstand subsequent seismic events. In the United States, FEMA provides funding to build back to a previous state, not a better one.[605] These differing rebuilding roadmaps offer examples of how even strong international building codes may not always precipitate updated buildings with creative earthquake-resistant strategies. The government can enhance existing building codes so that structures are not only built to save lives but also functional after a disaster.

Existing policies and approaches to land use have increased exposure to hazards. Land-use practices must marry up with the needs and vulnerabilities of communities and properties. Thus, losses are rising exponentially. Islands of resilience can become an outcome as permitting does not often align at the regional level, and various codes do not

[603] Vale and Campanella, 213.

[604] Vale and Campanella, 229.

[605] Sack and Schwartz, "Storms Keep Coming."

"speak to each other with respect to terminology and thresholds such that the relative risk tolerances make sense."[606] Thus, one size does not fit all.

The economic challenge in cities like Los Angeles is balancing affordable housing and structural resilience. The construction industry does not believe both can be supported simultaneously and has pushed for voluntary acquiescence.[607] In the 1990s, according to Tierney, there was a move to make "communities disaster *resistant* through more predisaster loss reduction measures, such as sound building practices, in order to contain disaster-related damage and disruption."[608] Indeed, the built environment and engineering standards and codes that dictate the building of structures can measure a community's resilience.

Unfortunately, disasters disproportionately affect areas where poor decision-making persists around often-unsolved development issues.[609] In the United States and elsewhere, Mileti argues there is a lack of guidance that "informs development in hazard-prone areas. Instead, a patchwork of innumerable federal, state, and local regulations creates a confusing picture and often reduces short term losses while allowing the potential for catastrophic losses to grow."[610] Therefore, building standards and codes meant to mitigate against and reduce disaster risk in the built environment will only be useful if they are unified and easy to understand.

The news media have taken notice of the unfortunate trend of building in vulnerable locations. In an October 2018 *New York Times* article, Sack and Schwartz write,

> Since at least 1950, an empathetic nation has supported the impulse to rebuild in place by financing much of the cost of disaster recovery through the federal budget. But the process adheres to the American conviction that,

[606] UR+ Vancouver, *Symposium Outcomes*, 3.

[607] Lin, "California Earthquake Standard Designed."

[608] Tierney, *Social Roots of Risk*, 165.

[609] Wisner, "Disaster Risk Reduction in Megacities," 192.

[610] Mileti, *Disasters by Design*, 7.

> regardless of who pays, decisions about land use and infrastructure should be made as locally as possible.[611]

Rebuilding in response to disasters seen in recovery efforts funded by federal tax dollars and pushed by local authorities has resulted in a lack of mitigation investment. Faulty human decision-making has propelled such disregard for DRR in the United States and allowed construction in vulnerable areas.

The continued choice in the United States to build human settlements in vulnerable areas indicates that losses tied to disasters will not subside.[612] This sentiment was passionately argued in the late 1990s by FEMA Administrator James Lee Witt: "You can't continue this with the pace and intensity of events we've seen today. . . . Somebody has got to break the cycle of damage, repair, damage, repair."[613] Project Impact, a program meant to build community resilience through social and physical resilience indicators, commenced under Witt's leadership but was later scrapped when the administration changed.

Nearly 20 years since Witt's plea, this cycle has continued. In October 2018, Gavin Smith, director of the Coastal Resilience Center of Excellence, a research consortium funded by the Department of Homeland Security, talked about this problem in a *New York Times* interview. He implores, "We need to rethink how and where we build before the storm, as well as how and where we reconstruct public buildings and infrastructure in the aftermath of extreme events."[614] This inability to build solely in areas that have lower risk profiles has lessened the nation's resilience.

c. Invest in Participatory Land-Use Planning through Diverse Committees, and Invest in Resilient Transportation

There needs to be an engagement of community members, emergency managers, risk assessment experts, and equity teams to encourage social equity and environmental

[611] Sack and Schwartz, "Storms Keep Coming."

[612] Sack and Schwartz.

[613] Sack and Schwartz.

[614] Sack and Schwartz.

justice weave into land-use planning. Land-use planning needs to be driven by community-based participatory design. Key lessons learned about land-use planning through adaptive community engagement came from a 2015 Brookings Institution case study, encouraging the use of large community meetings for various stakeholders to share policies and messages. These groups will shrink over time, as critical discussions move to breakout sessions, where specific initiatives garner feedback. The servant-leadership aspect of listening to community members about how individual land-use decisions will affect them can help policymakers govern land-use planning more effectively. As members broach new ideas and concerns, engagement can flex to meet community members' and land-use planners' needs.[615]

Los Angeles', Wellington's, and Vancouver's resilience strategies mention resilience growth through a focus on transportation. Transportation resilience should move beyond investing in retrofitting and updating transportation infrastructure and routes. Public transportation is sometimes the only means of getting to one's place of employment. Furthermore, the co-benefits of supporting low-cost shared vehicle use include fewer parking spaces needed in cities. With more open space available, there are greater opportunities to build dense housing, thus decreasing living costs.

4. Recommendations for Social Resilience

Crowley and Elliott concur with other academics that "disasters only occur at the interface of society and nature."[616] Thus, an event in nature is only a disaster once it affects people and communities. This designation, says Wisner, directly relates to the socially constructed nature of disasters and their tie to unsolved development problems more than events caused by natural forces.[617]

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[615] Michelle Mitchell, *Relocation after Disaster: Engaging with Insured Residential Property Owners in Greater Christchurch's Land-Damaged "Residential Red Zone"* (Washington, DC: Brookings, 2015), 31–33, https://www.brookings.edu/wp-content/uploads/2016/06/Brookings-Planned-Relocations-Study-New-Zealand-June-12-2015.pdf.

[616] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 208.

[617] Wisner, "Disaster Risk Reduction in Megacities," 192.

a. Address Mental Health

There is a temporal and emotional human element to disasters as well, which Alexander eloquently describes as "milestones in the lives of people who survived them and rebuilt their lives afterwards."[618] This personal element of rebuilding a life versus a community or building is not prevalent in the literature but a critical resilience component. A will to stay in a community to rebuild one's life after a disaster versus moving to another community is essential in building resilience. A community cannot be resilient without people and networks that connect them.

In an article in the *Los Angeles Times*, part of a late 2019 throughline about the devastation of earthquakes, Rong-Gong Lin remarks on the slow pace of recovery in Christchurch, exacerbated by "the physical, economic and psychological aftershocks."[619] His focus on the triad of physical (built environment), economic, and psychological elements impeding recovery is both insightful and a stark lesson for other earthquake-prone areas. Merely building back cities is not the keystone to recovery.

The NIST framework and models like it do not address people's post-disaster emotions and mental health, where elements like post-traumatic stress disorder can surface. Indeed, individuals experience several post-disaster phases. Directly following an earthquake, "after a community celebrates rescues and heroes, the public can enter a phase of unrealistic hope in which everyone thinks everything can return to normal quickly. Then there's a long phase downward, accompanied by stress, exhaustion and fatigue."[620] It is unclear whether this "long phase downward" lessens with substantial social capital. Reconstruction can be the next phase—about a year following the disaster—which, coupled with grief, can lead to emotional highs.[621]

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[618] Alexander, "Globalization of Disaster," 16.

[619] Lin, "Christchurch, New Zealand, Shattered by a 2011 Earthquake."

[620] Lin.

[621] "Phases of Disaster," Substance Abuse and Mental Health Services Administration, December 15, 2020, https://www.samhsa.gov/dtac/recovering-disasters/phases-disaster.

b. Understand and See Vulnerability

The term vulnerability can mask over swaths of groups of individuals. If social, economic, and physical vulnerability is seen as a broad brush away from vulnerable individuals, it is challenging to understand its nuance. Academics who dissect vulnerability with demographic and other markers have helped to find a more robust understanding of what vulnerability encompasses. Including all community members in resilience planning and execution will help ensure persons with disabilities, food insecurity, homelessness, incarceration, and poverty are not afterthoughts. Including race, class, education level, disabilities, and gender is an opportunity, not a barrier, to operationalize resilience equitably.

Social equity and environmental justice are themes that affect the physical resilience of lower-income residents. The UN's 2015 *Global Assessment Report on Disaster Risk Reduction* maintains, "Socially segregated urban development . . . generates new patterns of disaster risk. Low-income households are often forced to occupy hazard-exposed areas with low land values, deficient or non-existent infrastructure and social protection, and high levels of environmental degradation."[622] Thus, hazard-exposed areas affect lower-income communities, and Klinenberg advocates looking at proximity to environmental dangers as a measure of vulnerability.[623]

c. Put Volunteers at the Helm of Emergency Preparedness and Community Response

All of the cities' strategies highlight volunteerism. Benigno Aguirre, professor of sociology and criminal justice at the University of Delaware, claims that local volunteer organizations, connected by bridging social capital, such as parent–teacher associations,

[622] United Nations International Strategy for Disaster Reduction, *2015 Global Assessment Report on Disaster Risk Reduction—Making Development Sustainable: The Future of Disaster Risk Management* (Geneva: United Nations, 2015), vii, https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf.

[623] Klinenberg, "Denaturalizing Disaster," 245.

can be instrumental in mitigation and first-response efforts, such as helping to evacuate populations and linking families to schools.[624]

Kyoto is unique as *shobodan* (volunteer groups) run a bulk of emergency preparedness, response, and recovery actions. Like Kyoto, Los Angeles has volunteer community groups that realize disaster planning and preparedness, such as CERT-trained neighborhood groups.[625] Volunteerism provides myriad benefits, providing communities with a space to build social networks, linking to the government, growing trusted alliances within communities, and building coalitions.

Volunteer groups, including faith-based organizations, like government, may not always represent all demographics equitably. As with Japanese cities, Wisner writes, Los Angeles shows a middle-class bias that "excludes the homeless, mentally ill, and illegal immigrants" from disaster volunteer groups.[626] Thus, as in Kyoto and other Japanese cities, social capital in Los Angeles has grown only within specific homogenous groups.[627] Homogeneity and resilience are an area that could use further study.

E. LIMITATIONS

The academic study of resilience is boundless, so the literature review and analysis represent the wavetops of study, at best. The cases, too, represented only four cities and were not meant to be conclusive. Thus, recommendations for defining and operationalizing resilience more effectively were limited by what was studied. The unique nature of the term resilience as a boundary object that lives in various multidisciplinary spaces helped unearth creative solutions to improve resilience operationalization. An explicit definition of resilience would have further hemmed in the cases' resilience strategies, yet the cases showcase that the operationalization of resilience is limitless.

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[624] Benigno E. Aguirre, "On the Concept of Resilience," Preliminary Paper #356 (Newark: University of Delaware, Disaster Research Center, 2006), 6, http://udspace.udel.edu/handle/19716/2517.

[625] Wisner, "Disaster Risk Reduction in Megacities," 191.

[626] Wisner, 191.

[627] Wisner, 191.

F. SUMMARY

Resilience is about human behavior—how we interact with others and what choices we make around social structures, the built environment, money, and our leaders. Social capital is the key to resilience and is about connections, which arise from shared experiences and geographic locations. Unity through the web of relationships between formal social capital networks in government agencies, private-sector companies, and community groups and informal social capital can precipitate efforts in making change. Stakeholder engagement through understanding resilience before laying out a path for its governance is the first critical step as governance structures can get in the way of moving resilience initiatives forward. Diverse stakeholders need to feel empowered to implement and operationalize resilience strategies.

Humans are sentient, capable of using reason to make decisions about wicked problems. Changing the narrative from a focus on wicked problems to a collective cognitive switch toward the notion of grand challenges will enable us to move more confidently toward solutions. Resilience theory and practice need to adapt to current and future threats better. As resilience is a construct, like disasters, there requires a constant revisioning of what it is.

We live in societies comprising communities and cultures, and resilience indicators resemble puzzle pieces of society. Such indicators can be helpful during crises, as disasters are those which interface with society.[628] Indeed, both disasters and resilience are socially constructed. Disasters disrupt systems in society that are already vulnerable, but resilience helps strengthen these systems before disasters strike. Because it is becoming increasingly difficult to look backward to predict the future, resilience to all hazards at any time has become a social imperative.

Resilience is about adapting to change and moving forward to a more reliable, new space and about lessening social and physical vulnerabilities so that it can increase. Resilience can be a part of measuring and understanding vulnerabilities, though the concept

[628] Crowley and Elliott, "Earthquake Disasters and Resilience in the Global North," 208.

has also become a catch-all for society's ills. The term gives issues a place to sit in all government levels, consolidates problems, and may more forcibly push collaboration, budgeting, and policy support. Writing resilience strategies is a good step in making resilience a tangible reality.

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LIST OF REFERENCES

Aguirre, Benigno E. "On the Concept of Resilience." Preliminary Paper #356. Newark: University of Delaware, Disaster Research Center, 2006. http://udspace.udel.edu/handle/19716/2517.

Aldrich, Daniel P., and Michelle A. Meyer. "Social Capital and Community Resilience." *American Behavioral Scientist* 59, no. 2 (2015): 254–69. https://doi.org/10.1177/0002764214550299.

Alexander, Craig, and Francis Fong. *Income and Income Inequality—A Tale of Two Countries*. TD Economics, 2012. https://www.td.com/document/PDF/economics/special/ff1212_income.pdf.

Alexander, David E. "Globalization of Disaster: Trends, Problems and Dilemmas." *Journal of International Affairs* (Spring/Summer 2006): 1–22.

———. "Resilience and Disaster Risk Reduction: An Etymological Journey." *Natural Hazards and Earth System Sciences* 13, no. 11 (2013): 2707–16. https://www.nat-hazards-earth-syst-sci.net/13/2707/2013/nhess-13-2707-2013.pdf.

Anderson, William A., Patrick A. Kennedy, and Everett Ressler. *Handbook of Disaster Research*, edited by Havidán Rodríguez, Enrico Louis Quarantelli, and Russell Rowe Dynes. New York: Springer, 2006.

Anthony, Craig. "10 Countries with the Most Natural Resources." Investopedia, June 25, 2019. https://www.investopedia.com/articles/markets-economy/090516/10-countries-most-natural-resources.asp.

Anzilotti, Eillie. "Why did the Rockefeller Foundation Just Unceremoniously End Its Successful Resilience Program?" *Fast Company*, April 2, 2019. https://www.fastcompany.com/90328267/the-rockefeller-foundation-is-unceremoniously-ending-its-successful-resilience-program.

Associated Press. "California Is Now the World's Fifth-Largest Economy, Surpassing United Kingdom." *Los Angeles Times*, May 3, 2018. https://www.latimes.com/business/la-fi-california-economy-gdp-20180504-story.html.

Bajpai, Prableen. "The 5 Largest Economies in the World and Their Growth in 2020." Nasdaq, January 22, 2020. https://www.nasdaq.com/articles/the-5-largest-economies-in-the-world-and-their-growth-in-2020-2020-01-22.

bell hooks. *All about Love: New Visions*. New York: Harper Perennial, 2001.

Benadusi, Mara. “Pedagogies of the Unknown: Unpacking ‘Culture’ in Disaster Risk Reduction Education.” *Journal of Contingencies and Crisis Management* 22, no. 3 (2014): 174–83.

Berrick, Cathleen A. *Homeland Security: DHS’s Progress and Challenges in Key Areas of Maritime, Aviation, and Cybersecurity.* GAO-10-106. Washington, DC: Government Accountability Office, 2009.

Birkmann, Jörn. *Measuring Vulnerability to Natural Hazards: Towards Disaster Resilient Societies*. Tokyo: United Nations University, 2006.

Bonanno, George A. “Loss, Trauma, and Human Resilience: Have We Underestimated the Human Capacity to Thrive after Extremely Aversive Events?” *American Psychologist* 59, no. 1 (2004): 20–28. https://doi.org/10.1037/0003-066X.59.1.20.

Bourdieu, Pierre. “What Makes a Social Class? On The Theoretical and Practical Existence of Groups.” *Berkeley Journal of Sociology* 32 (1987): 1–17. http://www.jstor.org/stable/41035356.

Brand, Fridolin Simon, and Kurt Jax. “Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object.” *Ecology and Society* 12, no. 1 (2007). http://search.proquest.com/docview/220499837/.

Burton, Christopher G. “The Development of Metrics for Community Resilience to Natural Disasters.” PhD diss., University of South Carolina, 2012.

Cagney, Kathleen, David Sterrett, Jennifer Benz, and Trevor Thompson. “Social Resources and Community Resilience in the Wake of Superstorm Sandy.” *PLoS ONE* 11, no. 8 (2016). https://doi.org/10.1371/journal.pone.0160824.

California Governor’s Office of Emergency Services. “About Cal OES.” Accessed August 24, 2019, https://www.caloes.ca.gov/cal-oes-divisions/about-cal-oes.

California Volunteers. *Building Disaster Resiliency: A Roadmap for Investment & Innovation in California*. Sacramento: California Volunteers, July 2019. https://californiavolunteers.app.box.com/s/i1cl1py11r35hwpydgydky93j2gvjwyk.

Canadian Press. “Population of Metro Vancouver Outpaced National Growth Rate.” *Vancouver Sun*, February 8, 2017. https://vancouversun.com/news/local-news/new-census-data-population-of-metropolitan-area-of-vancouver-outpaced-national-growth-rate.

Carpenter, Ann. "Social Ties, Space, and Resilience: Literature Review of Community Resilience to Disasters and Constituent Social and Built Environment Factors." Discussion Paper 02–13. Atlanta: Federal Reserve Bank of Atlanta, 2013. https://www.frbatlanta.org/community-development/publications/discussion-papers/2013/02-literature-review-of-community-resilience-to-disasters-2013-09-25.aspx.

Central Intelligence Agency. "The World Factbook: Japan." Last modified February 16, 2021. https://www.cia.gov/the-world-factbook/countries/japan/.

Chatterjee, Ranit, Koichi Shiwaku, Rajarshi Das Gupta, Genta Nakano, and Rajib Shaw. "Bangkok to Sendai and Beyond: Implications for Disaster Risk Reduction in Asia." *International Journal of Disaster Risk Science* 6, no. 2 (2015): 177–88.

City of Los Angeles. "Building Forward LA." Accessed August 24, 2019. https://www.lamayor.org/BuildingForwardLA.

———. "Form of Government." Accessed August 24, 2019. https://www.lacity.org/government/popular-information/form-government.

———. "Mayor Eric Garcetti Announces Plan for a Resilient Los Angeles." Accessed August 24, 2019. https://www.lamayor.org/mayor-eric-garcetti-announces-plan-resilient-los-angeles.

———. "Mayor's Office of Resilience." Accessed August 24, 2019. https://www.lamayor.org/Resilience.

City of Vancouver. "Resilient Buildings." Accessed September 13, 2019. https://vancouver.ca/people-programs/resilient-buildings.aspx.

———. "Resilient Vancouver." Accessed September 13, 2019. https://vancouver.ca/people-programs/resilient-neighbourhoods-program.aspx.

———. "Volunteer to Help in an Emergency." Accessed September 13, 2019. https://vancouver.ca/home-property-development/how-you-can-help-in-an-emergency.aspx.

City Population. "Japan: Kyōto." Accessed January 28, 2021. https://www.citypopulation.de/en/japan/cities/kyoto/.

Community Connect Labs (blog). "From Awareness to Action: Public Pledging." August 28, 2019. https://www.communityconnectlabs.com/post/from-awareness-to-action-public-pledging.

Cowen, Jill. "They Call Her 'the Beyoncé of Earthquakes': An Interview with Lucy Jones." *New York Times*, July 10, 2019. https://www.nytimes.com/2019/07/10/us/california-earthquake-lucy-jones.html.

Crowley, K., and John R. Elliott. “Earthquake Disasters and Resilience in the Global North: Lessons from New Zealand and Japan.” *Geographical Journal* 178, no. 3 (2012): 208–15. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.664.7529&rep=rep1&type=pdf.

Cutter, Susan L., Lindsey Barnes, Melissa Berry, Christopher Burton, Elijah Evans, Eric Tate, and Jennifer Webb. “A Place-Based Model for Understanding Community Resilience to Natural Disasters.” *Global Environmental Change* 18, no. 4 (2008): 598–606. https://doi.org/10.1016/j.gloenvcha.2008.07.013.

Cutter, Susan L., Christopher G. Burton, and Christopher T. Emrich. “Disaster Resilience Indicators for Benchmarking Baseline Conditions.” *Journal of Homeland Security and Emergency Management* 7, no. 1 (2010). https://doi.org/10.2202/1547-7355.1732.

Cybersecurity and Infrastructure Security Agency. *A Guide to Critical Infrastructure Security and Resilience*. Washington, DC: Department of Homeland Security, 2019. https://www.cisa.gov/sites/default/files/publications/Guide-Critical-Infrastructure-Security-Resilience-110819-508v2.pdf.

Department of Homeland Security. “DHS Announces Funding Opportunity for Fiscal Year 2020 Preparedness Grants.” February 14, 2020. https://www.dhs.gov/news/2020/02/14/dhs-announces-funding-opportunity-fiscal-year-2020-preparedness-grants#:~:text=States%20are%20required%20to%20dedicate,threat%2C%20high%2Ddensity%20areas.

Douglas, Mary. *How Institutions Think*. Syracuse: Syracuse University Press, 1986.

Edmondson, Amy, Andrew Marshall, and Salley Jewell. “Leading in Government Demands the Stewardship of Public Trust.” *MIT Sloan Management Review*, January 21, 2020. https://sloanreview-mit-edu.cdn.ampproject.org/c/s/sloanreview.mit.edu/article/leading-in-government-demands-the-stewardship-of-public-trust/amp.

Enarson, Elaine. “Gender Issues in Natural Disasters: Talking Points and Research Needs.” *Crisis, Women and Other Gender Concerns* (2002): 5–12. https://www.academia.edu/943593/Gender_issues_in_natural_disasters_Talking_points_and_research_needs.

Etheredge, E., and R. Porcella. *Strong-Motion Data from the Whittier Narrows Aftershock of October 4, 1987*. Report No. 88–38. Washington, DC: United States Geological Survey, 1988. https://pubs.usgs.gov/of/1988/0038/report.pdf.

Federal Emergency Management Agency. *2014–2018 Strategic Plan*. Washington, DC: Federal Emergency Management Agency. https://www.hsdl.org/?view&did=757282.

Fleming, David A., Ilan Noy, Jacob Pástor-Paz, and Sally Owen. *Public Insurance and Climate Change (Part One): Past Trends in Weather-Related Insurance in New Zealand*. Wellington, NZ: Motu Economic and Public Policy Research, 2018. https://docs.niwa.co.nz/library/public/MotuWP18-09.pdf.

Garcetti, Eric. "Urban Areas Security Initiative FY 2016 Grant, Office of Homeland Security: Notification of Submission of a Grant Application and Request for Adoption of Governing Body Resolution." Official memorandum. Los Angeles: City of Los Angeles, June 29, 2016. http://clkrep.lacity.org/onlinedocs/2016/16-0777_rpt_MAYOR_06-30-2016.pdf.

Glanz, James, and Norimitsu Onishi. "Japan's Strict Building Codes Saved Lives." *New York Times*, March 11, 2011, https://www.nytimes.com/2011/03/12/world/asia/12codes.html.

Glenday, Craig, ed. *Guinness World Records 2009.* Vancouver: Jim Pattison Group, 2008.

Global Economy. "Canada: Government Spending, Percent of GDP." Accessed September 13, 2019. https://www.theglobaleconomy.com/Canada/government_size/#:~:text=Canada%3A%20Government%20spending%20as%20percent%20of%20GDP&text=The%20latest%20value%20from%202018%20is%2020.98%20percent.

Godschalk, David R. "Urban Hazard Mitigation: Creating Resilient Cities." *Natural Hazards Review* 4, no. 3 (2003): 136–43. https://doi.org/10.1061/(ASCE)1527-6988(2003)4:3(136).

Government of British Columbia. "Emergency Management." Accessed October 7, 2019. https://www2.gov.bc.ca/gov/content/safety/emergency-preparedness-response-recovery/emergency-management-bc/bc-disaster-mitigation.

Greater Wellington Regional Council. "Community Profile." Accessed October 5, 2019. https://profile.idnz.co.nz/greater-wellington/population.

Greenblatt, Alan. "Japanese Preparedness Likely Saved Thousands." National Public Radio, June 13, 2011. https://www.npr.org/2011/03/11/134468071/japanese-preparedness-likely-saved-thousands.

Greenleaf, Robert K. *The Power of Servant-Leadership: Essays*. San Francisco: Berrett-Koehler Publishers, 1998.

Ha, Kyung-Hun, Katja Niemann, Uta Schwertel, Philipp Holtkamp, Henri Pirkkalainen, Dirk Boerner, Marco Kalz et al. “A Novel Approach towards Skill-Based Search and Services of Open Educational Resources.” In *Metadata and Semantic Research: Proceedings of the 5th International Conference, MTSR 2011*, edited by Elenda García-Barriocanal, Zeynel Cebeci, Aydin Öztürk, and Mehmet C. Okur, 312–23. Berlin: Springer, 2011.

Hamai, Sachi A. “Accept 2018 Urban Area Security Initiative Grant Funds (All Districts) (3 Votes).” Official memorandum. Los Angeles: County of Los Angeles Chief Executive Office, July 30, 2019. http://file.lacounty.gov/SDSInter/bos/supdocs/138173.pdf.

Harvard Transdisciplinary Research in Energetics and Cancer Center. “Definitions.” Accessed April 15, 2020. https://www.hsph.harvard.edu/trec/about-us/definitions/#targetText=Transdisciplinary%20Research%20is%20defined%20as,to%20address%20a%20common%20problem.

Hauksson, Egill, and Susanna Gross. “Source Parameters of the 1933 Long Beach Earthquake.” *Bulletin of the Seismological Society of America* 81, no. 1 (1991): 81–98. https://authors.library.caltech.edu/37028/1/81.full.pdf.

Holling, Crawford S. “Resilience and Stability of Ecological Systems.” *Annual Review of Ecology and Systematics* 4 (1973): 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245.

Hooks, Bell. *All about Love: New Visions*. New York: Harper Perennial, 2001.

Hospers, Gert-Jan. “Jane Jacobs: Her Life and Work.” *European Planning Studies* 14, no. 6 (2006): 723–32.

Inland Marine Underwriters Association. “Natural Disasters: County Profile Series.” Accessed September 13, 2019. https://www.imua.org/Files/reports/Natural%20Disasters%20-%20Country%20Profile%20Series%20-%20Canada.html.

Integrated Partnership for Regional Emergency Management in Metro Vancouver. “About Us.” 2015. http://www.iprem.ca/about/Pages/default.aspx.

International Living. “The Economy of New Zealand.” Accessed October 5, 2019. https://internationalliving.com/countries/new-zealand/the-economy-in-new-zealand/.

International Research Institute of Disaster Science. *HFA IRIDeS Review Report: Focusing on 2011 Great East Japan Earthquake*. Sendai: International Research Institute of Disaster Science, 2014. http://irides.tohoku.ac.jp/media/files/HFA_IRIDeS_ReviewReport_Web_20140612(1).pdf.

Japan Times. "Past Calamities Revisited in Regional Collaborations." November 8, 2019. https://www.japantimes.co.jp/news/2019/11/08/national/past-calamities-revisited-regional-collaborations/#.XgTxO0dKgmQ.

Jensen, Jessica. *Preparedness: A Principled Approach to Return on Investment*. Falls Church, VA: International Association of Emergency Managers, 2011. https://www.ndsu.edu/fileadmin/emgt/IAEM_preparedness_principled_approach_81111.pdf.

Kay, Jonathan. "The Key to Canada's Economic Advantage over the United States? Less Income Inequality." *National Post*, December 13, 2012. https://nationalpost.com/opinion/jonathan-kay-the-key-to-canadas-economic-advantage-over-the-united-states-less-income-inequality.

Klein, Richard J. T., Robert J. Nicholls, and Frank Thomalla. "Resilience to Natural Hazards: How Useful Is This Concept?" *Environmental Hazards* 5 (2003): 35–45. https://doi.org/10.1016/j.hazards.2004.02.001.

Klinenberg, Eric. "Denaturalizing Disaster: A Social Autopsy of the 1995 Chicago Heat Wave." *Theory and Society* 28 (April 1999): 239–95. https://doi.org/10.1023/A:1006995507723.

Kosugi, Takanobu, Yoshiyuki Shimoda, and Takayuki Tashiro. "Neighborhood Influences on the Diffusion of Residential Photovoltaic Systems in Kyoto City, Japan." *Environmental Economics and Policy Studies* 21, no. 4 (2019): 477–505.

Kyodo News. "Japan to Tighten Gasoline Sale Rules After Kyoto Arson Attack." October 26, 2019. https://english.kyodonews.net/news/2019/10/a3a4a2e5ab11-japan-to-tighten-gasoline-sale-rules-after-kyoto-arson-attack.html.

Lin, Rong-Gong, II. "California Earthquake Standard Designed to Save Lives but Not Buildings. There's a New Push to do Both." *Los Angeles Times*, March 15, 2018. https://www.latimes.com/local/lanow/la-me-ln-earthquake-legislation-nazarian-20180313-story.html.

———. "This Is What a Devastating Earthquake in California Would Look Like: Christchurch, New Zealand, Shattered by a 2011 Earthquake, Offers an Urgent Lesson for California." *Los Angeles Times*, December 12, 2019. https://www.latimes.com/california/story/2019-12-12/aftershocks-christchurch-new-zealand-earthquake-what-california-can-learn.

Lin, Thung-Hong. "Governing Natural Disasters: State Capacity, Democracy, and Human Vulnerability." *Social Forces* 93, no. 3 (2014): 1267–1300. https://doi.org/10.1093/sf/sou104.

Longstaff, Patricia H., Nicholas J. Armstrong, Keli Perrin, Whitney May Parker, and Matthew A. Hidek. "Building Resilient Communities: A Preliminary Framework for Assessment." *Homeland Security Affairs* 6, no. 3 (2010): 1–23. https://www.hsaj.org/articles/81.

Los Angeles Emergency Management Division. "About EMD." Accessed August 24, 2019. https://emergency.lacity.org/about-emd.

———. "Supply Chain Resilience Initiative." Accessed August 24, 2019. https://emergency.lacity.org/supply-chain.

Los Angeles Fire Department. "Community Emergency Response Team (CERT)." Accessed December 4, 2020. https://www.lafd.org/join/volunteer/cert.

Manyena, Bernard, Geoff O'Brien, Phil O'Keefe, and Joanne Rose. "Disaster Resilience: A Bounce Back or Bounce Forward Ability?" *Local Environment: International Journal of Justice and Sustainability* 16, no. 5 (2011): 417–24. https://doi.org/10.1080/13549839.2011.583049.

Mayoral Seismic Task Force. *Resilience by Design*. Los Angeles: Mayoral Seismic Task Force, December 2014. https://www.lamayor.org/sites/g/files/wph446/f/article/files/Resilience%20by%20Design%20(1).pdf.

Mayunga, Joseph S. "Understanding and Applying the Concept of Community Disaster Resilience: A Capital-Based Approach." Munich: Summer Academy for Social Vulnerability and Resilience Building, 2007. https://www.u-cursos.cl/usuario/3b514b53bcb4025aaf9a6781047e4a66/mi_blog/r/11._Joseph_S._Mayunga.pdf.

McPherson, Miller, Lynn Smith-Lovin, and James M. Cook. "Birds of a Feather: Homophily in Social Networks." *Annual Review of Sociology* 27, no. 1 (2001): 415–44. https://doi.org/10.1146/annurev.soc.27.1.415.

Mileti, Dennis S. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington, DC: Joseph Henry Press, 1999.

Mitchell, Michelle. *Relocation after Disaster: Engaging with Insured Residential Property Owners in Greater Christchurch's Land-Damaged "Residential Red Zone."* Washington, DC: Brookings, 2015. https://www.brookings.edu/wp-content/uploads/2016/06/Brookings-Planned-Relocations-Study-New-Zealand-June-12-2015.pdf.

Miyatsuka, Akiko, and Eric Zusman. "What Are Co-benefits?" Fact Sheet No. 1. Hayama, Japan: Institute for Global Environmental Strategies, 2009. https://www.iges.or.jp/en/publication_documents/pub/nonpeer/en/2393/acp_factsheet_1_what_co-benefits.pdf.

Multihazard Mitigation Council. *Natural Hazard Mitigation Saves: 2018 Interim Report.* Washington, DC: National Institute of Building Sciences, December 2018. https://cdn.ymaws.com/www.nibs.org/resource/resmgr/mmc/NIBS_MSv2-2018_Interim-Repor.pdf.

National Institute of Standards and Technology. "Community Resilience Planning Guide." Last modified November 5, 2020. https://www.nist.gov/topics/community-resilience/planning-guide.

———. *Community Resilience Planning Guide for Buildings and Infrastructure Systems*. Vol. 1. NIST Special Publication 1190. Washington, DC: Department of Commerce, 2016. http://dx.doi.org/10.6028/NIST.SP.1190v1.

New Zealand Immigration. "Central Government." Accessed October 5, 2019. https://www.newzealandnow.govt.nz/living-in-nz/history-government/central-government.

———. "Local Government." Accessed October 5, 2019. https://www.newzealandnow.govt.nz/living-in-nz/history-government/local-government.

Norris, Fran H., Susan P. Stevens, Betty Pfefferbaum, Karen F. Wyche, and Rose L. Pfefferbaum. "Community Resilience as a Metaphor, Theory, Set of Capacities, and Strategy for Disaster Readiness." *American Journal of Community Psychology* 41, no. 1–2 (2008): 127–150. https://doi.org/10.1007/s10464-007-9156-6.

Oda, Kimisato, Christoph D. D. Rupprecht, Kazuaki Tsuchiya, and Steven R. McGreevy. "Urban Agriculture as a Sustainability Transition Strategy for Shrinking Cities? Land Use Change Trajectory as an Obstacle in Kyoto City, Jodaapan, Japan." *Sustainability* 10, no. 4 (2018): 1–15. https://doi.org/10.3390/su10041048.

Organisation for Economic Co-operation and Development. "Government at a Glance 2015: New Zealand." 2015. https://www.oecd.org/gov/New-Zealand.pdf.

Parkin, Andrew. "Most Canadians Don't Want a Province-First Approach to Climate Change." *Policy Options*, July 16, 2019. https://policyoptions.irpp.org/magazines/july-2019/most-canadians-dont-want-a-province-first-approach-to-climate-change/#:~:text=Canada%20is%20already%20the%20developed,government%20of%20any%20comparable%20country.

Planning Report. "LA Sanitation & Environment Leads U.S. in Protecting Biodiversity & Measuring Urban Ecosystem Health." February 2020. https://www.planningreport.com/2020/02/27/la-sanitation-environment-leads-us-protecting-biodiversity-measuring-urban-ecosystem.

Port of Los Angeles. *2018–2022 Strategic Plan*. San Pedro, CA: Los Angeles Harbor Department, 2018. https://kentico.portoflosangeles.org/getmedia/6ac20c8e-f574-44a8-b28e-da8683b41cf6/Strategic-Plan-2018-2022.

———. "About the Port of Los Angeles." Accessed December 4, 2020. https://www.portoflosangeles.org/about.

Preston, John. *Disaster Education: "Race," Equity and Pedagogy.* Rotterdam: SensePublishers, 2012.

Proag, Virendra. "The Concept of Vulnerability and Resilience." *Procedia Economics and Finance* 18 (2014): 369–76. https://doi.org/10.1016/S2212-5671(14)00952-6.

Public Safety Canada. *Advancing and Empowering Disaster Risk Reduction in Canada: Canada's Platform for Disaster Risk Reduction*. Vancouver: Public Safety Canada, 2018. https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/pltfrm-dsstr-rdctn-2018/index-en.aspx.

———. *Federal Policy for Emergency Management: Building a Safe and Resilient Canada*. Ottawa: Public Safety Canada, 2009. https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/plc-mrgnc-mngmnt/plc-mrgnc-mngmnt-eng.pdf.

———. "Federal Support for 61 Ontario Flood Mitigation Projects." July 25, 2019. https://www.canada.ca/en/public-safety-canada/news/2019/07/federal-support-for-61-ontario-flood-mitigation-projects.html.

Public Safety and Emergency Preparedness Canada. "Government of Canada Contributes to Resilient Communities in British Columbia." Cision, November 16, 2018. https://www.newswire.ca/news-releases/government-of-canada-contributes-to-resilient-communities-in-british-columbia-700694651.html.

Putnam, Robert D. "Bowling Alone: America's Declining Social Capital." *Journal of Democracy* 6, no. 1 (1995): 65–78. https://doi.org/10.1007/978-1-349-62965-7_12.

Rockefeller Foundation. "100 Resilient Cities." Accessed February 20, 2021. https://www.rockefellerfoundation.org/100-resilient-cities/.

Rockefeller Foundation 100 Resilient Cities. *Resilient Kyoto.* New York: Rockefeller Foundation, March 2019. https://resilientcitiesnetwork.org/downloadable_resources/Network/Kyoto-Resilience-Strategy-English.pdf.

———. *Resilient Los Angeles*. New York: Rockefeller Foundation, March 2018. https://www.lamayor.org/sites/g/files/wph446/f/page/file/Resilient%20Los%20Angeles.pdf.

———. *Resilient Vancouver.* New York: Rockefeller Foundation, June 2019. https://vancouver.ca/files/cov/resilient-vancouver-strategy.pdf.

———. *Wellington Resilience Strategy*. New York: Rockefeller Foundation, 2017. https://wellington.govt.nz/wellington-city/resilient-wellington/wellington-resilience-strategy.

Rockefeller Foundation and Arup International Development. *City Resilience Framework*. 2nd ed. New York: Rockefeller Foundation, 2015.

Sack, Kevin, and John Schwartz. "As Storms Keep Coming, FEMA Spends Billions in 'Cycle' of Damage and Repair." *New York Times*, October 8, 2018. https://www.nytimes.com/2018/10/08/us/fema-disaster-recovery-climate-change.html.

Science X. "San Andreas Fault Set for the 'Big One' (Update)." June 21, 2006. https://phys.org/news/2006-06-san-andreas-fault-big.html.

Seismo Blog. "Today in Earthquake History: San Fernando 1971." February 9, 2017. https://seismo.berkeley.edu/blog/2017/02/09/today-in-earthquake-history-san-fernando-1971.html.

Shaw, Rajib, Bam Razafindrabe, Parvin Gulshan, Yukiko Takeuchi, and Akhilesh Surjan. "Climate Disaster Resilience: Focus on Coastal Urban Cities in Asia." *Asian Journal of Environment and Disaster Management* 1 (2009): 101–16.

Southern California Earthquake Center. "Southern San Andreas Shakeout Scenario." Accessed January 28, 2021. https://www.shakeout.org/california/scenario/.

Spacey, John. "Risk Mitigation vs Risk Reduction." *Simplicable* (blog), November 13, 2015. https://simplicable.com/new/risk-mitigation-vs-risk-reduction.

Star, Susan Leigh, and James R. Griesemer. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies of Science* 19, no. 3 (1989): 387–420. https://doi.org/10.1177/030631289019003001.

Statista. "New Zealand: Ratio of Government Expenditure to Gross Domestic Product (GDP) from 2015 to 2025." Accessed January 28, 2021. https://www.statista.com/statistics/436523/ratio-of-government-expenditure-to-gross-domestic-product-gdp-in-new-zealand/#:~:text=The%20statistic%20shows%20the%20ratio,the%20country's%20gross%20domestic%20product.

———. "Population of Kyoto Prefecture in Japan from 1920 to 2018." Accessed January 28, 2021. https://www.statista.com/statistics/608402/japan-population-kyoto/.

Statistics Canada. *Canadian Demographics at a Glance*. 2nd ed. Ottawa: Minister of Industry, 2016. https://www150.statcan.gc.ca/n1/en/pub/91-003-x/91-003-x2014001-eng.pdf?st=ilauwXSI 5.

———. "Census Profile, 2016 Census: Lower Mainland–Southwest [Economic Region], British Columbia and British Columbia [Province]." Last modified August 9, 2019. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=ER&Code1=5920&Geo2=PR&Code2=59&Data=Count&SearchText=British%20Columbia&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=59.

———. "Population and Dwelling Count Highlight Tables, 2011 Census." October 2, 2020. https://www12.statcan.gc.ca/census-recensement/2011/dp-pd/hlt-fst/pd-pl/Table-Tableau.cfm?LANG=Eng&T=307&SR=1&S=10&O=D.

Statistics New Zealand. "Geography - Physical Features." Accessed February 22, 2021. https://web.archive.org/web/20130408074526/http://www2.stats.govt.nz/domino/external/web/nzstories.nsf/092edeb76ed5aa6bcc256afe0081d84e/54e50d25aff60a7bcc256b1e007adcb6?OpenDocument.

———. "Home Page." Accessed October 5, 2019. https://www.stats.govt.nz/.

Substance Abuse and Mental Health Services Administration. "Phases of Disaster." Accessed December 15, 2020. https://www.samhsa.gov/dtac/recovering-disasters/phases-disaster.

Tartar, Andre, and Reade Pickert. "One-Third of the U.S. Economy Is Jammed into Just 31 Counties. L.A. Is the Biggest." *Los Angeles Times*, December 19, 2019. https://www.latimes.com/business/story/2019-12-19/los-angeles-largest-economy.

Tate, Eric. "Social Vulnerability Indices: A Comparative Assessment Using Uncertainty and Sensitivity Analysis." *Natural Hazards* 63, no. 2 (2012): 325–47.

Tierney, Kathleen J. *The Social Roots of Risk: Producing Disasters, Promoting Resilience.* Stanford: Stanford Business Books, 2014.

Tierney, Kathleen J., and Michel Bruneau. "Conceptualizing and Measuring Resilience: A Key to Disaster Loss Reduction." *TR News*, May/June 2007. http://www.trb.org/Main/Blurbs/158992.aspx.

Tierney, Kathleen J., Michael K. Lindell, and Ronald W. Perry, eds. *Facing the Unexpected: Disaster Preparedness and Response in the United States*. Washington, DC: Joseph Henry Press, 2001.

Tomoya, Nagai. *Japan: National Progress Report on the Implementation of the Hyogo Framework for Action (2009–2011)*. Tokyo: Cabinet Office, Government of Japan, 2011. https://www.preventionweb.net/files/19650_jpn_NationalHFA progress_2009-11.pdf.

Trading Economics. "United States Government Spending to GDP." Accessed August 24, 2019. https://tradingeconomics.com/united-states/government-spending-to-gdp.

Trainor, Joseph, and Tony Subbio, eds. *Critical Issues in Disaster Science and Management: A Dialogue between Researchers and Practitioners.* Washington, DC: Federal Emergency Management Agency, 2015. https://training.fema.gov/hiedu/docs/critical-issues-in-disaster-science-and-management.pdf.

United Nations Economic and Social Commission for Asia and the Pacific. "What Is Good Governance?" Bangkok: United Nations Economic and Social Commission for Asia and the Pacific, 2003. https://www.unescap.org/sites/default/files/good-governance.pdf.

United Nations General Assembly. *Implementation of the Sendai Framework for Disaster Risk Reduction*. New York: United Nations, 2019.

United Nations International Strategy for Disaster Reduction. *2015 Global Assessment Report on Disaster Risk Reduction—Making Development Sustainable: The Future of Disaster Risk Management*. Geneva: United Nations, 2015. https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf.

United Nations Statistics Division. "High-Level Political Forum Goals in Focus—Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable." Accessed August 24, 2019. https://unstats.un.org/sdgs/report/2018/goal-11/.

United States Census Bureau. "QuickFacts: Los Angeles City, California." Accessed August 24, 2019. https://www.census.gov/quickfacts/losangelescitycalifornia.

United States Geological Survey. "Earthquake Glossary." Accessed August 24, 2019. https://earthquake.usgs.gov/learn/glossary/?term=Ring%20of%20Fire.

———. "Earthquake Hazards: Education." Accessed November 3, 2019. https://www.usgs.gov/natural-hazards/earthquake-hazards/education.

———. "M 6.7 - 1km NNW of Reseda, CA." Accessed August 24, 2019. https://earthquake.usgs.gov/earthquakes/eventpage/ci3144585/executive.

UN News. “UN Resilience ‘Scorecard’ to Help Cities Curb Disaster Losses from Climate Change, Other Risk Drivers.” May 23, 2017, https://news.un.org/en/story/2017/05/558002-un-resilience-scorecard-help-cities-curb-disaster-losses-climate-change-other.

UR+ Vancouver. *Symposium Outcomes: Recommendations for Actionable Strategies*. Washington, DC: Global Facility for Disaster Reduction and Recovery, 2017. http://www.bccassn.com/media/UR+%20Vancouver-Outcomes.pdf.

U.S. Green Building Council–Los Angeles. *Building Resilience Los Angeles: A Primer for Facilities*. Los Angeles: U.S. Green Building Council–Los Angeles, 2016. https://static1.squarespace.com/static/57dc2456e58c62e05fee0316/t/58177cb7725e25ba06357b20/1477934275541/10-24-2016_BuildingResiliency-LA.pdf.

Vale, Lawrence J., and Thomas J. Campanella. *The Resilient City: How Modern Cities Recover from Disaster*. Oxford: Oxford University Press, 2005.

Wellington City Council. “Become a Volunteer.” Accessed October 5, 2019. https://wellington.govt.nz/about-wellington/emergency-management/volunteering.

———. “Emergencies in Wellington.” Accessed October 5, 2019. https://wellington.govt.nz/about-wellington/emergency-management/emergencies-in-wellington.

———. “Emergency Management.” Accessed October 5, 2019. https://wellington.govt.nz/about-wellington/emergency-management.

Wellington Region Emergency Management Office. “Community Emergency Hubs.” Accessed October 5, 2019. https://wremo.nz/about-us/initiatives/hubs/.

Wilson, Geoff A. “Community Resilience, Globalization, and Transitional Pathways of Decision-Making.” *Geoforum* 43 (2012) 1218–31. http://dx.doi.org/10.1016/j.geoforum.2012.03.008.

Wisner, Ben G. “Disaster Risk Reduction in Megacities: Making the Best of Human and Social Capital.” *Building Safer Cities: The Future of Disaster Risk*, edited by Alcira Kreimer, Margaret Arnold, and Anne Carlin, 181–96. Washington, DC: World Bank, 2003. https://doi.org/10.1596/0-8213-5497-3

———. “Urban Social Vulnerability to Disaster in Greater Los Angeles.” *Sustainable Cities: Encyclopedia of Life Support Systems.* Paris: United Nations Educational, Scientific and Cultural Organization, 2003.

World Association of Disaster and Emergency Medicine. “Frameworks for Disaster Research and Evaluation.” Accessed June 27, 2019. https://wadem.org/publications/frameworks/.

Yin, Robert K. *Case Study Research and Applications: Design and Methods*. Thousand Oaks: SAGE Publications, 2017.

Zebrowski, Chris. “The Biopolitics of Resilience.” PhD diss., Keele University, 2012. https://eprints.keele.ac.uk/3827/1/Zebrowski%20PhD%202012.pdf.

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