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RESILIENCE TO NATURE'S CHALLENGES

Kia manawaroa – Ngā Ākina o Te Ao Tūroa

Short-Term Project: Deliverable 4

Multi-Capital Resilience Annotated Bibliography

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1 Annotated Bibliography Overview

This annotated bibliography provides an initial survey of resilience literature. The authors have assembled thorough critical summaries of approximately 160 papers. The literature assembled for this annotated bibliography is a systematic sample of peer-reviewed and gray literature within specific sub-sets of the resilience literature: highly cited papers covering general reflections on disaster resilience and policy, economic resilience, infrastructure resilience, organisational and institutional resilience, social and community resilience, human and psychological resilience, and social-ecological systems.

The coverage is biased toward highly cited and influential literature in these fields and research perspectives and empirical research developed in New Zealand. The majority of the resources (over 80%) were published between 2000 and 2015, reflecting some bias in the accumulation of resources but also reflecting the proliferation of the resilience concepts across academia and beyond in the last decade and a half.[1]

The bibliography is the collective effort of doctoral students and emerging researchers working across a number of fields in New Zealand. While this resource is not comprehensive, it has and should continue to facilitate trans-disciplinary thinking and discussion and serve as a literature primer for holistic approaches to disaster resilience research and practice.

2 Disaster Resilience Theory

Alexander, D.E. (2013) Resilience and disaster risk reduction: an etymological journey. ***Natural Hazards and Earth System Sciences Discussions*** **1 (2), 1257-1284.**

This article presents a thorough examination of the etymological and theoretical development of the term resilience and its emergence and interpretation in the disaster risk reduction discourse. The author demonstrates that despite the recent popularity of the resilience concept, resilience has a "long and distinguished history," (p. 1259). Alexander (2013) provides useful insights into the conflicts and contradictions in the way resilience is interpreted and assessed across the various fields in which it is applied. The author derives a conceptual map showing how theories of resilience in different fields influenced and shaped each other. The article warns against seeing resilience as a panacea paradigm for the future, arguing that some of the suspicion about the term resilience in disaster risk reduction discourse stems from the concept being pushed to "represent more than it can deliver," (p.1271). The author notes, however, that different interpretations of the relationship between resilience and associated concepts in DRR have made the concept of resilience difficult to operationalise. The author cites Klein et al.'s (2003) work that argued that enhacing and maintaining adaptive capacity should be the overall goal of resilience, simultaneously arguing that resilience is part of a socieity's capacity to adapt. The author argues that for resilience theory and science to develop authors need to better understand and reference how it is employed in other fields, as well as to acknowledge that the boundaries of the systems studied across the different fields are more or less difficult to define and therefore the interrelationships that define resilience in different systems may be more difficult to identify and characterize.

DEFINITION OF RESILIENCE: Alexander (2013) characterises the definition assigned in 2009 by the UNISDR as a "good definition of resilience, as the term is currently used in disaster risk reduction." The definition is as follows: “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.” (UNISDR, 2009, p. 24)." (p.1264) Alexender (2013) notes the

[1] The literature we analysed was almost exclusively published in “Western” countries: the United Kingdom, Europe (especially Northern European countries), the United States, Australia, and New Zealand, and the majority of case studies and empirical research were also conducted in Western countries.

particular usefulness of the definition's ability to blend the multi-faceted nature of resilience as "rebounding, adapting, overcoming, and maintaining integrity," (p. 1264).

COUNTRY: United Kingdom

PERPSECTIVE: Disaster risk reduction; Earth Systems Science

METHODOLOGY: Systematic literature review, critical discourse analysis

Bahadur, A., Ibrahim, M., Tanner, T. (2010). *The resilience renaissance? Unpacking of resilience for tackling climate change and disasters*, Brighton, UK, Strengthening Climate Resilience.

This working paper discusses the current conceptualisation of resilience in social, ecological, and social-ecological systems literature as it emerges as a prominent concept in the international discourse, policies, and programming related to climate change adaptation and disaster risk reduction. The article begins with a discussion of the various interpretations of resilience across disciplines of study. They then conceptually situate resilience in relation to vulnerability, adaptive capacity, and (political, social) scale. The authors review 16 overlapping conceptualisations of resilience from the literature, outlining key characteristics and indicators of resilience within each conceptual category. The article (like many before and after it) identifies a lack of conceptual clarity or consensus in the literature about the relationships between adaptation, adaptive capacity, and resilience. They attribute this in part to the small number of case studies and epirical research that opeartionalise the concept of resilience. They identify difficulties introduced by fuzzy interprtations of systems and system interactions. They also note the major gap in understanding how 'resilience' should be measured.

The authors derive ten characterisitcs of resilient social-ecological systems, which, they argue, help operationalise the concept of resilience. The characteristics include: high diversity, effective governance and institutions, acceptance of uncertainty and change, community involvement, preparedness activities that accomodate change, social and economic equity, honoring social values and structures, acknowledging non-equilibrium dynamics, continuous learning, and adopting cross-scalar perspectives.

DEFINITION OF RESILIENCE: The authors identify a number of resilience definitions across several disciplines, citing the most popular interpretation as “the ability to return quickly to a previous (and good) condition,” (p.4). The authors develop a definition of resilient systems by identifying 10 characteristics associated with resilience (presumably the more a system aligns with the characteristics the more resilient it is).

COUNTRY: United Kingdom

PERPSECTIVE: Disaster risk reduction, social-ecological systems

METHODOLOGY: Literature review, content analysis, and theory development

Béné, C., Wood, R. G., Newsham, A., Davies, M. (2012). *Resilience: New utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes*. Institute of Development Studies. CSP Working Paper Number 006, Brighton, UK.

Béné et al. (2012) build on recent lessons derived from the literature on resilience (both academic and project or programme-related) in order to, “review and expose the potential fits and limits of this concept,” focusing particularly on the structure and implementation of possible programmes aiming to build the resilience of households and/or communities. In the context of social protection, the authors see resilience as a useful technical concept as well as a policy narrative that has the potential to unify and integrate disperate approaches and agendas to achieve positive results. They do however, provide a thorough critical analysis of the limitations of resilience as theory and political discourse, and provide useful guidance for maximising the potential of resilience approaches in social programmes while

remaining realistic about the shortfalls of these approaches. Reviewing resilience in the context of climate-change related disasters, the authors argue that approaches that emphasise complex systems and system interdependence, as is common in resilience discourse, will be essential for adequately repsonding to new challenges brought on by climate change. Similarly, resilience thinking facilitates dealing with ontological uncertainties (the unknown unknowns) that will become more common as climate changes cause some environmental variables to deviate from their historical range. The shortfalls identified in this article include resilience theory's inability (up to this point) to appropriately reflect social dynamics and issues of agency and power. The authors also critique its uncritical interpretation as a positive and universally desirable characteristic, despite issues related to adaptive preference and persistence of systems that may be unhealthy in some respects.

A central contribution of this work is the introduction of the 3-D Resilience Framework and the 3P&T modification. The authors propose using three views of resilience: absorptive, adaptive, and transformatie capacity, "as the three structuring elements of an analytical framework aimed at understanding better what exactly 'strengthing resilience' means," (p.21). These capacities reflect the increasing intensity of change as well as increasing transaction costs within the system. The 3P&T analytical framework then captures a conceptual typology that better captures social protection interventions that may be implemented to address short to long-term structural vulnerability issues. These include protective, preventive, promotive, and transformative measures.

DEFINITION OF RESILIENCE: Resilience is, "the 'capacity to recover' and 'degree of preparedness," of human communities (p.10). More specifically the authors characterize resilience as a multi-scalar social ability that allows social systems to resist the negative impacts from a shock and facilitates adaptation. The authors also offer interesting insights into gaps in current definitions of resilience, noting that resilience is criticized for not adequately accommodating considerations of power and agency, "it is for instance illustrative to observe from the dozen of definitions of resilience proposed in the literature, that none contain the terms 'power', or 'political processes'. This raises some concerns about the ability of resilience (as defined in the current literature) to provide the right over-arching framework for understanding changes or shocks such as these induced by disasters and climate changes, and how individuals, communities and societies manage these changes and their impacts." (p.27).

KEY WORDS: social protection; disaster risk reduction, climate change adaptation, poverty, vulnerability

COUNTRY: United Kingdom

METHODOLOGY: Literature review

Carpenter, S., Walker, B., Anderies, J.M., & Abel, N. (2001). From Metaphor to Measurement: Resilience of What to What?. *Ecosystems.* 4(8), 765-781.

In this article the authors explore the possibilities and limitations of measurable operational indicators of resilience in socio-ecological systems. They establish an operational definition based on three general measurable system features: 1) the ability of the SES to stay in "the domain of attration" (which is defined as the state in which the system can retain controls on structure and function), 2) the ability of the SES to self-organise, and 3) the adaptive capacity of the SES. They explore their operational definition by systematically comparing resilience properties of two SES: lake districts in North America and rangelands in Western New South Wales. For theses systems they review theoretical models of resilience and adaptive cycles, and apply practical measures of resilience and adaptive cycles evaluating various management interventions. Ultimately they develop an operational framework characterising and comparing the resilience of the two systems (see Table 1. Resilience Measures for Lake Districts and Rangelands, p.777).

Resilience measurements need to specify appropriate boudaries around the systems of interest. To measure resilience, "one needs to specify the time scale," (p.767) and the spatial scale because, the authors explain, resilience at one scale can be achieved at the expense of resilience

at another ("cross-scale subsidies" p.767). Additionally it is critical to specify the system state of interest (resilience of what) and the system disturbances of interest (resilience to what).

Consistent with others approaching resilience from the SES perspective, the authors contest the need for systems to achieve stable or equilibrium conditions. Instead systems constantly progress through an adaptive cycle of rapid growth and exploitation, conservation, collapse or release, and renewal or reorganisation. Measures for a given system also need to evolve, "indicators of resilience that are appropriate for the current regime may become useless as ecological structures and social expectations shift," (p.779). Resilience changes and becomes differently relevant at various stages of the adaptive cycle, and resilience measures need to be regularly revaluated.

DEFINITION OF RESILIENCE: "Resilience is the magnitude of disturbance that can be tolerated before a socioecological system (SES) moves to a different region of state space controlled by a different set of processes," (p.765).

COUNTRY: USA, Australia

PERPSECTIVE: Socio-ecological systems, Ecology

METHODOLOGY: Case study review, literature review

Davoudi, S. (2012). Resilience: A Bridging Concept of a Dead End?. *Planning Theory and Practice*. 13(3), 299-307.

This paper is the opening of a special issue on resilience in the journal of *Planning Theory and Practice*. In order to set the tone for the issue, this article provides an in-depth review of the resilience concept and discusses the opportunities and risks of incorporating resilience language into planning. The authors note especially the inappropriateness of incorporating engineering approaches to resilience, with its emphasis on "bounce-back-ability" rather than adaptation into planning discourse. The article also examines the opportunities and limitations of translating ecology approaches to resilience into planning theory and practice. The authors note that ecology approaches that refer to an equilibrium state are not realistic nor appropriate for planning (or for any study of living systems), preferring instead "evolutionary resilience." (p.302). The panarchy model of resilience, developed most thoroughly in Gunderson & Holling (2002) is closely related to evolutionary approaches to resilience. The panarchy model of adaptive cycles demonstrates how resilience changes throughout the development of a system and has different meanings in the phases of development: growth, conservation, creative destruction, and reorganisation. The authors critique this model, however, as "overly deterministic" instead suggesting that each stage in the adaptive cycle should be considered a tendency rather than inevitable. According to the authors, evolutionary resilience is closely related to interpretive approaches to planning, which emphasizes, "fluidity, reflexivity, contingency, connectivity, multiplicity and polyvocality," (p.304).

DEFINITION OF RESILIENCE: *Evolutionary resilience* is, "the ability of complex socio-ecological systems to change, adapt, and, crucially, transform in response to stresses and strains," (p.302).

COUNTRY: United Kingdom

PERPSECTIVE : Social-ecological systems

METHODOLOGY: Literature review and critical analysis

Gallopin, G.C. (2006). Linkages between vulnerability, resilience, and adaptive capacity. *Global Environmental Change*. 16 (3): p. 293-303.

This article uses a socio-ecological systems (SES) perspective to analyse the conceptual relationships between vulnerability, resilience, and adaptive capacity. Vulnerability is most often conceptualized as exposure and susceptibility to change and/or harm when confronted with

perturbations. The author thoroughly parses different interpretations of system perturbations, stress, hazards, and shock and the relationship between the terms. For example, hazards are defined as "threats to a system, comprised of perturbations and stress," distinguishing between major spikes in system variation (perturbations) and continuous or slowly increasing pressure (stressors) (p.294). The author note that often, "capacity of response" to these disturbances is often considered an aspect of vulnerability. Gallopin (2006) introduces resilience as developed in SES through the adaptive cycle metaphor introduced in discussions of panarchy (see Gunderson and Holling (2002)) and domains of attraction in multi-stable systems.

DEFINITION OF RESILIENCE: Ecological resilience, "in terms of the stability landscape, implies the ability of a multistable system to keep the values of its state variables within a given domain of attraction in the face of perturbations, and is not concerned with the stability or constancy of the state *within* the basin," (p. 298).
Engineering resilience, "can be measured by the speed at which the system returns to the stable point or trajectory following a perturbation," (p.299).

KEY WORDS: Vulnerability, resilience, adaptive capacity, systems analysis, stability

COUNTRY: Chile (United Nations)

PERPSECTIVE : Social-ecological systems

METHODOLOGY: Literature review and critical analysis

Gunderson, L.H. & Holling, C.S. (2002) ***Panarchy: Understanding Transformations in Human and Natural Systems*****. Washington, Island Press.**

Panarchy, the orienting concept of the book, is a term that describes evolving hierarchical systems (such as ecosystems and societies). The authors coined the term Panarchy to rationalize the interactions between change and persistence, predictability and unpredictability, and to describe cross-scalar hierarchies that facilitate adaptive evolution. The objective of this volume is to begin developing a theory of regional sustainability that "integrates ecological, economic, and social dynamics," (p.420).

The book, while wide-ranging, is oriented around three fundamental themes: (1) Metaphors of stability, resilience, and change "where to seek measures of resilience, and they help define conditions for qualitatively different types of stability loss, for reversibility and irreversibility in a form that has relevance for both economies and ecosystems," (p.XXII), (2) Cross-scale interactions in human and environmental systems, and (3) Adaptive change and learning and the cycles of slow accumulation of natural and cultural capital interspersed with "rapid phases of reorganisations," (p.XXII).
Each chapter, in this edited volume, contributes to an integrated, cross-scalar, and dynamic understanding the topics emerging from the discussion of panarchy. They discuss the interactive dynamics of various systems, demonstrating the way policies, economic actions, institutional norms, and ecosystems can conflict with and compliment one another to create instability and adaptation. Through these discussions the authors also demonstrate the impotence and even danger of examining economic, ecological, and institutional systems in isolation.

DEFINITION OF RESILIENCE: Resilience in this book describes part of this complex system of panarchy, particularly referring to aspects of creative destruction and subsequent reorganisation.
Resilient systems are those in which there are multi-stable states, which can be fundamentally altered by discontinuous events and nonlinear processes and transition through adaptive processes. The authors of the various chapters offer several related, but somewhat divergent definitions of resilience. In Chapter 1, resilience encompasses the ability "experience wide change and still maintain the integrity of their functions," (p.15). In Chapter 2, authors Holling and Gunderson contrast ecological and engineering definitions of resilience noting that the former focuses on existence of function while the other focuses on efficiency of function established through constancy and predictability. In Chapter 8, Scheffer, Westly, Brock, and

Holmgren describe resilience simply as "the ability of the system to return to the original state after disturbance," (p.202). In Chapter 12, Gunderson, Holling and Peterson address the resilience of social systems describing human systems' unique ability to quickly create novelty

KEY WORDS: human ecology, political ecology, social ecology, biotic communities, environmental degradation, environmental policy, environmental management

COUNTRY: Multi-national

PERPSECTIVE : Socio-ecological systems

IOM (Institute of Medicine). (2015) *Healthy, resilient, and sustainable communities after disasters: Strategies, opportunities, and planning for recovery.* Washington, DC: The National Academies Press.

As stated in the preface, this report is, "intended as both a call to action and an action guide for maximally leveraging the resources associated with disaster planning and recovery toward realizing healthier communities," (p. ix). These actions are premised on the concept that the recovery phase following a disaster presents opportunities to use incoming expertise, resources, and political will for communities to enhance long-term, integrated, improvements to systems that support community health. Enhanced community health, in turn, they argue, supports community resilience and capacity to plan for and successfully implement recovery initiatives in the future. In the authors' view pre-disaster planning and post-disaster recovery should be treated as a cyclical process of community improvement. The report offers a comprehensive definition of a healthy community as one that is "safe, economically secure, and environmentally sound, as all residents have equal access to high quality educational and employment opportunities, transportation and housing options, prevention and healthcare services, and healthy food and physical activity opportunities," (p. ix). This definition is consistently tied to the underlying themes of equity, resilience, and sustainability.

The report is divided into two main parts, the first focusing on building a thorough case and strategic framework for the healthy community approach in disaster recovery policy and practice. The second part provides more practical operational guidance to support the integration of the healthy community approach in operations and recovery planning of critical health services such as the public health, primary health care providers, behavioural health (e.g. mental health services, substance abuse programing), social services, as well as urban, transportation, and environmental management planners, local governments, and the housing sector.

A significant output of the report is the 12 recommendations produced by the writing committee on the ways local and national leaders can mitigate disaster-related (adverse) health impacts and optimize the use of disaster resources. These recommendations range from broad strategic initiatives including "Develop a healthy community vision for disaster recovery," to policy improvement including "Integrate health considerations into recovery decision making through the National Disaster Recovery Framework," and community level interventions such as "Facilitate the engagement of the whole community in disaster recovery through simplified and accessible information and training," or recommendations about leveraging community social networks (p. 9-12). Their recommendations integrate well with current thinking on community and urban resilience planning through their linkages to place-based recovery strategies and recommendations.

DEFINITION OF RESILIENCE: "The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events (NRC, 2012, p. 1)," (p. xxii, Glossary).

Klein, R. J. T., Nicholls, R. J., & Thomalla, F. (2003). Resilience to Natural Hazards: How useful is this concept? *Environmental Hazards*. 5 (1): p. 35-45.

This article is based on a thorough review of the disaster resilience literature, and focuses particularly on coastal megacities and weather related hazards to frame the discussion around

the applicability of resilience in hazard risk reduction. The authors provide a clear argument for characterizing resilience as a specific system attribute that refers to 1. "the amount of disturbance a system can absorb and still remain within the same state or domain of attraction" and 2. "the degree to which the system is capable of self-organisation," (p.35). Resilience, the authors conclude, is a factor of the larger umbrella concept of adaptive capacity. Adaptive capacity is defined in this article, as "the ability to plan, prepare for, facilitate, and implement adaptation options," (p.38). As part of this discussion, the authors provide specific insights into adaptation strategies in urban coastal areas. For example, identifying five approaches to anticipatory climate change adaptation and their relevance to hazard risk reduction in coastal zones and megacities (see Klein et al. 2003, p. 38).

Drawing heavily on the work of Handmer and Dover (i.e. Dover and Handmer 1992, Handmer and Dover 1996) in their discussion of resilience to hazards, the authors identify different interpretations of resilience that present different benefits and challenges to operationalization in disaster risk reduction. While recognizing the contested interpretations of resilience, the authors recognize a common movement over the last three decades toward a general acknowledgement that human and ecological systems are interlinked and that "their resilience relates to the functioning and interaction of the systems rather than the stability of their components or the ability to maintain or return to some equilibrium state," (p.40).

The latter half of the paper addresses three central questions: (1) Is resilience a desirable attribute of megacities? Yes, resilience is desirable if defined relative to a system's capacity for self-organisation rather than a return to an equilibrium state. (2) Does enhanced resilience reduce the vulnerability of megacities to natural hazards? While resilience can contribute to urban recovery after disaster, the vulnerability of some marginal populations may remain unchanged. Therefore, socio-economic standing is a factor influencing whether resilience reduces vulnerability. And (3) Is resilience a useful concept for hazard risk reduction in megacities? The authors conclude that without an explicit and widely accepted operational definition of resilience, it will remain a vague concept rather than a practical policy or management tool.

DEFINITION OF RESILIENCE: Resilience is, "the amount of disturbance a system can absorb and still remain within the same state or domain of attraction, and the degree to which the system is capable of self-organisation," (p.43).

KEY WORDS: Hazards; Vulnerability; Risk; Resilience; Adaptation; Adaptive capacity; Climate change; Megacities; Coastal zones

PERPSECTIVE : urban geography, social-ecological systems, policy

METHODOLOGY: critical literature review

Manyena, S.B. (2006) The concept of resilience revisited. *Disasters*. 30 (4), 433-450.

Addressing what the growth and what the authors see as potentially problematic interpretations of resilience in disaster risk reduction discourse, this article reviews the definitions of resilience, the role of vulnerability in resilience discourse, and the differences between vulnerability and resilience. The author cites experts who feel the resilience concept has added nothing new to DRR while introducing confusion to existing terminology, while others are cited as suggesting that resilience has facilitated a new way of conceptualizing hazard consequences that moves away from poverty and vulnerability reduction toward capacity building. The author discusses a series of definitions and interpretations of resilience, and ultimately concludes, "Resilience is currently too vague a concept…to be useful in informing the disaster risk reduction agenda," (p.445). The author promotes resilience definitions that characterize it as a process rather than an outcome. These definitions tend to incorporate the concept of adaptation, which the author interprets (relatively narrowly) as "a strategy to mitigate future disasters."

The author also analyses the relationship between vulnerability and resilience, noting two primary interpretations: 1. Resilience and vulnerability are factors of each other and 2. Resilience

and vulnerability are discrete system characteristics. The author lists the "constituent elements" of both to clarify the distinction between interpretations of resilience and vulnerability (Box 4, p.445). The author presents three core arguments for continuing to develop resilience thinking so that it is applicable in DRR. First, resilience thinking extends DRR beyond coping or attaining minimum standards that is emphasized in discussions of vulnerability reduction. Second, resilience approaches that build on "affirmative action [utilizing local knowledge and augmenting existing capacities] rather than endless risk assessments and reactions to negatives," tend to have more positive development outcomes. Third, resilience discourse can improve project planning by encouraging whole system thinking.

DEFINITION OF RESILIENCE: "The argument presented in this paper suggests that disaster resilience could be viewed as the intrinsic capacity of a system, community or society predisposed to a shock or stress to adapt and survive by changing its non-essential attributes and rebuilding itself," (p.446).

COUNTRY: United Kingdom

PERPSECTIVE: Disaster risk reduction

METHODOLOGY: Synthesis of primary and secondary data. Primary: collected through "personal communication and group emails" from "those who have distinguished themselves in disaster scholarship and research," (p. 434).

3 Disaster Resilience Policy

WREMO. (2013) *Wellington Region Emergency Management Office: Community Resilience Strategy*. Wellington Region Emergency Management Office. Second edition: Version 3.1.

This regional strategy document outlines an engagement plan and set of community capacity building tools developed by Wellington Region Emergency Management Office. At the centre of their strategy is the acknowledgement that community actors have a continuum of interest and capacity to engage in resilience (or DRR) activities, and therefore, WREMO should apply a "communicate and collaborate" approach to determine local interest, utilize existing structures, and supports partnerships between community leaders and government to accomplish three strategic objectives: 1) Build community capacity, 2) Increase connectedness, 3) Foster cooperation. The strategy outlines the role of the Community Resilience Team, which is essentially to facilitate the development of practical activities that support the three strategic objectives outlined above. Additionally the document identifies and describes a number of practical tools for building capacity, such as the kinds of Civil Defence volunteer training available, emergency text alerts, and community events that build connectedness. The document outlines a number of community engagement principles meant to guide WREMO's interactions in their resilience building interactions. The principles focus on building trust; empowering communities by leveraging existing knowledge, expertise, and institutions; and on practical end-use focused outcomes.

In additional to the broader definition of community resilience (below), the strategy document also lists nine attributes of resilient community (WREMO, 2013, p. 8). The attributes focus on social connectedness/ social capital (including strong civic partnerships and sense-of-place), hazard awareness, and leadership and governance capacity.

DEFINITION OF RESILIENCE: "Community resilience is the capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change," (p.8). This definition was developed by the Community and Regional Resilient Institute and was seen as consistent with WREMO's vision statement: "A resilient community, ready and capable," (p.8).

KEY WORDS: [if provided by the author]

COUNTRY: New Zealand

PERPSECTIVE : Civil defence and emergency management; Disaster risk reduction

METHODOLOGY:

Canterbury Earthquake Recovery Authority, 2014. Canterbury Wellbeing Index June 2014. Canterbury Earthquake Recovery Authority, Christchurch.

CERA, in collaboration with a number of government agencies, has developed the Canterbury Wellbeing Index. This index is used to track social recovery in Christchurch following the earthquakes in the region. First published in 2013, the Canterbury Wellbeing Index is updated annually to enable agencies to respond to issues, and to provide the community with accurate and up to date information about the social recovery. In addition to the 28 agencies consulted during the development of the social indicators that make up the index, expert advice of international best practice was sourced from the Christchurch District Health Board literature review 'Designing indicators for measuring recovery from disasters' (Bidwell, 2011).

The Canterbury Wellbeing Index is comprised of indicators grouped by the following 7 themes:

- Knowledge and skills
  - Participation in education
  - Educational achievement: NCEA Level 2 pass rate
- Economic wellbeing
  - Employment outcomes
  - Household income
- Housing
  - Housing affordability and availability
- Health
  - Keeping well and having access to health services
  - Mental wellbeing
  - Risk factors
- Safety
  - Offending patterns
  - Child abuse and neglect
- Social connectedness
  - People participate in and attend the arts
  - Sports participation
  - Household are prepared for civil defence emergencies
  - Social connectedness
- Civil participation
  - Civil participation
- People
  - Population

The index utilises a wider range of specific measures to represent each of the above themes and indicators. Information is sourced from existing secondary datasets across a range of government organisations to track changes in each indicator. Where possible these indicators are tailored to the geographic boundaries of Christchurch city, Selwyn district, and Waimakariri District. CERA supplements these secondary datasets with their own CERA Wellbeing Survey to provide additional recovery focused data on residents during the recovery of Christchurch.

Definition of resilience:

Key words:

Country: New Zealand

Perspective: Social and community wellbeing, social recovery to hazard events

Methodology: Agency consultation and international best practice literature review to develop a practical social wellbeing index for recovery from an earthquake event. Indicators are built on secondary datasets supplemented by a bespoke wellbeing survey of local residents.

4 Economic Resilience

Cavallo, E., and Noy, I. (2009) *The Economics of Natural Disasters*. Inter-American Development Bank. IDB Working Paper Series #IDB-WP-124.

This report offers a thorough summary of the state of economic research on natural disasters and their consequences, and identifies questions that require further investigation to advance our understanding of the economics of disasters globally. The report thoroughly outlines the types and determinants of the costs of disasters on economies and society more generally, discussing the relationship between factors such as economic development and vulnerability. The authors also review work that illustrates how policy can be implemented to reduce the impacts of disaster and minimize the long-term economic damage. This includes the various benefits and drawbacks of natural disaster insurance coverage for different actors in the economy. The authors identify future challenges for studying and predicting the economic impact of disasters, especially in light of increasing evidence that climate change may affect the frequency and intensity of meteorological hazards. From their literature review the authors conclude that there are still significant gaps in our understanding of the economics of disasters. They cite the limitations of EM-DAT the only large database on disaster impacts, and recommend more detailed accounting of the physical destruction wrought by large disasters. They also note that there is limited understanding of the long-run effects of disasters.

COUNTRY: (Institution) Inter-American Development Bank

PERPSECTIVE : Macro-economic

METHODOLOGY: Literature review

Hallegatte, Stehane. (2014) *Economic Resilience: Definition and Measurement.* The World Bank Climate Change Group. Policy Research Working Paper 6852.

This report defines macroeconomic and microeconomic resilience and analyses these concepts in three ways. First the author introduces "rules of thumb" to estimate both types of resilience based on relevant parameters in the economy, identifying the significant challenge of finding appropriate indicators of resilience. The author offers a number of theoretical comparative calculations of impacts and resilience of "poor" and "non-poor" populations that are affected by disasters, and considers the effect of inequality on proportional welfare impacts of disasters.
Hallegatte then reviews policies that can increase micro- and macro-economic resilience. For example, Hallegatte demonstrates the benefits of social protection limits the welfare losses a household may experience. Finally, they provide a list of indicators that can be used to build economic indicators.

In the discussion, Hallegatte also identifies a number of ways in which non-marginal shocks (i.e. significant natural disasters) alter the economy and negate many typical economic assumptions. This is important when trying to calculate the impacts of a disaster. The author identifies a number of ways that economies reduce or recapture lost productivity and output, including input substitution, production rescheduling, mobilization of existing idle resources, and longer work hours or transferring production to unaffected areas or unaffected producers in the disaster area. Hallegatte additionally breaks down the stimulus effect of disasters on economies, importantly noting that the "stimulus benefits are not considered as positive outcomes of disasters," (p.14).
DEFINITION OF RESILIENCE: "The ability of an economy or a society to minimize welfare losses for a disaster of a given magnitude is often referred to as its resilience," (p.2). Note, welfare losses in this context are represented as consumption losses (household effects). "Macroeconomic resilience has two components: instantaneous resilience, which is the ability to limit the magnitude of immediate production losses for a given amount of asset losses, and dynamic resilience, which is the ability to reconstruct and recover," (p. i).

The author identifies that key drivers of macroeconomic and microeconomic resilience (p.31-32)

COUNTRY: (institution) World Bank

PERPSECTIVE : Economic development

Park, J., Cho, J., and Rose, A. (2011) Modeling a major source of economic resilience to disasters: recapturing lost production. *Natural Hazards*. 58 (1), 163-182.

This paper examines economic resilience through the lens of business responses in post-disruption environments. The authors develop a theoretical framework to demonstrate the way economic resilience relates to the ability to reduce business interruption due to property damage. Park, Cho, and Rose (2011) note that resilience is enacted through a business' ability to reduce the maximum potential impacts due to a disruptive event and the ability to recover as quickly as possible. An important source of resilience in this conceptualization is the business' ability "to reschedule, or recapture, lost production after the event," (Park, Cho, and Rose, 2010, p.163). The notable outputs of this paper are production recapture factor functions and a recaptured output path function for different industry sectors. They can adapt these functions to different regional industry and building composition and damage status features. The authors then test different model assumptions for different damage scenarios and recovery timeframes, and validate their model using a hypothetical earthquake event in Los Angeles. Their general recapture factor model can be used to improve natural hazard loss estimation (particularly in the U.S. based HAZUS loss estimation model).

DEFINITION OF RESILIENCE: Business resilience is the, "ability…to reschedule, or recapture, lost production after the event," (p.163).

KEY WORDS: Resilience, Production recapture, Business interruption, Disasters

COUNTRY: United States

PERPSECTIVE : Economic modelling

Rose, A. (1999) Defining and Measuring Economic Resilience to Disasters. *Disaster Prevention and Management*. 13 (4), 307-314.

This paper addresses some of the conceptual, operational, and empirical issues facing the study of economic resilience. The paper begins with a discussion of the conceptual dimensions of economic resilience including system elements that reduce the probability and consequences of failure following a disruptive event and reducing the time to recovery. This discussion is supported by a conceptual model demonstrating the role of resilience at various levels of the economy (i.e. micro, meso, and macro) and economic losses from disasters (See Figure 1, p. 310). Rose (1999) then demonstrates the beneficial use of computable general equilibrium (CGE) modelling analysing natural hazard impacts and policy responses. Rose then discusses improvements to CGE modelling introduced by the author to capture the periods of "disequilibrium" caused by major disruptive events. The author then demonstrates the empirical specification of this improved CGE model using a water disruption scenario for Portland (Oregon) Bureau of Water Works demonstrating the total regional economic resilience (TRER) with and without mitigation for the water system. The discussion points out some of the complementarities and trade-offs between mitigation and resilience, such as the outcome in one scenario where mitigation lowered direct losses but reduced adaptive capability of the system.

DEFINITION OF RESILIENCE:
"Economic resilience, as defined in this paper, refers to the inherent and adaptive responses to disasters that enable individuals and communities to avoid some potential losses," (p.307).
Inherent Resilience: "ability under normal circumstances (e.g. the ability to substitute other inputs for those curtailed by an external shock, or the ability of markets to reallocate resources in response to price signals)," (p.308);
Adaptive Resilience: "ability in crisis situations due to ingenuity or extra effort (e.g. increasing input substitution possibilities in individual business operations, or strengthening the market by providing information to match suppliers without customers to customers without suppliers)," (p.308).

Rose also clearly distinguishes resilience from mitigation: "In contrast to the pre-event character of mitigation, economic resilience emphasizes ingenuity and resourcefulness applied during and after the event. Also, while mitigation often emphasizes new technology (e.g. seismic warning) or institutions (e.g. insurance markets), resilience has greater behavioural emphasis. It focuses on the fact that individuals and organisations do not simply react passively or in a "business as usual manner" in the face of a disaster," (p.307).

KEY WORDS: Disasters, Economics, Measurement

COUNTRY: United States

PERPSECTIVE : Economic modelling, Economic theory

METHODOLOGY: CGE modelling

Anbarci, N., Escaleras, M., and Register, C.A. (2005) Earthquake fatalities: the interaction of nature and political economy. *Journal of Public Economics*. 89 (2005): 1907-1933.

This paper examines the role that national level income (GDP per capita) and income inequality plays in vulnerability to earthquakes (specifically mortality). The authors developed this research on the premise that collective action, which can reduce vulnerability to disasters, is limited by income as well as by a population's ability to equality distribute the economic burden of those actions. The article reviews differential effects of potentially catastrophic earthquakes in areas that had differing degrees of collective action (e.g. preparedness activities or successful enforcement of building codes), the lack of which had disproportionately negative effects on the poor.

The authors develop a theoretical model based on the degree of income inequality, collective action is modelled as the 'majority vote' to mitigate against an earthquake with a given probability of occurrence which in this paper is captured as the proportional tax rate. Their theorem states that collection action will be less likely as inequality increases.

Using empirical data from 269 earthquakes in 26 countries, the authors test the theoretical model with empirical data. They found that their analysis supports (with some caveats) the theoretical model that predicted that "holding constant reasonable control variables (such as magnitude, population, land area, distance from the epicentre, frequency of major quakes, unexplained regional factors), fatalities from a quake should be a decreasing function of both a country's level of per capita income and equality," (p. 1923).

Scale/ coverage: Comparative study of 269 earthquakes (magnitude 6 and up) occurring in 26 countries in Africa, Asia, Europe, and the Americas
Items: Earthquake: Secondary data on earthquake magnitude, depth, and proximity to population centres. Country factors: population of the provinces affected, the land area, and the frequency with which a country suffers through major earthquakes. Income: GDP per capita in constant (1995) U.S. dollars. Inequality: Gini Codes for distribution of income and distribution of land
Data source: from the National Geophysical Data Center's Significant Earthquake Database, World Development Indicators, World Census of Agriculture.
Time Scale: 1960-2002
Methods/Indicator Construction: Econometrics

KEY WORDS: Earthquake, fatalities, nature, political economy

PERPSECTIVE : Economics, Political economy

METHODOLOGY: Testing theoretical model with secondary data

Briguglio, L., Cordina, G., Farrugia, N., Vella, S. (2009) Economic Vulnerability and Resilience: Concepts and Measurements. *Oxford Development Studies*. 37 (3): 229-247

Through their review of the causes and indicators of economic resilience, the authors develop a conceptual and methodological framework for defining and measuring economic resilience. The authors juxtapose inherent economic vulnerability and "nurtured" resilience, discussing the way different economies are exposed and sensitive to shocks (vulnerable) and to differing degrees enhance resilience through policy mechanisms. The policies allow economies to either counteract or absorb shocks.

In the latter half of the paper, the authors construct a Resilience Index, which is intended to measure the effect of shock absorption and counteraction policies. The components of the index include: macroeconomic stability, microeconomic market efficiency, good governance, and social development. The authors describe each of these components and identify variables that can be used as measureable proxies (see p.234-2338). It is not entirely clear from the paper where they obtained data or quantified some of the indicators such as "the extent to which foreign banks are permitted to compete in the market." The authors average across the four components of resilience, to obtain an index score for each country. In the last part of the paper they relate GDP per capita, resilience and vulnerability, finding that GDP is highly correlated to economic resilience. Regression analyses indicate that resilience policies have a larger influence on GDP per capita than inherent resilience.

Scale/ coverage: National/ Global comparison
Items: The components of the index include: macroeconomic stability, microeconomic market efficiency, good governance, and social development.
Data source: National Statistical Offices, Economic Freedom of the World Index, IMF, World Bank
Time Scale:
Methods/Indicator Construction:

- "The macroeconomic stability sub-index is made up of the simple average of the following three variables: the fiscal deficit-to-GDP ratio; the sum of the unemployment and inflation rates; and the external debt-to-GDP ratio.
- The microeconomic market efficiency index is a component of the Economic Freedom of the World Index (Gwartney & Lawson, 2005), namely "regulation of credit, labour and business", and is intended to measure the extent to which regulatory restraints and bureaucratic procedures limit competition and the operation of financial, labour and product markets.
- The governance index consists of five components, namely: judicial independence; impartiality of courts; the protection of intellectual property rights; military interference in the rule of law; and the political system and the integrity of the legal system.
- The social development index is the sum of the education and health indices of the HDI for the years 2000–02 (see UNDP, 2002, 2003, 2004). Education is measured by the adult literacy rate and school enrolment.
- The resilience index is the simple average of the four indices in the previous four components." (p.245)

DEFINITION OF RESILIENCE: "economic resilience refers to the policy-induced ability of an economy to recover from or adjust to the negative impacts of adverse exogenous shocks and to benefit from positive shocks ," (p. 233).

5 Infrastructure Resilience

Anderson, W. P., Maoh, H., & Burke, C. (2011) ***Assessing risk and resilience for transportation infrastructure in Canada*****. Transportation and Innovation: The Roles of Governments, Industry and Academia, 298-312.**

This paper provides a detailed methodology for assessing the potential impact and cost of transportation infrastructure disruption on the economy of Canada. In this article, the concept of resilience is considered as a measure of economic losses in a critical infrastructure link. (Anderson et. al, 2011) model focuses on the system performance. The recommendation from this research proposes

a policy approach to combating the vulnerability of an infrastructure while reducing risk as in the figure below.

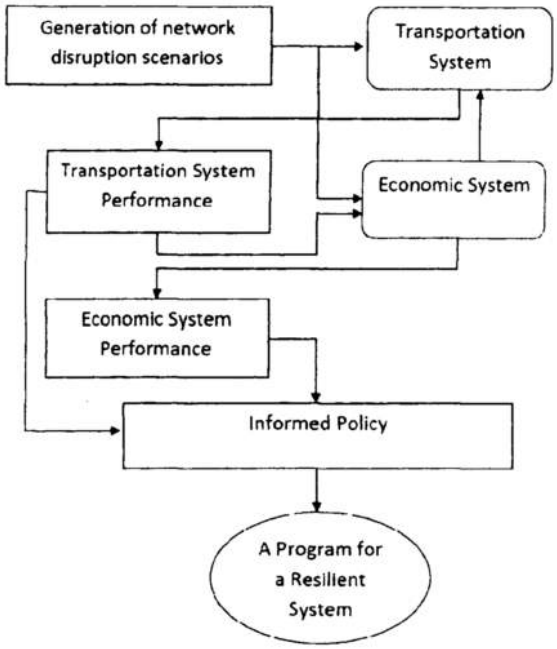

Figure 1: Model Framework for Assessing Risk and Resilience

Definition of Resilience: Resilience is defined in two components; "1) How well the system can function for a given level of damage and 2) how quality it can be restored to its pre-event state."
Country: Canada
Perspective: Road infrastructure
Methodology: numerical hypothetical, quantitative

Comes, T., & Van de Walle, B. (2014) Measuring Disaster Resilience: The Impact of Hurricane Sandy on Critical Infrastructure Systems, In: *Proceedings of the 11th International ISCRAM Conference,* University Park, Pennsylvania. Online, Available from: http://www.iscramlive.org/ISCRAM2014/papers/p18.pdf. (pp. 195-204).

This study focuses on the case study for Hurricane Sandy with regards to measuring the response and relief efforts. Comes et al. (2014) uses an empirical analysis to assess the resilience of a critical infrastructure from the impact of Hurricane Sandy. Comes et al. (2014) compares the interconnection and linkages between resilience and recovery. The study demonstrates that disaster resiliencies are closely linked to recovery processes as in the figure below.

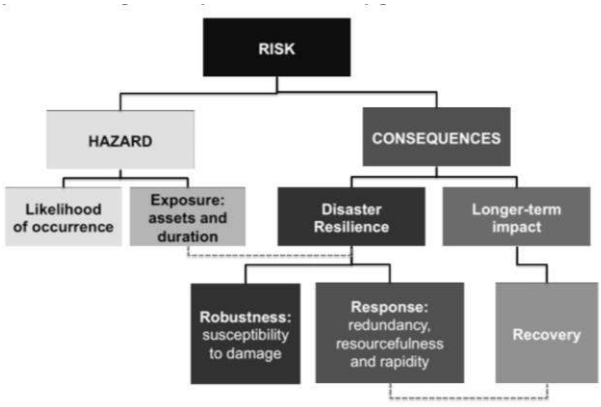

Figure 1: Conceptual model to assess disaster risk

Key Words: Hazard, Critical Infrastructure System, Resilience, Vulnerability Assessment, Decision Support, Hurricane Sandy
Country: USA
Perspective: Electricity, Railway transport
Methodology: Quantitative & qualitative assessment

Dorbritz, R. (2011, May). Assessing the resilience of transportation systems in case of large-scale disastrous events. In *Proceedings of The 8th International Conference on Environmental Engineering*, Vilnius, Lithuania (pp. 1070-1076).

This paper presents the assessment of large-scale failure in a transport railway system. This assessment orders the failures and recommends the most appropriate method to improve the resilience. The study examines the contributing hazards that result in disruption of the railway network as shown in the figure below.

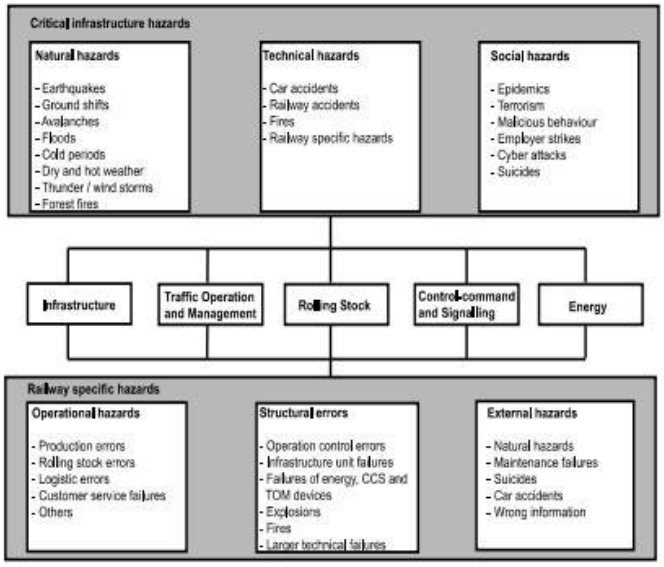

Fig 1. General and railway-specific hazards threatening the railway system (TOM – Traffic Operation and Management, CCS – Command-control and Signaling)

Dorbritz (2011) concept of resilience incorporates the prevention, intervention and recovery. In the paper, Dorbritz (2011) states that disruption in major nodes in the railway network results in more major reductions to system performance. This research can calculate alternative paths and anticipate potential multiple failures in a system.

Key Words: public transport systems, disaster resilience analysis, R-software programming, simulation and visualization of blockades, system performance, scale-free networks, planned and degraded operation.
Country: Switzerland
Perspective: Railway infrastructure
Methodology: Quantitative network models

Garbin, D. & Shortle, J. (2007) *Measuring resilience in network-based infrastructures*, George Mason University School of Law, Critical Infrastructure Protection Program. Discussion Paper: February 2007.

This study as the author stated "intends to explore the benefits of quantifying network resilience as part of an overall risk assessment approach and present a framework and methodology for deriving a resilience index for real infrastructures". An explanatory comparative study has been carried out to show the importance of network resilience and differences between traditional risk assessments with new network resilience approach. The author believes that the first step in resilience analysis for network-based infrastructure is to identify key parameters, which describes that specific infrastructure. He classifies these parameters into four general categories: demand, topology, capacity, and routing. Each category has been discussed in article. Simulation method has been applied to base a resilience index formulation for networked infrastructure. The author believes that any methodology for determining resilience index must be applicable and easy to implement. He concluded that critical infrastructure is highly network based and consequences to other interdependent infrastructure should be considered in resilience indexing.

Definition of Resilience: "the ability of infrastructures to degrade gracefully in the face of natural or man-made disasters," (p.98).
Key Words: resilience, network-based infrastructure
Country: USA
Perspective: Infrastructure
Methodology: Simulation (analytic model based on queuing theory)

Hughes, J. F., & Healy, K. (2014) *Measuring the resilience of transport infrastructure*. New Zealand Transport Authority. Research Report 546.

This paper presents a qualitative resilience measurement framework developed on the guiding principle of resilience within the New Zealand's National Infrastructure Plan. Hughes et al. (2014) uses technical and organisational dimensions to develop the indicators. This research is applicable to a wide cross section of the land-based transport system (road and rail). The method of the paper examines the measurement of resilience at various scales (asset/network/region). Hughes et al. (2014) describes this tool as easy and practical tool to comprehend the resilience of the transport system for prioritization of intervention for investment.

Key Words: resilience ; transportation
Country: New Zealand
Perspective: Transportation
Methodology: Interviews, paper review

Imran, M., Cheyne, C., & Harold, H. (2014) *Measuring Transport Resilience: A Manawatu-Wanganui Region Case Study*. Massey University, Resource and Environmental Planning. Report, Online, Available from http://hdl.handle.net/10179/5725.

This research paper presents the development of a Transport Resilience Indicator Framework (RIF). Imran et al. (2014) examines six key dimensions of transport infrastructure resilience: engineering, services, ecological, social, economic and institutional. This paper provides a holistic approach to measuring transport resilience. The framework developed measures for both qualitative and quantitative indicators. Imran et al. (2014) concluded that a successful implementation of the framework should be achieved through a multi-disciplinary approach.

Key Words: resilience,transportation
Country: New Zealand
Perspective: Road Infrastructure
Methodology: Interviews, qualitative, expert judgement

Jackson, S. & Ferris, T.L. (2013) Resilience principles for engineered systems. *Systems Engineering*. 16 (2), 152-164.

This article scrutinizes the components and sub-components of system resilience distributed in the literature. The study aimed to propose a "concrete" solution for application of principal feature for a

resilient system. The author gathered principles and sub-principles of resilient system from previous case studies. The newly developed principles were used as supplementary to add existing principles. The potential of gathered principles to match with define and evaluate a resilient system. 14 principles of resilient systems were discussed in this article: (1) Absorption, (2) Physical Redundancy, (3) Functional Redundancy, (4) Layered Defence, (5) Human in the Loop, (6) Reduce Complexity, (7) Reorganisation, (8) Repairability, (9) Localized Capacity, (10) Loose Coupling, (11) Drift Correction, (12) Neutral State, (13) Inter-Node Interaction, and (14) Reduce Hidden Interactions. Furthermore, the interdependency attribute of systems has been deliberated for each main principle. The author matched each resilience design principle application to the phases of response to a threat. All in all this paper has argued the limitations and vulnerabilities of each principle for resilient systems. Also the interdependent principles to achieve recovery for system were discussed. The outcomes of this paper are applicable to infrastructure and lifelines as complex systems.

Definition of Resilience: Resilience is defined as, "the ability to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption".
Key Words: resilience, principles, threats, disruptions, recovery
***Country*:** USA
Perspective: Infrastructure
Methodology: Literature, expert judgment

Madhusudan, C., & Ganapathy, G. P. (2011) Disaster resilience of transportation infrastructure and ports–an overview. *International Journal of Geomatics and Geosciences*. 2 (2), 443-455.

This journal article examines a review for a series of research on the impact of disasters on the resilience of the transportation and port infrastructure in the developing countries over a decade. Madhusudan et al. (2011) highlighted the significance of the Bruneau et al. (2003), resilience framework for studying the resilience of critical infrastructure based on four parameters – Robustness, Redundancy, Resourcefulness and Rapidity (R4 Framework). Madhusudan et al. (2011) concluded given there is no standard method for measuring resilience in road infrastructure there needs to be further research for assessing resilience in road infrastructure.
Key Words: Disaster, Disaster Resilience, Transportation Infrastructure, Transportation Network, Port.
Country: India
Perspective: Transportation and port infrastructure
Methodology: Paper review, expert judgement

Moteff, J.D. (2012) *Critical Infrastructure Resilience: The Evolution of Policy and Programs and Issues for Congress*, Congressional Research Service. Report: R42684. Online, Available from https://www.fas.org/sgp/crs/homesec/R42683.pdf.

This report provides a good summary of definition and policies applied by Homeland Security Advisory Council around concept of resilience. The definition and resilience measurement methods have been discussed in the context of critical infrastructure. Additionally policy development and implementation issues at Department of Homeland Security (DHS) have been debated. This report also provides easy to understand examples of principles that can help to improve system resilience. The outcome of this report is quite helpful for national resilience policy makers to have a general overview of critical infrastructure resilience strategies and actions.

Definition of Resilience: a change in the system's normal operating environment that has the potential, if not the effect, of disrupting normal system performance.
Key Words: critical infrastructure; Resilience
Country: USA
Perspective: Infrastructure
Methodology: Literature, expert judgment

Murray-Tuite, P. M. (2006, December). *A comparison of transportation network resilience under simulated system optimum and user equilibrium conditions*. In Simulation Conference, 2006. WSC 06. Proceedings of the Winter (pp. 1398-1405). IEEE.

The article presents the assessment of transportation network resilience. This paper gave ten dimensions for transportation resilience; redundancy, diversity, efficiency, autonomous components, strength, collaboration, adaptability, mobility, safety, and the ability to recover quickly. This study developed only four components (adaptability, safety, mobility, and recovery) for measuring the resilience of a transport network. The assessment uses different measures to evaluate the impact of traffic assignment using the four resilience dimensions. The finding from the study indicates that traffic assignment should not be the only factor in assessing transportation resilience. Murray-Tuite (2006) recommended that other dimensions be incorporated for evaluating the systems' resilience.

Definition of Resilience: Murray-Tuite (2006) defines resilience in this article as "a characteristic that indicates system performance under unusual conditions, recovery speed, and the amount of outside assistance required for restoration to its original functional state."
Key Words: Safety, traffic transportation
Country: USA
Perspective: Road infrastructure
Methodology: Network sample traffic simulation, quantitative

Omer, M., Nilchiani, R., & Mostashari, A. (2009). Measuring the resilience of the trans-oceanic telecommunication cable system. *Systems Journal, IEEE*. 3(3), 295-303.

This article gives an insight into how the resiliency of the trans-oceanic telecommunication cable infrastructure is enhanced through vulnerability reduction. The research examines a developed model that measures the base resiliency of a system using three variables (demand, capacity, and flow information). The resiliency is calculated using the ratio of the delivery of systems compared to the delivery of the system before disruption. Omer et al. (2011) concluded that reducing the system's vulnerability through increased redundancy can significantly improve the system performance for a given disturbance.

Definition of Resilience: "the ability of the system to both absorb shock as well as to recover rapidly from a disruption so that it can return back to its original service delivery levels or close to it".
Key Words: Infrastructure, Internet, resiliency, vulnerability
Country: USA
Perspective: Telecommunication
Methodology: Quantitative models

Omer, M., Mostashari, A., & Nilchiani, R. (2013). Assessing resilience in a regional road-based transportation network. *International Journal of Industrial and Systems Engineering*, 13(4), 389-408.

Omer et al. (2013) introduces a methodology to measure resilience using a Networked Infrastructure Resiliency Assessment (NIRA) framework. The paper describes resilience metrics in terms of travel time resiliency, environmental resiliency, and cost resiliency. Omer et al. (2013) in the study examines the impact of disruptions on the user choice of the road network. The findings conclude that the increase in capacity of the system will reduce the recovery time in an existing road network.

Definition of Resilience: Omer et al. (2013) define resilience as, "the response of the system in the face of shock and its ability to continue to provide the expected service delivery levels".
Key Words: resiliency; infrastructures; network; transportation; mode choice
Country: USA
Perspective: Road Infrastructure
Methodology: Quantitative models

Omer, M., Mostashari, A., & Lindemann, U. (2014). Resilience Analysis of Soft Infrastructure Systems. *Procedia Computer Science*, 28, 565-574.

This paper provides a procedure for assessing the resilience of soft infrastructure using social network analysis. There was on the soft infrastructure for a National Intelligent Transportation System (ITS) the system's resilience is defined as the centrality measures. The degree centrality measures how well a node is connected; this metric was used to identify the most critical nodes in the network that would cause the maximum network damage when disrupted.

Key Words: Resilience metrics, organisational networks, soft infrastructure system, social network analysis
Country: USA
Perspective: transportation
Methodology: Quantitative model

O'Rourke, T.D. (2007) *Critical infrastructure, interdependencies, and resilience*, Bridge-Washington National Academy of Engineering, 37 (1), 22.

This study provides a good explanation of critical infrastructure and more specific concepts like lifelines. The author has clarified the basics of infrastructure resilience and why researchers and policy makers have developed such a concept. Moreover, the author exemplifies interdependencies of lifeline systems, and discusses the Loss of Resilience equation for communities proposed by Bruneau et al. (2003). The author argues that multidimensional community resilience framework by Bruneau et al. (2003) can be applied to different aspects of infrastructural resilience (i.e. technical, organisational, social, and economic dimensions). Methods of promoting infrastructure resilience such as awareness, leadership and planning were discussed in this paper. The author concludes that developing resilient infrastructure requires a resilient community, although this requirement does not appear to have direct impact on the engineering and technology aspects of infrastructure. So engineering and technology are two other factors that need to be considered in creating resilient infrastructure.

Definition of Resilience: "the ability to bounce or spring back into shape, position, etc., after being pressed or stretched."
Country: USA
Perspective: Critical infrastructure, Resilience, Interdependency

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Petit, F.D., Eaton, L.K., Fisher, R.E., McAraw, S.F. and Collins, M.J., III. (2012) Developing an index to assess the resilience of critical infrastructure, *Int. J. Risk Assessment and Management*. 16 (1/2/3), 28–47.

This paper is a continuation of national policy research by the US government to develop an index to assess resilience for critical infrastructure. The article has begun with a brief introduction of past research carried out by Department of Homeland Security (DHS) around the concept of resilience and the role of this concept in national programmes and policies. The author pointed out that "generating reproducible results"and "completed vulnerability analysis" are the main characteristics of a good resilience-analysis, which can be used, in decision-making processes. Data collection process is mainly used to create a Resilience Index (RI), which can be reproducible and compared with other resilience valuations. As a result, the author proposed an RI equation based on three levels of resilience measures. Each level of components and sub-components is assigned with a weight of importance. Assigned weights are related to principles of 'decision analysis" under uncertainty disaster scenarios. The author presented an example of weight assessment by a group of experts. The proposed methodology is quite applicable for future resilience-related strategies within infrastructure sector. The author has concluded that this article is just an initial step of a comprehensive practice for assessing infrastructure resilience. Further indicators should be developed to create a more accurate resilience index.

Definition of Resilience: The authors of this article have defined infrastructure resilience as, "The ability of a system to minimise the costs of a disaster, to return to a state as good as or better than the status quo ante, and to do so in the shortest feasible time."
Key Words: Critical infrastructure; critical infrastructure protection; resilience assessment; risk management, risk analysis; critical infrastructure assurance; USA.
Country: USA
Perspective: Infrastructure resilience
Methodology: Questionnaire, multi-attribute utility theory, expert judgment

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Chang, S.E., McDaniels, T., Fox, J., Dhariwal, R. and Longstaff, H., (2014). Toward Disaster-Resilient Cities: Characterizing Resilience of Infrastructure Systems with Expert Judgments. *Risk Analysis*, 34(3), 416-434.

This journal article proposes a practical approach for analysts to characterize a community's infrastructure vulnerability and resilience in a time of crisis. Metro Vancouver, Canada, was used as a case study in this article to focus on disruptions on infrastructure services in the event of flood and earthquake. The article develops information on regional infrastructure risk and engages infrastructure organisations in the process. The author believes that tasks of risk managers to create a resilient infrastructure have two main components: (i) characterizing vulnerabilities and resilience within existing systems to disasters, and (ii) setting priorities for mitigation efforts to improve resilience. Obstacles to fostering resilience are summarized as partial incentives, limited and asymmetric information, and lack of experience. Each of these challenges was discussed in the article. Infrastructure failure interdependencies (IFIs) for upstream and downstream disruptions have been evaluated and the result has been offered through an interdependency diagram. Service disruption levels for different infrastructure sectors were assessed. The author proposes a practical process to characterize infrastructure vulnerability and resilience.

Definition of Resilience: In this article Resilience of complex systems like infrastructure was defined as the ability to absorb shocks while maintaining function.
Key Words: Disasters; expert judgment; infrastructure; interdependencies; resilience
Country: Canada
Methodology: Expert Interview, Data Synthesis, Information sharing methods (workshops, summary reports, etc.)

Omer, M., Mostashari, A. & Nilchiani, R. (2011) Measuring the resiliency of the Manhattan points of entry in the face of severe disruption, *American Journal of Engineering and Applied Sciences*. 4 (1), 153-161.

This study offers the Networks Infrastructure Resiliency Assessment (NIRA) framework to evaluate the road network for Manhattan case study in New York City. The researcher believes in creating a network model of transport systems to size the effect of disruptive events on system's performance and ultimately its resilience. The author indicated that the proposed network model should be designed in a way that "hypothetical disruptions" can be easily defined for it. The study considers "Travel-Time" as a base for resilient network modelling purposes. The model has operationalised "Link and Node" approach, which the nodes are the regions that are connected via the tunnel and bridges and the links are entry points of the Manhattan case study. The author believes that disruption in bridges and tunnels within network will cause the greatest negative impacts on resilience of road segments. Omer et.al (2011) compared the travel time between any two nodes in a proposed model before and after disruption scenario. She has applied decision tree analysis for evaluation of practical resilience strategies to improve network system. She concluded, "resiliency is achievable by taking proactive measures prior to a disruption and reactive measures preceding a disruption."

Definition of Resilience: In this study, "resiliency is measured in terms of the impact of disruptions on the system's performance measures; a service disruption in one of the bridges or tunnels would cause traffic congestions that result in an increase in travel time that is used to calculate the travel time resiliency."
Key Words: Manhattan points, Resiliency infrastructure systems, Decision trees
Country: USA
Perspective: Infrastructure
Methodology: Network Modelling, Decision Trees

Petit, F. D. P., Bassett, G. W., Black, R., Buehring, W. A., Collins, M. J., Dickinson, D. C., ... & Peerenboom, J. P. (2013) *Resilience Measurement Index: An Indicator of Critical Infrastructure Resilience* (No. ANL/DIS-13-01). Argonne National Laboratory (ANL).

This study provides a very good overview of the concept of resilience in infrastructure sector. It proposes a methodology to calculate Resilience Measurement Index (RMI) for critical infrastructure. The research has focused on four general characteristics of resilience (Preparedness, Mitigation Measures, Response Capabilities, and Recovery Mechanisms). The author has matched these measurement components with provided definition of resilience. Petit and his colleagues gathered all information for RMI using Infrastructure Survey Tool (IST). These data has been collected into 6 main levels to increase the specificity of this research. All data later assigned to higher level of components. A relative weighting for each measures of resilience has been assigned to evaluate the rate of

contribution in overall resilience index. Authors have deliberated methods of using RMI. The limitation and advantages of proposed methodology has been discussed in this study. The authors came to this point that RMI provides valuable information to critical infrastructure owners and operators about their sector assets and about various ways to enhance resilience.

Definition of Resilience: Resilience is, "the ability of an entity—e.g., asset, organisation, community, region—to anticipate, resist, absorb, respond to, adapt to, and recover from a disturbance."
Country: USA
Perspective: Infrastructure, Resilience
Methodology: Infrastructure Survey Tool (IST), Site Assistance Visits (SAVs)

Vugrin, E.D., Warren, D.E., Ehlen, M.A. & Camphouse, R.C. (2010) *A framework for assessing the resilience of infrastructure and economic systems*. In Sustainable and Resilient Critical Infrastructure Systems, Springer, pp. 77-116.

This study proposes a general resilience assessment framework for evaluation of critical infrastructure and economic system. The framework was formulated by Sandia National Laboratories (Sandia). It provides three main components of resilience assessment: (1) definition of resilience for critical infrastructure, (2) measurement methodologies: a quantitative model to evaluate the degree of system resilience after a crisis, (3) system performance metrics; a qualitative method of system improvement to match with infrastructure resilience policies. The researcher believes that this framework has two main advantages. Firstly, it is a general framework, which is applicable to different types of infrastructure systems. Secondly, it considers system restoration cost since money always matters. This paper has also proposed a comparative study between resilience and other similar systems concepts, such as survivability. The author claims in the event of disruption if the same level of performance increases and decreases for two similar systems, with equal amount of recovery time, the system which uses fewer resources to return to a stable position would be more resilient. Absorptive capacity, adaptive capacity, and restorative capacity were discussed as systems' main capacities to determine resilience. A sample resilience assessment for earthquake in the New Madrid Seismic Zone of the Midwestern United States was proposed to exemplify the qualitative aspect of proposed framework. This study offers a general tool to evaluate infrastructure resilience with financial consideration; however, the author believes further studies should be carried out on infrastructure resilience especially in design process.

Definition of Resilience: "Given the occurrence of a particular disruptive event (or set of events), the resilience of a system to that event (or events) is the ability to efficiently reduce both the magnitude and duration of the deviation from targeted system performance levels."
Country: USA
Perspective: Infrastructure, Economy, Resilience
Methodology: Cost analysis, Case study

6 Organisational Resilience

There are a large number of conceptual pieces outlining the case for resilience and drawing from organisational management, change, strategy and risk management to propose resilience attributes. Development has been based primarily on literature, logical argument, experience, and case study research.

Some authors have developed composite indicators or assessment frameworks for specific organisational concepts (e.g. SMEs, manufacturers, supply chains). Each proposed resilience indicator links to different streams of literature, including strategy, high performance, risk or crisis management.

Abdullah, N.A.S, Noor, N.L.M & Ibrahim, E.N.M. (2013) Resilient Organisation: Modelling the Capacity for Resilience *3rd International Conference on Research and Innovation in Information Systems,* Malaysia, 27-28 November.

This article reviews existing literature and proposes dividing resilience capacity into Internal Resilience factors and Environmental Context factors. Internal Resilience factors relate to the individuals within an organisation, which are enabled or hindered by the environmental conditions including structures, processes, culture and extra-organisational factors such as market demands. The most important contribution of the article is the conclusion that research on organisational resilience indicators is primarily led by Western economies. The significant differences in culture between the west and Asia mean that empirical research is needed to devise indicators appropriate in that context.

DEFINITION OF RESILIENCE: A resilient organisation is able to absorb, adapt and recover quickly from unexpected events or critical business function and operations.
KEY WORDS: Business Continuity Management, Resilience Management, Organisational Resilience, Building Resilience
COUNTRY: Malaysia
METHODOLOGY: Field Study, Interview and Questionnaire

Bhamra, R., Dani, S. & Burnard, K. (2011) Resilience: the concept, a literature review and future direction. *International Journal of Production Research, Vol.49, No. 18, p. 5375-5393*

This article explores resilience focusing on SMEs. A literature review taking an interdisciplinary perspective was undertaken seeking to review the concept of resilience as applied to any scale and to identify gaps and opportunities in relation to understanding SME resilience. The authors find that work to date has focused on building theories and definitions with little work seeking to empirically test those theories. They suggest more empirical work is needed to ensure the translation of theory into real-world actions able to be taken by SMEs.

DEFINITION OF RESILIENCE: Resilience is the capability and ability of an element to return to a stable state after a disruption.
KEY WORDS: resilience, literature review, risk, uncertainty, disaster preparedness, business continuity
COUNTRY: UK
METHODOLOGY: Literature Review

Boin, A. & McConnell, A. (2007) Preparing for Critical Infrastructure Breakdowns: The Limits of Crisis Management and the Need for Resilience. *Journal of Contingencies and Crisis Management*, 15(1), 50-59.

This article focuses on our dependence upon critical infrastructure, and therefore our increased vulnerability to disruption to that infrastructure. The authors suggest the complexity and coupling of these systems increases the potential for multiple breakdowns and 'compound' crises. The authors suggest that traditional crisis-management responses, particularly the notion that we can prevent or plan for these crises, are not sufficient to deal with these events and that building societal resilience should therefore be a priority. They believe that resilience is what enables an effective response in the first hours and days following a crisis whilst strategic leadership only becomes effective in the longer run (weeks to months). They then suggest strategies to enhance societal resilience including preparing potential first responders, promoting business continuity planning for organisations and ensuring communication with communities in preparing contingency plans. Collaboration is emphasized as important with joint efforts by private, public and government needed. The authors then identify a number of barriers to enhancing resilience including the mind-sets of it won't happen here or to us, the lack of flexibility within organisations, the costs of preparation, an inclination to top-down structures and overall socio-economic disparities.

DEFINITION OF RESILIENCE: The ability to bounce back after suffering a damaging blow
COUNTRY: The Netherlands/Australia
METHODOLOGY: Conceptual

Braes, B. & Brooks, D. (2010) Organisational Resilience: A Propositional Study to Understand and Identify the Essential Concepts. ***Proceedings of the 3rd Australian Security and Intelligence Conference, Edith Cowan University, Perth, Western Australia,*** **30 November.**

The authors argue that resilience is not an overarching philosophy, strategy, process or system but a foundation comprising the outcomes from many applied domains – "a sum of essential concepts". The authors propose 20 characteristics of Organisational Resilience, although with limited discussion about their origins. These include a list of organisational and strategic traits along with contributors and tactical steps. The authors then outlined their proposed process to review those indicators including comparison with Standards currently published in the USA, Netherlands and Denmark, expert panels and interviews to establish a hierarchy of significance.

DEFINITION OF RESILIENCE: Quality or fact of being able to recover quickly or easily from, or resist being affected by a misfortune, shock, illness etc.
COUNTRY: Australia

Carley, K.M. (1997) Organisational Adaptation. ***Annals of Operation Research,*** **75, 25-47.**

This article examines successful adaptation from the perspective of organisational design. Computational analysis and distributed artificial intelligence are used to explore adaption and organisational form within single organisations. Both strategic and operational level change is explored with an organisation viewed as a system than can adapt and that is filled with adaptive agents. Findings include issues around disengagement of staff as organisation size increases. Organisational learning occurs not just within individual agents but also as a function of the connections between them and between people and tasks. Carley suggests that there is no one optimal form and that altering organisational structure can improve organisational adaptation and performance.

COUNTRY: USA
PERSPECTIVE : Operations research
METHODOLOGY: Experimental modelling

Coutu, D.L. (2002). How Resilience Works. ***Harvard Business Review,*** **May.**

Coutu (2002) argues that individual resilience traits also apply to organisational resilience. Traits include an acceptance of reality, a belief that life is meaningful, and an ability to improvise. To be truly resilient requires all three capabilities. Accepting reality is about an organisation not only being honest about the situation they face but also being prepared for the 'toughest reality'. Creating meaning even in the face of challenging circumstances allows organisations to avoid being overwhelmed by the situation and is related by the author to asking "Why not me?" rather than the cry of "Why me?". In the organisation context, meaning is created in strong values systems. The author notes that resilience does not equal good, with values potentially perceived as negative still creating resilience. The ability to improvise also referred to as bricolage refers to an organisation creating solutions to problems despite an absence of proper or obvious tools to do so. The author also notes the ability of strong rules and regulations to provide sufficient structure, which also allows the energy needed for creativity when the situation demands.

Dalziell, E. & McManus, S. (2004) Resilience, vulnerability, and adaptive capacity: implications for system performance. ***Presented at the International forum for Engineering Decision Making (IFED), Stoos, Switzerland, December 6-8***

This conference paper suggests a potential framework for evaluating the resilience of organisations and defines resilience as a function of both the vulnerability of the system and its adaptive capacity. Discusses the differences between ecological and engineering resilience and determines that ecological resilience is a more appropriate paradigm for the complex open systems that comprise organisations. This discussion leads to the conclusion that resilience is about recovering to a new equilibrium not returning to what was before. The authors argue there is a need for metrics to enable measurement of organisational actions to develop resilience and the discusses the difficulties of doing so.

DEFINITION OF RESILIENCE: the qualities that enable an organisation to cope with adapt to and recover from a disaster event.

KEY WORDS: Resilience, Organisations, Systems, Vulnerability, Recovery
COUNTRY: New Zealand

Demmer, W.A., Vickery, S.K., & Calantone, R. (2011) Engendering resilience in small-and medium-sized enterprises (SMEs): a case study of Demmer Corporation. International Journal of Production Research, Vol. 49, Iss. 18, 5395-5413

This article also focuses on SMEs using one case study of an organisation, which based on its longevity and performance is classed as resilient. The authors seek to consider resilience criteria developed in the context of large organisations and test their applicability to this case. They take strategic view of resilience as relating to ongoing change as well as crisis. Based on prior literature, antecedents of resilience considered in this study are:

- Elimination of allegiance to the status quo
- An emphasis on internal knowledge sharing
- A search for new knowledge
- Aggressive identification of new options and opportunities
- Externalization of some innovation
- Support of a portfolio of strategic experiments
- Renewal an equal partner with optimization

Overall, they conclude that resilience antecedents identified in prior literature are applicable in the SME context; however, the SME in this case has 1500 employees and a turnover of $600 million.

Additional facilitators of resilience identified as relevant in this case are:

- Top managers as champions of innovation
- Mission focused organic organisational structure
- Robust strategic planning process with entrepreneurial focus
- Embedding of the company with major customers
- Investing in human resources

DEFINITION OF RESILIENCE: a firm's ability to continually evolve and thrive over time in the face of adverse and sometimes hostile circumstances which naturally arise in dynamic environments
KEY WORDS: SMEs, resilience, manufacturing performance, enterprise renewal
COUNTRY: USA
METHODOLOGY: Case Study

Gittell, J.H., Cameron, K., Lim, S., Rivas, V. (2006) Relationships, Layoffs, and Organisational Resilience: Airline Industry Responses to September 11. *The Journal of Applied Behavioural Science*. 42(3), 300-329.

This article considers the performance of the US airline industry following the widespread downturn in air-travel after the September 11, 2001 terrorist attacks seeking to understand why some organisations struggled while others recovered. They found that staff layoffs intended to bolster financial performance had a negative effect on recovery. They discuss the strong link between a viable business model which allows for preservation of relational reserves which feedback to financial reserves and contribute to resilience. They found that accepting the short-term financial impacts of excess staffing is beneficial for resilience in that it fosters an innovative and cohesive response to crisis. Their conclusions in line with earlier work by Meyer (1982) are that "financial reserves coupled with a strong commitment to employees are pivotal to an organisations ability to cope with environmental jolts". Positive relationships are discussed as being a prerequisite of organisational resilience.

DEFINITION OF RESILIENCE: Recover from or adjust easily to misfortune or change
KEY WORDS: Resilience, layoffs, relational reserves, financial reserves, crisis
COUNTRY: USA
METHODOLOGY: Publicly Available Data - Case Studies

Hamel, G., & Valkingas, L. (2003) The Quest for Resilience. *Harvard Business Review,* September.

This article views resilience primarily from a strategic perspective arguing that the only way to maintain competitive advantage in an ever-changing world is to be able to "reinvent your business model before circumstances force you to". The authors discuss how difficult this is to achieve for companies accustomed to relative success in benign environments. They suggest four challenges that organisations need to address to become resilient:

- The cognitive challenge – similar to Weick's attitude of wisdom whereby an organisation is continually conscious of changes occurring and willing to review the impact of those changes, free from arrogance, denial or nostalgia
- The strategic challenge – the ability to innovate and create new options
- The political challenge – the ability to divert resources to experiment with new futures
- The Ideological challenge – balancing optimization of current processes with the ability to innovate, experiment and adapt

DEFINITION OF RESILIENCE: the ability to dynamically reinvent business models and strategies as circumstances change.
COUNTRY: USA
METHODOLOGY: Conceptual

Hornell, J.F. & Orr, J.E. (1998) Assessing Behaviors that create Resilient Organisations *Employment Relations Today,* Winter.

Outlines how organisational resilience offers a practical response to a world now characterized by rapid and discontinuous change. The authors differentiate between resilient individuals and resilient organisations specifying that strong resilient individuals can be a weakness in the organisational context if they override the vision of others.

Seven major contributors to resilience are identified along with discussion as to how they overlap to create an interlinked whole of system response. Contributors to resilience include:

- Community - described as the internalized understanding of people within the company as to their mission, vision and values.
- Competence - the fit of capacity to conditions.
- Connections – Relations within the organisation
- Commitment – Ability to work together maintain trust and goodwill
- Communication – Sharing of relevant information
- Co-ordination – Linking of efforts to achieve results
- Consideration – Acknowledging the stresses of change on human capital

Explains the development of an Organisational Resilience Inventory, which is a 74-item assessment tool, designed to identify the occurrence of the behaviours above. Identifies how this measurement tool can be used to assist in developing resilience initiatives. No copy of the assessment tool is provided.

DEFINITION OF RESILIENCE: to respond productively to significant change that disrupts the expected pattern of events without engaging in an extended period of regressive behaviour.
COUNTRY: USA

Hutter, G. (2011) Organising social resilience in the context of natural hazards: a research note. *Natural Hazards*. 67 (1), 47-60.

Hutter argues that social resilience may be a helpful concept in the field of natural hazard research and practice but that research into resilience should end, rather than start with a definition. Hutter synthesizes the contribution organisational theory can make to natural hazard studies in terms of framing the resilience concept. The author frames resilience as constituting the opposing behaviours from those identified by Staw in work on Threat-Rigidity effects on Organisational Behaviour. A broadening of information processing and a loosening of control characterize resilient responses and building and utilizing slack resources.

DEFINITION OF RESILIENCE: The intrinsic ability of an organisation (or system) to maintain or regain a dynamically stable state, which allows it to continue operations after a major mishap and/or in the presence of continuous stress.
KEY WORDS: Floods, Organising, Radical Change, Resilient response, Small groups, Threat-rigidity thesis
COUNTRY: Germany

Ismail, H.S., Poolton, J. & Sharifi, H. (2011) The role of agile strategic capabilities in achieving resilience in manufacturing-based small companies, *International Journal of Production Research*. 49 (18), 5469-5487.

This article suggests that SMEs should aspire to a state of 'strategic readiness' developed through a top down planning approach to building resilience. They incorporate the perspective of operational agility, usually conceptualized as an operational bottom up process, with insights from organisation strategy to argue that achieving resilience requires a top down approach to developing internal capabilities as well as considering alternative strategies to ensure growth. The lack of strategic planning in SMEs and the resultant vicious circle of little planning due to constant fire fighting is discussed. They argue that strategic agility is built by considering current and future capability needs against a variety of future scenarios in order to develop a degree of readiness for those various different futures. Strategic management tools are adapted to fit the SME perspective and implemented in two manufacturing organisations. The process of enacting the strategic readiness process has resulted in improvements to organisations internal capabilities.

DEFINITION OF RESILIENCE: the maintenance of positive adjustment under challenging conditions (Weick)
KEY WORDS: resilience, agility, strategic planning
COUNTRY: UK
METHODOLOGY**:** Case Study

Lee, A.V., Vargo, J., Seville, E., (2013) Developing a Tool to Measure and Compare Organisations' Resilience, *Natural Hazards Review*. 14, 29-41.

This paper develops a survey tool to enable organisations to measure and compare organisational resilience. Rather than adopting lagging measures, which would consider retrospective events, the tool adopts leading indicators, which measure "observable processes, actions and practices that contribute towards resilience". The authors emphasize the links between resilience and competitiveness suggesting that efforts to improve organisational resilience will be of benefit to performance in 'normal' as well as crisis times. A model of organisational resilience is developed and tested using a survey of Auckland organisations. The initial model is based on factors identified in prior literature; particularly on the theses of McManus (2008) and Stephenson (2011). Following testing, an adjusted two factor solution comprising 13 indicators is presented that is supported by the survey data. The indicators are: minimization of silos, internal resources, staff engagement and involvement, information and knowledge, leadership, innovation and creativity, decision making, situation monitoring and reporting, planning strategies, participation in exercises, proactive posture, external resources, and recovery priorities.

DEFINITION OF RESILIENCE: Discussed but not defined
KEY WORDS: Organisational Resilience, Measuring Resilience; New Zealand, Planning, Adaptive Capacity
COUNTRY: New Zealand
METHODOLOGY: Quantitative

Mallak, L. (1998) Putting Organisational Resilience to Work. *Industrial Management*, Nov-Dec.

This magazine style article reviews resilience research and practice from psychology and crisis management to derive principles for organisational resilience. Practice focused article that suggests the following principles for developing organisational resilience:
1. Perceive experiences constructively.
2. Perform positive adaptive behaviours.

3. Ensure adequate external resources.
4. Expand decision-making boundaries.
5. Practice bricolage.
6. Develop tolerance for uncertainty.
7. Build virtual role systems.

DEFINITION OF RESILIENCE: how to design and implement positive adaptive behaviours quickly that are matched to the immediate situation – while enduring minimal stress all the while
COUNTRY: USA

McManus, S., Seville, E., Vargo, J., & Brunsdon, D., (2008) Facilitated Process for Improving Organisational Resilience. *Natural Hazards Review,* 9 (2), 81-90.

This article argues that organisational resilience is not just a crisis management or emergency issue, instead linking resilient daily operation to the ability to respond to crisis. Three attributes of a resilient organisation are discussed; situation awareness, management of keystone vulnerabilities and adaptive capacity. A facilitated process to enable organisations to critically assess and improve these attributes is suggested. This process works within existing organisational planning strategies providing a holistic platform to develop resilience, integrating it into day-to-day operation rather than addressing it solely through crisis or risk plans. Tools in this process include consequence scenarios, selection of essential organisational components and accompanying vulnerability assessments, identification and prioritization of keystone vulnerabilities and readiness and disaster simulations to improve adaptive capacities.

DEFINITION OF RESILIENCE: Resilience is a function of an organisation's overall situation awareness, management of keystone vulnerabilities, and adaptive capacity in a complex, dynamic and interconnected environment
KEY WORDS: New Zealand, Resilience, Risk Management, Organisations, Planning
COUNTRY**:** New Zealand
METHODOLOGY: Case Study

Nilakant, V., Walker, B., Van Heugten, K., Baird, R., De Vries, H. (2014) Research Note: Conceptualising Adaptive Resilience using Grounded Theory. *New Zealand Journal of Employment Relations.* 39 (1), 79-86.

This article presents the initial findings of an empirical study on the resilience of critical infrastructure organisations following the Canterbury earthquakes of 2010-11. Interviews with 200 employees from 11 organisations are analysed using a grounded theory methodology. Four key enablers of adaptive resilience are identified. These are:

- Quality of top AND middle level leadership
- Quality of external and internal linkages and collaboration
- Ability to learn from experience
- Staff well-being and engagement

The authors conclude that resilience is a process and that it is highly contextual.

DEFINITION OF RESILIENCE: Adaptive resilience – dynamically responding to emergent situations that are outside of their plans
COUNTRY: New Zealand
METHODOLOGY: Interviews, Grounded Theory

Rapaport, C. & Kirschenbaum, A. (2008) Business continuity as an adaptive social process. *International Journal of Emergency Management.* 5, (¾), 338-347.

This study examines the response of 13 organisations in northern Israel who were impacted by an on-going rocket bombardment in 2006. The majority of these organisations continued to operate despite the risk and disruption. The authors state that business continuity is a social process determined less by plans or drills and more by adaptive behaviours of employees. Employees past experiences, family and community attitudes, and social relations within the workplace determine those adaptive

behaviours. Employees rather than management were the source of improvisation necessary to enable operation but were enabled by a management approach, which enabled adaptive behaviours and enhanced a positive social environment for employees.

KEY WORDS: business continuity, adaptation, social networks, organisational response
COUNTRY: Israel
METHODOLOGY: Field Study, Interview and Questionnaire

Sheffi, Y., & Rice Jr, J. B. (2005). A supply Chain View of the resilient Enterprise. *MIT Sloan Management Review*, *47* (1).

This article makes the case for resilience to be a strategic initiative with benefits for both competitiveness and the ability to bounce back from disruption. They state that both redundancy and flexibility need to be built into supply chain to achieve greater resilience. Part of building flexibility is organisational systems or processes that allow early detection of disruption and a culture that allows information to be heard and acted upon. This includes the idea of empowering front-line employees to use initiative with distributed decision making.

DEFINITION OF RESILIENCE: The ability to bounce back from a disruption
COUNTRY: USA
METHODOLOGY: Case Studies

Seville, E., Van Opstal, D. & Vargo, J. (2015) A Primer in Resiliency: Seven Principles for Managing the Unexpected. *Global Business and Organisational Excellence*. March/April, 6-18.

This article views organisational resilience as a key strategic competency, which is necessary for organisations to remain competitive, not just as a response to crises. The authors characterize change and unpredictability to be the norm and classify our current era as the "Age of Turbulence". Resilience is linked not only to surviving in this era but also to enabling the identification of opportunity even in adversity. They recommend organisations develop a resilience program aligned with the following seven principles:

- Make adaptive capacity a core competency
- Develop leaders that people want to follow
- Become a learning organisation
- Build Social Capital
- Practice resilience as a team sport
- Design resilience into Operational Excellence
- Look beyond risks to see Opportunities

Within each principle, the means to develop these attributes are discussed and examples from a variety of cases given to illustrate the application and value of the principle.

DEFINITION OF RESILIENCE: The ability to survive and thrive
COUNTRY: New Zealand/USA
METHODOLOGY: Conceptual

Seville, E., Brunsdon, D., Dantas, A., Le Masurier, J., Wilkinson, S. & Vargo, J. (2008) Organisational resilience: Researching the reality of New Zealand Organisations, *Journal of Business Continuity and Emergency Planning*, 2 (3), 258-266.

This paper takes a systems view of resilience arguing that effective resilience management requires an organisation to consider its multiple interdependences alongside its own resilience. Drawing from a review of the literature, resilience is defined as a function of an organisation's:

- Situation Awareness
- Management of keystone vulnerabilities
- Adaptive Capacity

The authors suggest that resilience issues are more influenced by the less tangible aspects of an organisation including its culture, leadership and vision. Improving resilience requires an on-going commitment and acknowledgement of collective, rather than individual responsibilities.

DEFINITION OF RESILIENCE: The ability to survive, and potentially even thrive, in times of crisis.
KEY WORDS: Resilience, Crisis Response, Organisations, Vulnerability, Adaptive Capacity, Situation Awareness
COUNTRY: New Zealand

Stark, A. (2014) Bureaucratic Values and Resilience: An Exploration of Crisis Management Adaptation, *Public Administration,* 92 (3), 692-706.

This article discusses resilience in the context of large public sector bureaucracies involved in crisis management activities. Interviews are carried out with 25 civil servants from the European Commission and United Kingdom. The author discusses the perceived lack of flexibility highlighted in official reports into some aspects of crisis response in the UK, New Zealand and Australia. Creating an adaptive organisation is identified as key to overcome these identified failings; however, the particular institutional values that 'envelop the bureaucrat' may hinder this adaptive capacity. In particular the public sector endeavour to create both structural and financial efficiency – to find ways to always do more with less hinders the adaptive capacity of an organisation. Countering this are the people within the organisations who may seek to innovate and create flexibility despite the environmental constraints. The issue of post-crisis accountability is also discussed as a potential barrier to innovation outside of normal organisational procedures. This article highlights the importance of organisational culture and structure on an organisations adaptive capacity and the important issue of considering how people within those environments can still be empowered to innovate and adapt when necessary.

DEFINITION OF RESILIENCE: Continuously adapt to unremitting environmental fluctuations (Gunderson)
COUNTRY: UK/Europe
METHODOLOGY: Semi-Structured Interviews

Stevenson, J.R., Chang-Richards, Y., Conradson, D., Wilkinson, S., Vargo, J., Seville, E., & Brunsdon, D., (2014) Organisational Networks and Recovery Following the Canterbury Earthquakes, *Earthquake Spectra,* 30 (1), 555-575.

This article focuses on the role of networks in organisational resilience following the Canterbury earthquake sequence of 2010-11. The social and economic connectivity of organisations from all sectors is noted as extremely important in shaping recovery. Longitudinal case studies are used to examine recovery trajectories and examine the role of networks in supporting recovery. The authors found that impacted organisations received the majority of support from within the effected region and that this support helped to reinforce a sense of community. Support networks were used to redistribute workloads and to cope with resource shortages. For many organisations, the disaster was the stimulus for organisational review and the formation of beneficial partnerships.

DEFINITION OF RESILIENCE: An organisation's ability to resist the negative impacts of a crisis, to maintain or quickly restore its functionality, and to incorporate positive adaptive changes.
COUNTRY: New Zealand
METHODOLOGY: Case Studies

Sutcliffe, K.M. & Vogus, T.J. (2003) *Organising for Resilience,* in Cameron, K.S., Dutton, J.E. & Quinn, R.E. (Eds.) Positive Organisational Scholarship, San Francisco, Berrett-Koehler.

This book chapter frames organisational resilience within the growing field of positive organisational scholarship arguing that a resilience perspective "promotes a new way of seeing" that runs counter to existing theory which suggests organisations will react rigidly when faced with threats. The concept of resilience allows us to begin to specify and explain how it is that some organisations are still effective despite the adversity they face. The authors link resilience not only to crisis but also to the rapidly changing environment. The authors review literature from individual resilience, organisational

learning and adaptation, dynamic capabilities and high-reliability organisations and propose the following model of resilient or rigid responses. This model is suggested as a conceptual starting point for developing theory and conducting empirical research.

DEFINITION OF RESILIENCE: Positive adjustment under conditions of adversity. How organisations continually achieve desirable outcomes amid adversity, strain and significant barriers to adaptation or development
COUNTRY: USA
METHODOLOGY: Conceptual

Tierney, K. (2003) *Conceptualising and Measuring Organisational and Community Resilience: Lessons from the Emergency Response following the September 11, 2001 Attack on the World Trade Centre*. University of Delaware Disaster Research Center Preliminary Paper 329.

This article considers how the responses to the World Trade Centre attacks serve as an important case study in how organisations and communities can achieve resilience in the event of an unprecedented and unplanned for disaster. The author suggests resilience consists of the following properties:

- Robustness – withstand stress without loss of function
- Redundancy – the existence of alternative elements or systems that can perform if primary units are damaged
- Resourcefulness – ability to identify problems, prioritise and mobilise resources
- Rapidity – capacity to achieve aims in a timely manner

The responses to the World Trade Center events highlight the importance of resourcefulness and the importance of being able to manage emergent resources. Management of resources was enabled by loose coupling whereby organisations were able to focus on specific tasks while also maintaining links to the bigger picture. Additionally, a common vision developed by the managing entities enabled the resource mobilization. Weick's term of collective sense-making is related to this concept of resourcefulness in that organisations responding to the disaster actively created their environments rather than simply passively reacting to the events. Emergent networks and enacted environments were the product of social activity that enabled collective sense-making.

DEFINITION OF RESILIENCE: The ability to adjust to normal or anticipated stresses and strains and to adapt to sudden shocks and extraordinary demands
COUNTRY: USA
METHODOLOGY: Case Study

Valkingas, L., Georges, A., & Romme, L. (2013) How to Design for Strategic Resilience, *Journal of Organisational Design*. 2 (2), 44-53.

This article examines one large US retailer to understand its quest to develop resilience. This retailer initiated a resilience project due to the belief of the CEO that a whole company approach was needed to identify future threats and opportunities. The author spent a period of 18 months as a participant observer of the organisation. Senior management determined a grassroots approach to building capability with activities persisting for 18 months until a new COO, appointed due to poor financial results cut the program, despite its low cost.

The authors suggest three key conditions for organisational resilience:

- Generative doubt – despite the company's excellent performance to date, the CEO questioned the organisations potential future performance. The CEO recognized a need to develop sensing and learning capabilities throughout the organisation.
- Organisational slack – a history of stable performance allowed slack, which enabled innovative activity.
- Mindful engagement – Continually questioning and reassessing the organisation enabled that slack to be directed towards resilience initiatives.

DEFINITION OF RESILIENCE: Strategic Resilience – Benefit from and act on serendipity inherent in unfolding change with its many uncertainties

KEY WORDS: Resilience, organisational resilience, strategic resilience, organisation design, mindfulness, generative doubt, slack resources, leadership
COUNTRY: USA
METHODOLOGY: Case Study

Vogus, T. J. & Sutcliffe, K. M. (2007) Organisational resilience: towards a theory and research agenda. *Systems, Man and Cybernetics*, 2007. ISIC. IEEE International Conference, 3418-3422.

This conference paper suggests that existing organisational theory is inadequate to answer questions about why some organisations thrive and others crumble in the event of disruption. The authors state that a new theory of organisational resilience is necessary and "outline the contours" of such a theory. The authors suggest that resilience requires both avoidance of error by design, and sufficient monitoring and simulation to allow for swifter detection of threatening events which are not anticipated. The article outlines potential affective, cognitive, relational, and structural mechanisms that contribute to resilience. This is a conceptual piece that sets out a research agenda of a broad range of questions that need to be empirically tested to progress theory.

DEFINITION OF RESILIENCE: the maintenance of positive adjustment under challenging conditions such that the organisation emerges from those conditions strengthened and more resourceful
COUNTRY: USA

Vargo, J. & Seville, E. (2011) Crisis strategic planning for SMEs: finding the silver lining. *International Journal of Production Research,* 49 (18), 5619-5635.

This article proposes a model combining knowledge from crisis management and strategic planning to assist organisations in thinking strategically in the midst of a crisis. This approach enables organisations to more clearly see the opportunities, and not just the challenges resulting from a crisis situation, giving the potential to not just survive but also thrive. The importance of leadership, culture, decision-making and situational awareness are essential to enabling this strategic thinking in crisis situations. Finding an appropriate balance between planned and adaptive approaches to these enablers is necessary for achieving resilience. Three case studies are considered resulting in a summary of potential types of organisational resilience relating to their tendencies for either planning or adaptation across the four enablers. This model assists organisations in reviewing how their tendencies may impact on the type of resilience they can achieve.

DEFINITION OF RESILIENCE: The ability of an organisation not only to survive but to thrive, both in good times and in the face of adversity.
KEY WORDS: Resilience, organisations, strategic planning, opportunities, crisis management, SMEs
COUNTRY: New Zealand
METHODOLOGY: Case Study

Weick, K.E. (1993) The collapse of sensemaking in organisations: The Mann Gulch Disaster, *Administrative Science Quarterly,* 38, 4, 628-652.

This article is now a highly cited work, which provides the foundations of some of the key organisational resilience principles discussed in later works. The article reanalyses the events of a forest fire disaster, which claimed the lives of 13 fire-fighters through the lens of organisational theory. Weick considers what went wrong and how that can inform the development of resilience which he describes as preventing organisations from 'unravelling'. Weick found that a loss of organisational structure led to a loss of sense-making which ultimately caused the tragedy. He suggests four sources of resilience, which may have prevented the disintegration of the group. Firstly, improvisation and bricolage which means to construct something from whatever is at hand. This involves being able to remain creative under pressure and improvise solutions no matter what the constraints. Secondly, virtual role systems, whereby members of an organisation are able to mentally assume the roles of others understanding their perspectives even when tangible contact is lost. Thirdly, Weick argues that an attitude of wisdom, which is characterized by curiosity, openness and complex sensing, is needed. This attitude strikes a balance between over-confidence and over-cautiousness, allowing experience but also doubt to influence situational assessment. Finally, he identifies the need for respectful interaction where individuals respect the input of others and are willing to base actions on them. This relates to

the basic principles of trust, honesty and self-respect. The importance of structure in preventing collapse is discussed along with the importance of leadership in creating and maintaining that structure and related meaning.

COUNTRY: USA
METHODOLOGY: Case Study

Weick, K.E. (2015) Ambiguity as Grasp: The Reworking of Sense. *Journal of Contingencies and Crisis Management,* pre-print (2015).

This article builds upon the attitude of wisdom discussed in his 1993 article suggesting that high reliability organisations achieve this attitude of wisdom through grasping, rather than minimizing ambiguity. "Grasp is the acceptance that behind ambiguity lies more ambiguity, not clarity". Weick sets out a framework with behaviours to move towards the actual practice of managing ambiguity suggesting the following mind-sets:

- Every experience should count – no event is the same as prior experience as you are not the same.
- Every experience can be deepened – expand upon the meaning of each experience.
- Every experience is sifted conceptually – acknowledge and then re-examine facts and relations that were at first discarded.
- Every experience makes sense – make sense of ambiguity by using the resources of social context, identity, retrospect, salient cues, on-going projects, plausibility and enactment.
- Every experience is composed of wary improvisation – a response that is both adaptive or ad-hoc and based on 'know how'.

COUNTRY: USA
METHODOLOGY: Conceptual

Whitman, Z.R., Kachali, H., Roger, D., Vargo, J., Seville, E. (2013), Short-form version of the Benchmark Resilience Tool (BRT-53), *Measuring Business Excellence,* 17 (3), 3-14.

This paper explains the development and validation of a short form measurement tool for assessing organisational resilience. The short-form benchmark resilience tool is based upon the model and survey developed through the theses of McManus (2008) and Stephenson (2010) and refined as discussed above in Lee et al (2013). The deployment of that survey by these authors following the Canterbury earthquakes of 2010-2011 provides experience and insights to improve that tool, including the need to develop a shorter instrument in order to reduce the commitment of time and energy required from respondents. The validity and reliability of this newly developed short form tool are tested against three datasets.

DEFINITION OF RESILIENCE: The ability to plan for, respond to and recover from emergencies and crises.
KEY WORDS: Resilience, Short-form, Organisational performance, Quantification methodology, corporate strategy, information modelling
COUNTRY: New Zealand
METHODOLOGY: Quantitative

Whitman, Z., Stevenson, J., Kachali, H., Seville, E., Vargo, J., Wilson, T., (2014) Organisational Resilience following the Darfield earthquake of 2010. *Disasters.* 38 (1), 148-177.

This study of organisational recovery following the September 2010 Canterbury earthquake includes urban, farming, and rural non-farm organisations. The survey took place prior to the second damaging earthquake that occurred in February 2011. Factors identified as most significant in mitigating disruption to organisations' operations were building strength, relationships with staff and non-interruption or swift resumption of critical services. The biggest challenge for organisations was staff wellbeing.

DEFINITION OF RESILIENCE: Organisational attributes that mitigate the effects of disasters and allow organisations to adjust to possible damaging changes post-disaster

KEY WORDS: Canterbury, Darfield, disaster, earthquake, organisation, resilience
COUNTRY: New Zealand
METHODOLOGY: Surveys, Quantitative analysis

Zaato, J.J., & Ohemeng, F.L.K., (2015) Building Resilient Organisations for Effective Service Delivery in Developing Countries: The experience of Ghana Water Company Limited. *Forum for Development Studies,* in press.

This article argues that the perspective of organisational resilience offers much help to developing nations, which often face significant challenges in creating public sector organisations capable of driving development. After an extensive discussion of extant literature the reforms undertaken by the Ghana Water Company are contrasted with resilience attributes. This article is significant in that it applies the principles of organisational resilience to the challenges faced by developing countries of developing effective public organisations that are able to drive development.

DEFINITION OF RESILIENCE: Organisations able to anticipate events in the environment, adapt to change, and rapidly rebound from failures
KEY WORDS: Developmental state, Ghana, resilience, resilient organisation, service delivery
COUNTRY: Ghana
METHODOLOGY: Conceptual, Case Study

British Standards Institute. (2015) BS65000:2014 Guidance on Organizational Resilience. Online, Available from www.bsigroup.com.

Published in November 2014, BSI says "the new standard BS 65000 provides clarity and guidance, describing the nature of resilience and ways to build and enhance resilience in your organisation. BS 65000 defines organisational resilience as the ability to anticipate, prepare for, respond and adapt to events – both sudden shocks and gradual change. That means being adaptable, competitive, agile and robust.

One way to improve resilience is by integrating and coordinating the various operational disciplines in an organisation, so BS 65000 draws on other standards relating to these disciplines. Most organisations work within a complex web of interactions. The standard recognises that it is essential to build resilience not only within an organisation but also across networks and in partnership with others.

Using agreed terminology, BS 65000:

- Clarifies the meaning of resilience,
- Highlights the key components of resilience,
- Helps an organisation to measure its resilience and make improvements,
- Identifies good practice found in other disciplines and defined in existing standards

BS 65000 will be very valuable to anyone responsible for building resilience in their organisations. That includes risk managers and continuity practitioners and those involved with governance, emergency management and supply chain management.

To demonstrate the global value of this standard, ISO (International Organisation for Standardization) is developing ISO 22316 – *Organisational Resilience* which is due to publish in 2016, and BS 65000 is providing the basis for this standard"

See http://shop.bsigroup.com/ProductDetail/?pid=000000000030258792

Commonwealth of Australia, (2011) *Organisational Resilience: Australian Case studies*. Position Paper for Critical Infrastructure, p.43. Online, Available from http://www.tisn.gov.au/Documents/Organisational+Resilience+PDF.pdf.

This position paper from the Australian Government presents resilience as the ability to bounce back and also potentially forwards,

"The REAG has identified three broad behavioral attributes of resilience, which are detailed below:

Leadership and culture

The leadership and cultural attributes include:

- Develops an organisational mindset/culture of enthusiasm for challenge, agility, flexibility, adaptive capacity, innovation and taking opportunity
- Promotes a consistent and transparent organisational commitment to a resilience culture, values and vision, including a belief of 'one in – all in'
- Fosters an environment that supports agility, flexibility and initiative in decision making through trust, clear purpose and empowerment of employees
- Encourages increased personal resilience by employees, and
- Boards and senior executives engage and provide leadership appropriate to their position on organisational resilience.

Networks

The network attributes include:

- Establishes relationships, mutual aid arrangements and regulatory partnerships
- Understands an organisation's community interconnectedness and its vulnerabilities across all aspects of supply chains and distribution networks, and
- Promotes open communication and mitigation of internal and external silos

Change ready

The change ready attributes include:

- Promotes proactive anticipation and preparation for future challenges
- Develops a forewarning of disruption threats and their effects through sourcing a diversity of views, increasing sensitivity and alertness, and understanding social vulnerability
- Promotes empowered and broadly embraced organisational and individual self-efficacy, as well as enthusiasm for finding effective solutions to complex challenges
- Promotes requisite decision making using both rational and intuitive abilities, and
- Promotes critical reflective learning, lesson retention, knowledge sharing and continuous improvement"

U.S. Department of Homeland Security. (2014) *Resilience*. Official website of the Department of Homeland Security. Online, Available from http://www.dhs.gov/topic/resilience.

"The term "resilience" refers to the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies. Whether it is resilience towards acts of terrorism, cyber attacks, pandemics, and catastrophic natural disasters, our national preparedness is the shared responsibility of all levels of government, the private and non-profit sectors, and individual citizens." The United States officially recognized resilience in national doctrine in the 2010 National Security Strategy, which states that, "we must enhance our resilience—the ability to adapt to changing conditions and prepare for, withstand, and rapidly recover from disruption." The U.S. Department of Homeland Security also recognized resilience in the 2014 Quadrennial Homeland Security Review, which established a series of goals and objectives in the areas of critical infrastructure, global movement and supply chain systems, and cyberspace."

7 Social & Community Resilience

Allan, P., Bryant. M. (2011). Resilience as a framework for urbanism and recovery. *Journal of Landuse Architecture*. 6(2), 34-45.

This paper proposes the concept of resilience as a way of aligning the common interests of recovery planning and urban design to provide healthy and safe urban communities. The authors focus much of their critique of current approaches to urban design and recovery on the neglect of holistic urban design evaluations, noting that relatively few studies consider the role of urban space in facilitating urban recovery and improving urban function. The paper uses two case studies of post-earthquake recovery: the 1906 San Francisco earthquake and the 2010 earthquake in Concepcion, Chlie evaluating each city's urban morphology and its relationship with it's disaster recovery process. They extrapolate lessons from these events to inform the reconstruction of Christchurch, New Zealand following the 2010/2011 series of earthquakes. The paper ultimately draws two implications for pre- and post-disaster urban design: "The resilience framework and its attributes are important tools for the evaluation and design for earthquake prone cities," which characterizes resilience as a conceptual approach and framework for evaluating urban planning decisions; and "The implementation of the framework in practice" which the authors argue requires shifting the discourse of recovery to provide holistic perspectives of cities' unique conditions.

DEFINITION OF RESILIENCE: The authors use a definition of ecological resilience developed by Walker et al. (2004), where resilience is "the capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks". (Walker, Holling, Carpenter & Kinzi8 2004)" (p.39).

KEY WORDS: Adaptability, landscape architecture, recovery, resilience, urban design

COUNTRY: New Zealand

PERSPECTIVE: Urban planning

METHODOLOGY: Critical analysis

ARUP. (2014) *City Resilience Index: City Resilience Framework*. London, Ove Arup & Partners International Limited. Online, Available from: http://www.arup.com/cri.

The purpose of this report is to provide an "accessible, evidence-based articulation of city resilience," (p.3). The report presents resilience as a relevant construct for cities facing disasters and climate change - highlighting the resilience focus on enhancing overall performance and on flexibility and adaptability in contrast to risk management which relies on knowledge about specific hazards and their possible consequences. The authors align themselves with systems based approaches to urban problem solving (as opposed to asset-based approaches) to ensure that components within a system are accounted for as well as the connections between those components and connections at different scales. There are three key conceptual outputs of this report: 1) The seven qualities of resilient cities, 2) The 8 city functions that are critical to resilience, and 3) the 12 key themes that need to be addressed in contribute to city resilience. The qualities are: reflective, robust, redundant, flexible, resourceful, inclusive, and integrated. The 8 city functions that are critical to resilience include: delivers basic needs; safeguards human life; protects, maintains and enhances assets; facilitates human relationships and identity; promotes knowledge; defends the rule of law, justice, and equity; supports livelihoods; stimulates economic prosperity. The 12 key themes or indicators are: minimal human vulnerability; diverse livelihoods and employment; adequate safeguards to human life and health; collective identity and mutual support; social stability and security, availability of financial resources and contingency funds; reduced physical exposure and vulnerability; continuity of critical services; reliable communications and mobility; effective leadership and management; empowered stakeholders; integrated development planning. These qualities, factors, and indicators are then critically evaluated conceptually through a series of case studies of cities faced with significant challenges.

DEFINITION OF RESILIENCE: “City resilience describes the capacity of cities to function, so that the people living and working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter."

PERSPECTIVE: Urban systems, social-ecological systems

METHODOLOGY: Literature review, Thematic analysis

ARUP. (2014) *City Resilience Index: Research Report Volume 1, Desk Study*. London, Ove Arup & Partners International Limited. Online, Available from: http://www.arup.com/cri.

This report begins by discussing the conceptual evolution of resilience and describes how ARUP through their review of current work on resilience derived their qualities and functions of urban systems. The report goes on to discuss how resilience emerges through performance rather than through a collection of resilience enhancing attributes or assets. The report discusses definitions of resilience and the relationships between vulnerability, resilience, and urban function. They carefully recognize resilience as a latent concept that "does not translate easily into practice...evidenced by the often noted challenges of measuring resilience, and the usage of proxy indicators of resilience," (p.14). As in the City Resilience Framework, this report spends time developing and contrasting asset based and systems based approaches to resilience, again emphasizing the importance of systems based approaches in shifting from risk management to resilience. They summarize da Silva et al.'s (2012) work which identified 3 categories of urban systems: networked infrastructure, knowledge networks, and institutional networks - and their various sub-systems. The authors expand on the 8 qualities of a resilient city, interpreting each quality through the implementation of resilience interventions and the maintenance and effective functioning of city systems. They add to this by introducing a performance-based approach to resilience, highlighting the "organic life" of urban systems that have functional characteristics through which they enact resilience. When cities properly perform their essential functions they create resilience and when they do not perform there is collapse or failure of all or parts of the urban system.

DEFINITION OF RESILIENCE: “City resilience describes the capacity of cities to function, so that the people living and working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter."

PERSPECTIVE: Urban systems, social-ecological systems

METHODOLOGY: Literature review, Thematic analysis

Bidwell, S., (2011). *Designing indicators for measuring recovery from disasters*. Canterbury District Health Board, Christchurch.

This literature review discusses current approaches to measuring recovery from disasters, the paper aims to inform and support Community and Public Health, and other groups, for monitoring recovery from the Christchurch earthquakes. The focus of the paper is on sources of routinely collected data to measure recovery indicators, and the most useful methods that ensure collected information is: reliable; consistent; timely; frequently updated; and easily accessible. Routinely collected data that is disaggregated by social or geographic group is the most useful source for many indicators of recovery, though there can be problems when the unit of measurement is not consistent across different datasets. None the less, routinely collected data such as school enrolments, postal addresses, and workforce information, have been used previously following disasters to track recovery over time and space. The authors cite a particular weakness of routinely collected data, the inability to measure indicators of individual and community wellbeing. Psychosocial indicators of recovery include measures of: coping; resilience; and optimism, these are often best captured by surveying individuals directly. They also note that many previous examples of such surveying after disasters tend to focus on psychosocial deficits rather than factors of functioning and wellness. The Short Form (36) Health Survey and General Health Questionnaire are cited as two examples of frequently used survey tools implemented in post-disaster communities, though the authors find little evidence to suggest why they were chosen. A selection of alternate scales that focus on positive psychosocial outcomes are introduced, most of

these have been implemented at small scales on specific groups of survivors and emergency personnel following disaster events. These generally assess exposure to the disaster and elements of coping, support, adjustment, and functioning.

The authors conclude with recommendations for measuring recovery to the earthquakes in Christchurch. Indicators need to be built on available information that is suitable for the context where possible, they do however state that it is likely additional information will be required to understand why some groups are recovering better than others. Existing survey instruments could be adapted to the circumstances in Christchurch to ensure their validity and reliability.

Definition: The report does not define resileince, but defines recovery as, "The return to an acceptable level of stability, though conditions may not be equivalent to those that existed prior to the disaster (Quarantelli, 1999). Successful recovery implies that measures have been taken to mitigate the impact of future disasters."

Country: New Zealand

Perspective: Disaster recovery, psychosocial recovery of individuals and communities

Methodology: Systematic literature review, review of peer suggested literature.

Bruneau, M. et al. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra*, 19(4), 733–752.

This paper offers a conceptual framework and quantitative measures that define seismic resilience of communities. The authors argue that a resilient system should be able demonstrate three qualities: reduced failure probabilities, reduced consequences from failures, and reduced time to recovery. Central to achieving these qualities is identifying and measuring the underlying dynamic properties of the four dimensions of community resilience—technical, organisation, social, and economic (TOSE). These properties include robustness, redundancy, resourcefulness, and rapidity. Robustness describes the ability of a system to absorb and withstand the impacts of a hazard. Redundancy implies the substitutability of systems' components. Resourcefulness is characterised by the ability of systems' users to prioritize needs and procure the necessary capitals (e.g., human, financial, informational, or physical resources) to ensure the functionality of those systems. Rapidity refers to the length of time it takes for systems to return to functionality. The authors propose sample measures for each of these four community resilience dimensions. For instance, measurements of technical and organisation resilience may include electric power system reliability and performance targets at different scenarios. Social resilience can be evaluated by measuring a community's capacity to provide housing for residents.

Definition: Community seismic resilience is defined as the ability of social units (e.g., organisations, communities) to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize social disruption and mitigate the effects of future earthquakes.
Country: USA
Perspective: Physical and social community systems approach

Buckle, P., (2006). Assessing social resilience. In D. Paton & D. Johnston (Eds.). *Disaster Resilience: An Integrated Approach*. Springfield, Illinois: Charles C Thomas Publisher.

From the perspective of a practitioner, Buckle (2006) offers a list of vulnerability characteristics and qualities of resilience to help guide the process of identifying factors that contribute to resilience. The levels of social resilience are categorised into individual, family, tribe or clan, locality or neighbourhood, community, social associations, organisation, systems such as environmental and economic systems, as well as region and nation. The author also identifies five attributes that support resilience at the individual level, and they include information and advice, resources, management capacity, personal and community support, and involvement. At the community level, characteristics that contribute to resilience include knowledge of hazards, shared community values, established social infrastructure, positive social and economic trends, partnerships between agencies, and resources and skills. These attributes and characteristics of resilience are context specific, which are based on time and hazard type. Due to the complex interaction and dynamic nature of various characteristics at different levels and contexts, the author casts doubts on whether resilience can be measured prior to a hazard event, except on a very coarse scale. However, he suggests using a "functional" approach in

assessing vulnerability and resilience, an assessment that is based on the ability of a person or a community to achieve certain outcomes, such as the capacity to offer information and appropriate resources such as food, shelter, and health care at appropriate levels.

Country: Australia
Perspective: Social vulnerability and resilience
Methodology: Discussion.

Cutter, S.L. et al., (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, 18(4), 598–606.

In this paper Cutter and her colleagues put forward the disaster resilience of place (DROP) model, which links vulnerability, adaptive capacity, and resilience and the associated variables that contribute to community resilience. The model captures the inherent or antecedent conditions and post-disaster adaptive processes that exist in communities, and it acknowledges the influences of federal policies and local regulations on levels of community resilience. The model stresses the need to assess inherent resilience of communities. The authors present 29 candidate variables that measure six community dimensions (i.e., ecological, social, economic, institutional, infrastructure, and community competence). They suggest further refinement of resilience indicators.

Definition of resilience: Resilience is the ability of a social system to respond and recover from disasters and includes those inherent conditions that allow the system to absorb impacts and cope with an event, as well as post-event, adaptive processes that facilitate the ability of the social system to re-organise, change, and learn in response to a threat.
Key words: Resilience, vulnerability science, disasters, hazards
Country: USA
Perspective: Community

Djalante, R., Thomalla, F., (2010) Community Resilience To Natural Hazards And Climate Change Impacts: A Review of Definitions and Operational Frameworks, in: *5th Annual International Workshop & Expo on Sumatra Tsunami Disaster and Recovery*.

This paper reviews definitions of resilience across a number of organisations, various resilience frameworks that have been developed, and the conceptualisation of resilience as both an outcome and a process. The authors address the implementation of resilience frameworks in practice to reflect on lessons learnt, and how the understanding of resilience has been furthered by these experiences. From an original list of 38 identified resilience frameworks, those that did not specifically consider community resilience were excluded, leaving 12 for review. The authors note that there is a large body of literature focused on defining resilience, with the concept being adapted to apply to short-term natural hazard disasters, and long-term phenomena such as climate change. More recently research has attempted to understand why some groups and places are comparatively more or less resilient to disasters. This approach has led to the integration of individual, community, institutional, and environmental perspectives, to develop indicators of social vulnerability, built-environment vulnerability, hazard exposure, and mitigation to determine the resilience of a particular place or community.

From the review of resilience definitions and a gap analysis of the 12 resilience frameworks, the authors conclude that there are three fundamental aspects: sustainable development, disaster risk reduction, and community development. Resilient communities and places must be able to cope with events of varying severity and stress, therefore resilience building must promote resilience in various elements to reduce risks, accelerate recovery, and adapt to changing conditions. The authors argue that resilience building must be undertaken in line with community goals so the application of frameworks will vary by social, geographic, and hazard exposure environments.

This paper states the importance of viewing resilience as a process, rather than an end-goal or outcome. Resilience building activities should therefore contribute to future lessons and improvements; the use of frameworks and indicators is useful to review progress against other countries, regions, or cities. Though meaningful comparisons can be difficult to make as reporting relies on government institutions that are often responsible for managing disasters at a national level, so indicators are generally broad and highly aggregated, making for limited insight into resilience building.

Key words: resilience; definitions, frameworks; natural hazards, climate change

Country: Australia

Methodology: Review of international definitions of resilience, and resilience building frameworks that specifically include community resilience.

Dwyer, A., Zoppou, C., Nielsen, O., Day, S., Roberts, S., (2004). Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *Geoscience Australia Record.* 2004/14.

This report focuses on certain aspects of social vulnerability and its role in contributing to the risk from natural hazards. This work is driven by two needs: firstly, to develop a methodology for quantifying social vulnerability in Australia, and second, to integrate social issues with hazard model development to investigate the greater risk to communities. The research develops a practical experimental methodology for measuring elements of social vulnerability. A step-by-step guide is presented and the working methodology is applied to theoretical examples of social vulnerability among census district areas in Perth, Australia.

The authors state that accessibility to services and infrastructure may increase lifestyle capacity for residents, but also increase vulnerability in a disaster if these highly clustered services are damaged. Therefore, how individuals fare in the event of a natural hazard is influenced not just by exposure and infrastructure, but also personal attributes, community support, access to resources, and governmental management. These factors affect social vulnerability, and when combined with wider factors in the urban environment, and the hazard itself, comprise resilience to natural hazards. The authors argue that social vulnerability is an important element of risk as building damage, hazard magnitude, and economic loss.

The authors state that better understanding of who is at risk in our communities will ultimately lead to better risk management by government and local decision makers. However, they cite the need for further work to develop community vulnerability indicators, such as resource availability and social capital, and regional vulnerability indicators, such as dependency on regional economy and access to service areas.

Definition of resilience: The characteristics of an element exposed to a hazard – road, building, person, economy – that contributes to the capacity of that element to resist, cope and recover from the impact of a natural hazard (Department of Regional Development, 1991).

Country: Australia

Perspective: Human, Social, and Community

Methodology: This study examined a range of quantifiable indicators of social vulnerability/resilience to natural hazards, thirteen in total were included: age; income; gender; employment; residence type; household type; tenure type; health insurance; house insurance; car ownership; disability; English language skills; and debt/savings. Two additional indicators for hazard context were also included as part of post-event assessment or resilience: residential damage and injuries linked to a hazard event.

The authors conducted a survey to assess individual perceptions of the relative importance of these proposed factors for social vulnerability/resilience. Of the indicators that related to pre-event conditions the highest rated were: house insurance; income; tenure type; and age respectively.

The authors applied their index to a range of hypothetical hazard scenarios in the city of Perth. Pre-event indicators were measured using a range of secondary data sources while the post-event injury and building damage indicators were varied to represent multiple hazard impact severities. The methodology was compared to the Cities Project methodology (Granger & Hayne, 2001). The authors ultimately concluded that apart from some evidence of similarities under given event scenarios, comparisons were difficult to arrive at due to the different indicators used in each methodology.

Goodman, R.M. et al., (1998). Identifying and defining the dimensions of community capacity to provide a basis for measurement. *Health Education & Behavior*, 25(3), 258–278.

This paper captures the different dimensions of community capacity. Community health researchers from the US and Canada defined and clarified 10 different major constructs of community capacity: 1) citizen participation; 2) leadership; 3) skills; 4) resources; 5) social and inter-organisational networks; 6) sense of community; 7) understanding of community history; 8) community power; 9) community values; and 10) critical reflection. Each of the constructs also consists of sub-dimensions. The authors discussed these community capacity dimensions further with support of relevant literature.

Country: USA
Perspective: Community
Methodology: Input from subject matter experts and researchers from a two-day symposium

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Mayunga, J.S., (2007) *Understanding and applying the concept of community disaster resilience: A capital-based approach*, Munich, Germany.

The author uses a capital-based approach to measure community resilience. Conceptually, the capital framework comprises of five different forms of capital: social, economic, physical, human, and natural. Thematic indicators are developed for the five capital domains. The social capital domain consists of indicators including trust, norms, and networks. Economic capital measures income, savings, and investment. Human capital refers to education, health, skills, knowledge and information. Indicators including housing, public facilities, and business contribute to physical capital of a community. Natural capital consists of resources stocks, land and water, and ecosystem measurements.

Definition of resilience: Community disaster resilience is referred to as the capacity or ability of a community to anticipate, prepare for, respond to, and recover quickly from impacts of disaster.
Key words: Community disaster resilience; Resilience index; Capital domains; Framework; Indicators
Country: USA
Perspective: Community capitals

Mueller, M., Spangler, T. & Alexander, S., (2013). *Community Resilience: Conceptual Framework and Measurement Feed the Future Learning Agenda*, Rockville, Maryland, USA.

This report offers a community resilience framework and indicators for resource-dependent communities in developing countries. Drawing from a livelihood theoretical approach, a disaster risk reduction (DRR) approach, and perspectives from the social capital and collective action literature, the resulting framework differs from other resilience framework as it emphasises collective action capacities within the context of DRR and social capital in contributing to sustainable livelihoods in developing countries. The community resilience measurement comprises of three dimensions: asset (capital), social dimension, and collective action. Asset consists of different forms of capital (e.g. financial, human, natural, social and political). Social dimensions of social capital that enable communities to take collective action are measured through community levels of preparedness, responsiveness, learning and innovation, memory, self-organisation, diversity, inclusion, and aspirations. Under the collective action resilience aspect, four indicators of collective action capacities were identified: disaster risk reduction, conflict mitigation, social protection, natural resource management, and management of public goods and services. A total of 80 indictors across these dimensions were identified, using both quantitative and qualitative sources of data.

Definition of Resilience: The general capacity of a community to absorb change, seize opportunity to improve living standards, and to transform livelihood systems while sustaining the natural resource base. It is determined by community capacity for collective action as well as its ability for problem solving and consensus building to negotiate coordinated response. Adopted from Walker, Sayer, Andrew, & Campbell, 2010.
Country: USA (for developing countries)
Perspective: Community – all aspects
Methodology: Quantitative and qualitative measures

Norris, F.H. et al., (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*, 41(1-2), 127–150.

The authors see community resilience as comprising of four primary sets of adaptive capacities: economic development, social capital, community competence, and information and communication. These adaptive capacities are defined as resources (i.e. capitals) with dynamic attributes (robustness, redundancy, rapidity) (Bruneau et al., 2003). Under each of these resources are indicator themes, and 21 indicator themes are proposed. Because adaptive capacities are a means to an end, community-level adaptation is characterised by a "high prevalence of wellness in the community, defined as high and

non-disparate levels of mental and behavioural health, role functioning, and quality of life in constituent populations" (Norris et al., 2008: 133). Hence, "population wellness" is central to community resilience as it provides measurable levels of adaptation in populations after a disturbance (2008: 133).

Definition of resilience: Resilience as a process linking a set of adaptive capacities to a positive trajectory of functioning and adaptation after a disturbance. Adaptive capacities are resources with dynamic attributes.
Key words: Resilience, community resilience, disaster, preparedness
Country: USA
Perspective: Community adaptive capacities

Paton, D., (2006) Disaster resilience: building capacity to co-exist with natural hazards and their consequences. In D. Paton & D. Johnston, Eds. *Disaster Resilience: An Integrated Approach*. Springfield, Illinois: Charles C. Thomas Publisher.

Adaptive capacity exists at different levels, including personal, community, cultural, and institutional/environmental levels and consists of four components: resources, competencies, planning and development strategies, sustainability of resources and competencies. Resources refer to goods, plans, and infrastructure that protect people and organisations and enable them to continue their activities and work after a hazard event. Competencies refer to the skills that people and organisations have that would enable them to effectively address the challenges posed by the hazard event. Planning and development strategies help ensure these resources and competencies are available when needed and offer a platform for anticipating future challenges and post-disaster growth. The last component emphasises the importance of sustainability of resources and competencies in a changing environment throughout the disaster cycle. Resilience is a measure of how well people and societies can adapt to a changed reality.

Definition of resilience: Resilience as adaptive capacity. Adaptive capacity is a society's capability to draw upon its individual, collective and institutional resources and competencies to anticipate, cope with, adapt to, recover from and develop/learn from the demands, challenges and changes encountered before, during and after disaster.
Country: Australia
Perspective: Individual and community adaptive capacities

Peacock, W.G. et al., (2010). *Advancing resilience of coastal localities: Developing, implementing, and sustaining the use of coastal resilience indicators: a final report.* Hazard Reduction and Recovery Center, Texas A&M University, College Station, Texas.

Peacock and his colleagues developed the Community Disaster Resilience Framework (CDRF) and its associated index – Community Disaster Resilience Index (CDRI) – to measure community disaster resilience. The framework focuses on the intersection between disaster management activities and the necessary community capital required to carry out those activities. It consists of four components of capital: social, economic, physical, and human. The capital resources form the basis of the Community Disaster Resilience Index, which consists of 75 indicators representing four types of capital resources. Out of the 75 indicators, nine are social capital indicators, six are economic capital indicators, 35 are physical capital indicators, and 25 are human capital indicators. These indicators fall under one or more of the disaster management phases – hazard mitigation, disaster preparedness, emergency response, and disaster recovery.

(The application of this framework can be found in the empirical research section below.)

Keywords: Coastal; Hazard Reduction; Resilience Indicators
Country: USA
Perspective: Community – all aspects
Methodology: Composite indicator construction using secondary data

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Pearson, A.L., Pearce, J., Kingham, S., (2013). Deprived yet healthy: Neighbourhood-level resilience in New Zealand. *Soc. Sci. Med.* 91, 238–245.

This article presents a conceptual indicator framework for measuring neighbourhood-level resilience to poor health outcomes despite high social deprivation. The author states that the relationship between geographical and social inequalities on health outcomes is a growing body of literature. Findings of this research have subsequently demonstrated that despite relatively disadvantageous settings, there are neighbourhood with unexpectedly good health outcomes. This paper defines resilience as the capacity to recover from or adapt to harmful stressors, such as living in relative deprivation, and entails "both a level of adversity and an unanticipated positive result," (p. 238). At the neighbourhood level there are particular characteristics that influence resilience, and even socially deprived areas may provide a 'healthy' environment in terms of access to essential infrastructure, services, and community cohesion.

The authors propose the Resilience Index New Zealand, a framework of indicators applied to New Zealand census area units that is used to identify areas with unexpectedly high or low mortality given their level of deprivation. The index is comprised from a number of neighbourhood characteristics from the built (healthcare, healthy living infrastructure, unhealthy living infrastructure, and education), physical (air quality, water quality, and overall environment), and social (culture, participation, rurality, and cohesion) environments.

The authors find areas of New Zealand where mortality is lower than expected given the level of deprivation, and "identified pivotal and amenable factors to potentially improve health in similarly deprived places," (p. 242). Resilient neighbourhoods had poorer access to unhealthy neighbourhood factors such as gambling and alcohol outlets, and better access to safe drinking water and lower levels of overall environmental deprivation. Socially resilient places have high numbers of incoming residents, a finding echoed in other literature (e.g. Mitchell et al. 2009) and were more densely populated, characterising more urban environments.

The findings of this work suggest that some place-specific factors may build resilience in some areas but not others so it is important to understand interactions between people and their neighbourhoods, not just the presence of certain indicators.

Definition of resilience: Deprived places with unexpectedly good health outcomes.

Key words: Resilience; inequality; deprivation; neighbourhoods; health; New Zealand

Country: New Zealand

Perspective: Neighbourhoods and health, socio-economic inequality and health

Methodology: Regression modelling of neighbourhood factors to identify geographic areas of model over- (resilient) and under-performance (non-resilient).

Pelling, M., & High, C. (2005). Understanding adaptation: What can social capital offer assessments of adaptive capacity? *Global Environmental Change*, *15*(4), 308–319.

This paper argues that social capital provides a basis for studying the co-evolution of social networks and norms in the production of adaptive capacity among collectives such as communities. It examines the different components of social capital (i.e., bonding, bridging, and linking social capital, as well as trust and reciprocity) and discusses the utility of social capital theory for adaptation to climate change. The authors delineated four different areas in which social capital can facilitate collective action within the context of climate change adaptation. Two of these involve using social capital to generate material interventions, one through facilitating direct collective action to reduce climate change vulnerability and the other to reduce secondary vulnerabilities, such as reduction in illiteracy. The other two areas centre on institutional interventions. One of which centres on individuals and communities participating in activities, such as voting, that affect changes in procedures and processes of collective decision-making. The other institutional intervention uses social capital to directly respond to climate change stress on an individual or community level. These four domains provide a framework to which social capital can be examined and for development of research questions. The authors argued for examination contextualizing social capital in communities of place, with consideration of the political, social, and cultural influences that exert the mobilization of latent capacity of social capital.

Keyword: Social capital; community; adaptive capacity; social organisation
Country: England

Perspective: Community – all aspects

Phillips, B., (2001). Promoting social and intergenerational equity during disaster recovery, In: *Holistic Disaster Recovery: Ideas for Building Local Sustainability after a Natural Disaster*. Natural Hazards Center, Boulder, Colorado.

This paper introduces two perspectives of social vulnerability/resilience according to Boyce (2000). The first, a wealth-based approach, argues, "Those individuals who are willing (and, perforce, able) to pay more, deserve to get more. While the second, a rights-based approach emphasizes, "the egalitarian distribution of the right to a clean and safe environment."

The authors of this paper find that most democratic countries follow a rights-based approach, however in spite of this viewpoint, inequity is common among most societies, meaning some groups may be less resilient to the impact of natural hazards. The authors propose a range of indicators for social and intergenerational equity after a disaster. These are built upon a theory of post-disaster recover that promotes social and intergenerational equity – an equal chance to survive across time – where every stakeholder gets a chance to participate and benefits from recovery processes.

The indicators developed within this framework include:

- Equity in housing: track relocations of residents following an event, the size of post disaster housing (measure of quality)
- Equity in overall recovery – who leaves the area permanently?
- Equity of risk – socio-economic status of affected households, who was forced to move? How were these homes replaced? Where did they go?
- Equity in deaths, injuries, damage – are these the same across groups?
- Equity in disaster preparedness – particularly among vulnerable populations, what agencies provide support before an event?
- Equity in outreach
- Equity in economics – number of people who lost their jobs and the social groups they belong to, types of businesses damaged, effect on household income across social groups.
- Equity in infrastructure – are all areas of the community repaired and replaced at comparable levels and times?
- Gender equity – including indicators such as incidence of domestic violence during and after recovery.

Country: USA

Perspective: Social equity

Themes/ideas: Builds on theory of social equity and environmental justice, individual communities have a unique set of circumstances that make blanket application of indicators difficult, indicators must be connected and tied to long-term community development that applies both within and outside of disaster contexts.

Ritchie, L.A. & Gill, D.A., (2011). The role of community capitals in disaster recovery. In *PERI Symposium: Community Recovery from Disaster*. Public Entity Risk Institute (PERI), pp. 1–9.

The authors proposed a Community Capitals Framework (CCF) in measuring community resilience. This framework expands on Mayunga's (2007) framework to include cultural and political capitals. The CCF emphasises a community's ability to mobilise each of the seven types of resources in the aftermath of a disaster. In order for a community to recover, responders, planners, and other community stakeholders must possess an awareness of existing resources, an understanding of how they can be used, and accessibility to them. The framework also highlights the differential susceptibility, temporality, demands, and values of these capitals at different phases of recovery. Capitals such as physical infrastructure are easier to quantify and to fix than others (e.g. social and cultural values). Additionally, some capitals are more important at certain times than others. For example, capitals relating to the provision of water, food, and shelter and other lifelines are more critical immediately following a disaster than other resources. Therefore, capitals across these seven domains are not valued equally as the recovery process progresses.

Country: USA

Perspective: Community capitals

Ross, A.D., (2014). *Local disaster resilience: administrative and political perspectives*, New York, USA: Routledge.

Ross' study builds upon the work of Cutter and her colleagues' baseline resilience indicators for communities (BRIC) (Cutter, Burton, & Emrich, 2010) and the community disaster resilience index developed by researchers at Texas A&M University's Hazard Reduction and Recovery Center (Peacock et al., 2010) by examining resilience from the perspective emergency managers and municipal elected officials and developing an adaptive capacity index for 75 counties across the Gulf Coast. This study examined how resilience is defined locally from the perspectives of local administrators and political elites, assessed local adaptive capacities and processes, and addressed conditions that facilitate resilience, including collaboration and coordination. Ross reframed the BRIC as adaptive capacities, which are defined as community assets that contribute to disaster response and recovery. They measure antecedent qualities of communities before a disaster. Adaptive capacities for resilience span six dimensions: social resilience, community capital, economic resilience, institutional resilience, infrastructure resilience, and ecological resilience. The indicators, except for the ecological resilience component, were adopted from Cutter et al.'s BRIC (2010). The study also measures community's capacities for adaptive processes, which consist of improvisation, coordination, engagement of the community, and endurance. These processes occur post-disaster, during both response and recovery phases. However, out of the four aspects of adaptive processes, Ross only provided measurable variables for the coordination component. Coordination variables include urban/rural character of a community, disaster severity, leadership, and resources for emergency management. The other process components were highlighted through case studies.

By intersecting the datasets for both adaptive capacities and adaptive processes, Ross was able to determine the resilience 'profiles' of each county (from low to high). The study found that the factors that most affect resilience include state context (states that allow counties to self-govern – 'home rule'), urban-rural character of localities, disaster severity (in terms of property damages, tornado intensity, and economic loss from oil spills within a 10-year period), and resources for emergency management (fiscal and human resources). Counties with the highest resilience are categorized by localities' ability to self-govern, high population (metropolitan areas), having experienced considerable disaster damages, and possessing high fiscal and personnel resources dedicated to emergency management. Furthermore, when intersecting the resilience profiles of each county with results from the local emergency managers and elected officials' perceptions of resilience capacities, the study found that emergency managers in counties with low levels of disaster resilience but high hurricane and tornado damages are more likely to overestimate their county's resilience. Increases of time lapse since the last severe disaster also increase the likelihood of overestimation. Moreover, emergency managers with college educations were also more likely to overestimate resilience.

The findings underscore the importance of contextualizing resilience on a local level and identify opportunities for developing resilience, from the legislative perspective to human and fiscal resources.

Definition of Resilience: "A set of capacities that imbue a community with the strengths needed to respond, cope, and recover from a disaster event as well as a process of collective action enabled by these capacities to adapt to the post-disaster environment" (p. 51)

Country: USA
Perspective: Community – all aspects
Methodology: Secondary data, primary data, including interviews and surveys.

Tatsuki, S. & Hayashi, H., (2001). Seven critical element model of life recovery: General linear model analyses of the 2001 Kobe Panel Survey data. *Proceedings of 2nd workshop for comparative study on urban earthquake disaster management*, pp.14–34.

This paper presents findings of critical factors that have contributed to life recovery of residents from the Kobe Earthquake. This study seeks to construct reliable measures that can be used to monitor long-term recovery of residents impacted by the earthquake and to assess the effectiveness of government's

recovery assistance initiatives and provide policy recommendations. Life recovery consists of recovery of daily activity, social relationships, subjective wellbeing, life satisfaction and quality of life, and optimist/pessimistic prospects of life. Seven critical elements to life recovery have been identified and they include housing, social ties, townscape, mind and body, preparedness, economic/financial situation, and relation to government. Housing refers to types and structure of housing units. The social ties element measures self-governance and community solidarity. Townscape measures residents' sense of attachment to urban commons (e.g. parks) and community events. The mind and body variable assesses residents' physical and mental health. Preparedness measures residents' risk perceptions to future earthquakes within the next fifty years. The last variable – relation to government – measures residents' views of their government. In addition to these life recovery variables, the study also assesses house and economic damages resulting from the earthquake, demographics of residents, as well as damage-by-demographics. The study finds that the integration of these variables account for 60% of the total variance for life recovery among the 1,204 adults surveyed in the Kobe-Hanshin region. The strongest predictors of life recovery are indices relating to housing and economic damages, mental stress, demographic/socioeconomic variables income, generation/age, occupation), housing type, and critical life recovery elements including social ties and general health practices (mind and body variable).

Country: Japan
Perspective: Built and socioeconomic
Methodology: Surveys

Tobin, G.A., (1999). Sustainability and community resilience: the holy grail of hazards planning? ***Environment: Science and Policy for Sustainable Development*****, 1, 13–25.**

This paper presents a theoretical framework on community resilience and post-disaster sustainability, which can be analysed by understanding three separate, but linked models that are viewed at different societal dimensions (e.g., social, economic, and political) and interconnected scales (e.g., local, national, and global). In this framework, the three models include a mitigation model, a recovery model, and a structural-cognitive model. The different models within the framework provide a basis for creating resilient and sustainable communities. The mitigation model, for instance, focuses on reducing exposure to and impact from hazard risks, and includes conditions for effective implementation such as having clear policy objectives and capable leaders. The recovery model emphasises the recovery process and factors such as the restoration of societal capitals and infrastructures that enhance on-going recovery. The structural-cognitive model highlights the structural and cognitive influences on the other two models (i.e., mitigation and recovery). Community characteristics, such as culture, demographics, political, economic, and psychological and attitudinal factors play an integral role in either enhancing or impeding mitigation or recovery efforts.

Country: USA
Perspective: Social – individual and community

The work covered in the remainder of this section examines community or social resilience, and is supported by empirical data or case studies.

Aghabakhshi, H. & Gregor, C., (2007) Learning the lessons of Bam: the role of social capital. ***International Social Work*****, 50(3), 347–356**.

This study examines the implications of social capital for relief efforts in the aftermath of the 2003 earthquake in Bam, Iran. The authors found that in the early days after the earthquake, relief agencies distributed supplies in an ad hoc manner. Local people and pre-existing support networks were not utilized and they began to mistrust agencies in charge of aid delivery. Other observations included mistrust of government agencies, and fellow earthquake survivors. Rehousing of displaced residents and children was done without consideration of their needs. Distrust also existed between relief organisations and they did not coordinate with local non-governmental organisations to help support existing social networks. Although there was a pervasive sense of mistrust between people and organisations, the study found that social workers served as information links between residents and relief agencies. These people could also help translate and adapt national disaster recovery plans on a local level.

Country: Iran
Perspective: Human; social work
Methodology: Interviews, observations and field notes

Aldrich, D.P. & Crook, K., (2008). Strong civil society as a double-edged sword: siting trailers in post-Katrina New Orleans. *Political Research Quarterly*, 61(3), 379–389.

This paper examines the negative aspect of social capital in New Orleans' disaster recovery. The study found that social capital – as measured by the percentage of eligible voters voting in past elections – correlates with the two dependent variables under analysis: the number of trailers in a zip code and the number of trailer parks in a zip code. Other variables that demonstrate significant results include zip codes that were in New Orleans (instead of outside), population density, and per cent unemployed. But the factors with the largest effect on the number of trailers per zip code were the New Orleans variable (that is, more trailers are sited within New Orleans' boundary than outside) and voter turnout. The authors found that the more politically active people were within a zip code, the less likely a trailer or a trailer park would be sited there. The study's model predicts that an area where 80% of the voters turnout would have only a single trailer park, compared to fifteen or more in an area where less than 40% of residents voted. The results suggested that authorities are more focused on designating unwanted projects – the same projects that could enhance overall community resilience – in areas with less potential for controversy. As such, the better organised and better-connected areas are less likely to receive unwanted post-disaster projects.

Key words: New Orleans, Hurricane Katrina, civil society, temporary trailers, facility siting
Country: USA
Perspective: Social capital
Methodology: Secondary source data

Aldrich, D.P., (2012) Social, not physical, infrastructure: The critical role of civil society after the 1923 Tokyo earthquake. *Disasters*, 36(3), 398–419.

This study assesses the factors associated with population recovery in Tokyo following the 1923 earthquake. The author examined whether levels of damage, population density, human capital, economic capital, as well as social capital contributed to differential population recovery rates. Using archival data archived statistics of the Tokyo Metropolitan Police department, as well as electoral and earthquake-related damage records published by local government agencies, the author did not find evidence that the levels of damage, population density, human capital, and economic capital altered the pace of population recovery. However, social capital was found to be statistically significant in explaining recovery rate. The two social capital variables included in the analysis – voter turnout in municipal elections and higher-than-average numbers of political demonstrations – positively associated with population increase following the earthquake. Findings from this research study have three important policy implications. First, intervention strategies focused on strengthening social networks before or after disasters stand a better chance of post-disaster population recovery. Second, emergency managers should evacuate people in the same social network. Last, the author argues for increased allocation of recovery aid in preserving and promoting social networks and structures, ensuring social connectedness throughout the recovery phase.

Key words: Disaster recovery, social capital, Tokyo earthquake
Country: Japan
Perspective: Social – social capital
Methodology: Archival data/secondary

Aldrich, D.P., (2010). The power of people: social capital's role in recovery from the 1995 Kobe earthquake. *Natural Hazards*, 56(3), 595–611.

This paper analyses the role social capital plays in population recovery in nine different wards after the 1995 Kobe earthquake in Japan. Controlling for economic status, levels of welfare dependence, earthquake damage, socioeconomic inequality, and geographic conditions, the amount of social capital positively correlates with recovery rates. In this study, social capital is measured in the time-series,

cross-sectional data over an 18-year period as the number of new neighbourhood level non-profit and community-based organisations (NPOs) created per capita. These NPOs were created to assist the redevelopment and reconstruction of the ward and provide aid for those living there. According to the data, the most active neighbourhoods recreated three new NPOs per 10,000 residents, while the least mobilized created only five per 100,000 people. As the dependant variable, population change per ward was analysed five years before the earthquake and 13 years after impact. The results showed growth rates pre-disaster significant influenced post-disaster population growth rate; higher percentage of residents dependent on welfare was associated with decreased post-earthquake population growth rate; and the number of NPOs created per capita positively and significantly correlated to growth rate two years after the earthquake. Controlling for socioeconomic factors, wards with higher social capital experienced higher population growth rates. The author suggested that communities with higher social capital were able to self-organise to better respond to earthquake consequences and overcome collective action problems, thus improving the lives of fellow residents.

Keywords: Kobe earthquake, population recovery, social capital, disaster, resilience
Country: Japan
Perspective: Social – Social capital
Methodology: Secondary source data

Beaudoin, C.E., (2007). News, social capital and health in the context of Katrina. *Journal of health care for the poor and underserved*, 18(2), 418–430.

This study examines how news information and social capital influenced public health of affected residents from Hurricane Katrina. The researcher conducted in-depth interviews with 57 shelter residents, primarily African-Americans with low incomes and little education. Results of the study showed that shelter residents sought out news information as a way to deal with post-disaster uncertainty and health threats, but such reliance resulted with greater likelihood of psychological and physical health problems. Depression rates were higher among residents with low pre- and post-hurricane positive social interactions, but high levels of post-hurricane negative social interactions. This finding supports previous studies on the impacts of social capital on health outcomes, in that positive social capital facilitates positive health outcomes and negative social capital results in negative health outcomes (e.g., Lochner et. al. 2003). However, this study did not find correlation between social capital and physical health problems related to the hurricane. The author suggested three potential rationales for this finding. First, social connections and social support are not determinants of health in a major disaster except in the case of psychological wellbeing. Second, social capital plays a more complex role than tested in this study. Third, it could be that the post-disaster effects were so large that social capital was insufficient for avoiding illness and injury. As noted in other studies here (e.g., Lochner et. al. 2003), social capital is critical, but not sufficient to contribute to improved health outcomes.

Country: USA
Perspective: Human; health
Methodology: Semi-structured in-depth interviews

Berke, P.R. et al., (2008). Human-ecological dimensions of disaster resiliency in Thailand: social capital and aid delivery. *Journal of Environmental Planning and Management*, 51(2), 303–317.

This study takes on a different approach to understanding resilience – it seeks to understand how human communities adapt to changing conditions post-disaster and how well they address a decline in disaster resiliency due to degradation of mangrove ecosystems, which are a source of food, income, and protection from coastal hazards. Through the lens of social capital, the authors examined whether communities that engage in collective actions – that is, communities with high levels of social capital – and a bottom-up approach to external aid – which puts affected communities in control and thus facilitates community social capital– will increase restoration and protection of coastal mangrove ecosystems. Compared to pre-tsunami, the study found that residents in six villages impacted by the 2004 Indian Ocean tsunami had a heightened propensity to act collectively to address the degradation of common pool resources, such as the mangrove forest degradation. The researchers also found increase salience of mangrove degradation, and its effects on livelihoods and coastal hazard mitigation.

However, the study found that differential performance outcomes in terms of restoration and protection of mangrove ecosystems, with one village demonstrating high performance in conservation, while three had moderate level of effort and two villages did not undertake mangrove conservation practices. Social capital was found to provide a stabilising influence in the immediate aftermath of the disaster. Prior social networks took on response and recovery tasks and local norms and networks of cooperation ensured allocation of aid delivery was fair. Yet, high levels of social capital did not translate into active mangrove restoration and protection. External aid programmes that emphasised bottom-up approaches facilitated the mobilisation of local social capital and directed it toward recovery activities that meet local needs and capabilities. Conditions that impede effective recovery program implementation include 1) top-down aid delivery strategies, 2) lack of trust toward aid agencies and governments, and 3) uncertainty in rule-making authority of local resources.

Definition of Resilience: Resilience refers to "the capacity to restructure, adapt and adjust to situations of stress."
Country: Thailand
Perspective: Human-ecological
Methodology: Semi-structure interviews with key informants using World Banks' Social Capital Assessment tool (SOCAT); field notes of council meetings' informal discussions.

Burton, C.G., (2014) A validation of metrics for community resilience to natural hazards and disasters using the recovery from Hurricane Katrina as a case study. *Annals of the Association of American Geographers*, 105(1), 67–86.

This paper seeks to externally validate a set of social, economic, institutional, infrastructural, community-based and environmental metrics for measuring at sub-county levels, with the aim of identifying pre-existing conditions within communities that could affect how a community recover from natural hazard impacts. The metrics contain 64 variables across the six different resilience domains and they were validated against recovery progress of coastal Mississippi counties. Photographic observations of the built environment at 131 different sites over a five-year period were taken. By linking disaster recovery to the resilience indicator, the author highlighted key predictors for post-disaster recovery. For the social resilience construct, people not belonging to a minority group and those with at least a high school diploma are the strongest predictors for recovery for the five-year period. In terms of economic resilience component, per capita income and homeownership are the strongest predictors. Predictors for institutional resilience include the presence of hazard mitigation plan and flood insurance program predict positive recovery process. Infrastructure resilience variables that strongly correlate with recovery include housing density, non-mobile homes, and the number of primary and secondary schools. Furthermore, community capital resilience is explained by the presence of art, entertainment and recreation centres; religious organisations; social advocacy organisations; and per cent of people in professional service occupations. For the environmental component, land area with protective environmental features such as swamp, marshes, and dunes is a predictor to recovery. A composite index score was applied to the study area. The study found that the amount of damage sustained is the strongest predictor of achieving a full recovery in the long-term, followed by social and then economic factors of resilience. Correlations of other factors are ranked in the following order: infrastructural indicators, community capacity indicators, institutional indicators and environmental indicators. However, the study noted only one case study was used and that the explanatory power of regression models of the index was moderately low to low, indicating that a large portion of the variance of recovery unexplained. The author suggested further work in understanding and measuring resilience using alternative assessments and use of primary source data.

Definition of resilience: Resilience as the ability of social systems to prepare for, respond to, and recover from damaging hazard events
Key words: Composite indicators, Hurricane Katrina, recovery, resilience, resilience measurement
Country: USA
Perspective: Community - all
Methodology: Secondary data – census block group, photographs, GIS

Cope, M.R. et al., (2013) Does time heal all wounds? Community attachment, natural resource employment, and health impacts in the wake of the BP Deepwater Horizon disaster. *Social Science Research*, 42(3), 872–881.

This paper examined the impacts of the BP-Deepwater Horizon oil spill disaster on the mental and physical health of affected residents in coastal Louisiana. Using the data collected from the Louisiana Community Oil Spill Survey, which is a randomized telephone survey of 6,000 households that was conducted at three different time series – two months after the rig explosion, four months after the first survey, and one year from the initial rig explosion, the researchers sought to understand how community attachment influences mental and physical health impacts from the disaster over time. In this study, health was measured against indices of negative mental and physical health symptoms. Community attachment was measured using a five-item index. Past research studies have linked community attachment to social capital as a framework for studying disasters, however, the authors of this study cautioned against conflating the social capital concept with community attachment. They argued that social capital refers to network structures, while community attachment reflects sentiments about place. The results showed that higher levels of community attachment are associated with significantly lower negative mental and physical health impacts. Fishers, the people reliant on the ocean for their livelihoods, experienced significantly higher levels of negative mental and physical health impacts than non-fishers across all three time-series. Other demographic groups that were more prone to negative health impacts included those who are unemployed, with less education, women, and older people. On a policy level, disaster planning should consider people's vulnerability and social attributes that characterize people and places, especially those whose livelihoods are dependent on local resources. Community attachment should be viewed as a key component of disaster mitigation strategies.

Keywords: BP oil spill; Community attachment; disaster; health; vulnerability; resilience
Country: USA
Perspective: Human
Methodology: Telephone survey in three different time series

Cox, R.S. & Hamlen, M. (2014) Community disaster resilience and the Rural Resilience Index. *American Behavioral Scientist*, 59(2), 220–237.

This paper explained the development of a community-driven resilience index that reflects the priorities of local actors in rural and remote communities in Canada. The Rural Resilience Index (RRI) draws on the knowledge of academic research and disaster resilience assessment frameworks and tools, input of emergency management practitioners, and a grounded theory analysis of the residents form nine rural, coastal, or remote communities in British Columbia. The development of the index combined expert-driven selection of indicators and a bottom-up approach that integrated local expertise. The RRI consists of three domains (i.e. social fabric, community resource, and disaster and emergency management preparedness) with 53 dimensions. The web version of the RRI consists of 16 dimensions and each with 11-17 indicator statements. The authors pointed out the dilemma in the development process of assessment tools and indices – striking the balance between the need for brevity and the need for comprehensiveness and accuracy. They also noted that the process of identifying areas of community resilience can generate community awareness and cultivate an empowered community. The RRI serves to encourage a collective approach to building resilience and to connect resilience to everyday contexts, thus increasing the relevancy of the tool. The RRI also addresses other key areas of community resilience, mainly flexibility, empowerment, and integration.

Key words: Community resilience, disaster, rural resilience, preparedness
Country: Canada
Perspective: Community
Methodology: Qualitative and quantitative; participatory action research; workshop, semi-structured interviews, focus groups

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Cox, R.S. & Perry, K.M.E., (2011). Like a fish out of water: reconsidering disaster recovery and the role of place and social capital in community disaster resilience. *American Journal of Community Psychology*. 48, 395–411.

This paper discusses how factors including place attachment, place identity, and social capital contributed to the disaster recovery process and community resilience in two rural communities affected by a wildfire in British Columbia, Canada. The study found that residents experienced "disorientation" when returning to a changed landscape (e.g. scorched ground and blackened

vegetation) and the collective disruption triggered a collective identity crisis. The recovery process also highlighted a collective sense of recreating shared identities among residents through redefining their place – both materially and symbolically. Because of residents' deep attachment to the natural environment, they took on "re-greening" of the environment, both on an individual but also collectively through environmental restoration projects. Community identities also changed as a result of the disaster, shifting from neighbourhood-centric focus to one that embraces a regional identity comprising of affected communities. This shift of community identity was in part driven by government authorities and by economic recovery necessity. In terms of social capital, the fire brought residents together to preserve and invest even greater importance in their community identity. Through their interviews with residents, the authors observed an increased sense of connectedness and camaraderie in the early stages of the reorientation process. However, the influx of financial and material aid diminished reciprocity between neighbours and diminished the positive potential for the development of social relationships and community capacity building. This study argues for a deeper understanding of how people and communities recover, particularly on the process of reorientation of place, social capital and identity formation. It also encourages recovery processes to address and integrate affected residents' emotional, psychological and social recovery needs in recovery planning and allocation of relief funds and resources.

Definition of Resilience: Community resilience is a reflection of people's shared and unique capacities to manage and adaptively respond to the extraordinary demands on resources and the losses associated with disasters (adapted from (Norris, et al., 2008; Paton & Johnston, 2006)
Key words: Social capital, disaster, trauma recovery, community disaster resilience, place, ethnography
Country: Canada
Perspective: Human; social capital
Methodology: Multi-sited ethnographic research with key informants and residents from two communities; critical discourse analysis, grounded theory – constant comparative methods

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Cutter, S.L., Burton, C.G. & Emrich, C.T., (2010). Disaster resilience indicators for benchmarking baseline conditions. *Journal of Homeland Security and Emergency Management*. 7(1).

Based on the disaster resilience of place (DROP) model (Cutter et al. 2008), this paper presents composite indicators for disaster resilience and measurements for 736 counties within FEMA Region IV (southwestern US). Out of the six domain of resilience identified in the DROP model (social, economic, institutional, infrastructure, ecological, and community capital), ecological resilience was excluded due to data inconsistency and relevancy of proxies for ecological systems resilience for large and diverse study areas. Thirty-six variables that showed internal consistency were used for the study, and data were collected from publicly available data sources. Each of the resilience subcomponent contains seven to eight variables. Social resilience variables include education equity, age, literacy levels, disability levels, transportation coverage, communication capacity and health coverage.

Country: USA
Perspective: Community - all
Methodology: Secondary data sources

Cutter, S.L., Ash, K.D. & Emrich, C.T., (2014) The geographies of community disaster resilience. *Global Environmental Change*. 29,–77.

Using US counties as a unit of analysis, this study employs the Baseline Resilience Indicators for Communities (BRIC). Building upon previous research (Cutter et al. 2010), variables culled from publicly available data sources for all six resilience domains – social, economic, housing and infrastructure, institutional, community, and environmental - were identified. A total of 49 variables were used to analyse community resilience in the continental US. The authors indicated that a linear negative statistical relationship between BRIC and SoVI (social vulnerability index), but they are not on the opposite ends of the vulnerable-resilient spectrum. Although they share common information, 75% of the variability in the resilience index remains unaccounted for by SoVI. BRIC, therefore, suggests that inherent resilience in communities cannot be fully explained by SoVI. The authors argued that BRIC provides a reference point for examining inherent resilience at the county level.

Because data can be easily sourced publicly, the use of BRIC can be used by local leaders to assess resilience progress over time and provide targeted intervention measures such as disaster risk reduction and capacity building policies.

Country: USA
Perspective: Community - all
Methodology: Secondary data sources

The Economist Intelligence Unit, 2014. The South Asia Women's Resilience Index: Examining the role of women in preparing for and recovering from disasters. In Line, D. (Ed.) *The Economist.* 2014 (November).

The South Asia Women's Index assesses resilience levels, in particularly gender-specific resilience, of Bangladesh, Bhutan, India, Nepal, the Maldives, Pakistan, and Sri Lanka. Japan was included as a benchmark country. The Index is comprised of 68 indicators measuring four resilience domains: economic, infrastructure, institutions, and social. Thirty-one of the indicators are based on quantitative data and thirty-eight are based on qualitative assessments. Of the 69 indicators, approximately 40% have a gender-focus. The social resilience sub-index measures population vulnerability, education and gender, and health. This index seeks to benchmark current resilience capacities of South Asian countries. The report authors found that most of these countries fare poorly in considering women in disaster risk reduction (DRR) and resilience building; large gaps between policy and implementation that undermine women's disaster resilience; and significant vulnerabilities and disempowerment among women that impede capacity building efforts. They recommended a number of policy goals, including introducing accountability for gender-specific DRR targets, empower women to build resilience at the community level; recognize and integrate women in DRR planning leadership roles; increase coordination in and decentralize disaster planning; and align DRR and resilience building with poverty reduction and sustainable development programs.

Definition of Resilience: Resilience refers as building capacity of institutions, processes and capacities that specifically deal with unanticipated, quick-onset events.
Country: South Asia
Perspective: Economic, infrastructure, institutions, and social
Methodology: Selected national-level resilience indicators from literature, interviews with subject matter experts, workshop with stakeholders from think tanks, universities, and NGOs.

Elliott, J.R., Haney, T.J. & Sams-Abiodun, P., (2010). Limits to social capital: comparing network assistance in two New Orleans neighborhoods devastated by Hurricane Katrina. *Sociological Quarterly*, 51(4), 624–648.

This study examines social network activation among residents of two unequal neighbourhoods – Lower Ninth Ward and Lakeview – during the different phases of the Hurricane Katrina disaster. The variables under investigation included bonding and bridging social capital, as well as their spatial dimensions – local and translocal. Lower Ninth ward was a disproportionally poor, African-American community and Lakeview was an affluent, white enclave. Using a phone survey, 90 residents from Lakeview and 89 residents from the Lower Ninth Ward were interviewed. The authors asked residents about early assistance from neighbours prior to the hurricane landfall, evacuation time, translocal support during relocation post-disaster, and reconnection with neighbours and neighbourhood meeting participation during recovery. Independent variables included residential tenure, home ownership, and number of neighbours known by name; the study controlled variables including gender, age, and parental status. The study found that the average Lower Ninth Ward resident evacuated more than a day later than their Lakeview counterparts. Possible explanations to the delay included lack of personal automobiles and subsequent inability to evacuate entire networks of residents. Residents in the poor neighbourhood also received less informal pre-disaster assistance, even if they know an equal number of neighbours as their wealthier counterparts from Lakeview. This result suggests that neighbours in a poor neighbourhood couldn't help each other as all of them might be facing similar vulnerable situations. In a post-disaster environment, residents from the Lower Ninth Ward were less likely to relocate to an area with a network tie. The benefits of knowing more neighbours pre-disaster dissipated post-disaster as the network is spatially displaced. However, contrary to other studies (e.g., Aldrich, 2012), they received the same level of assistance from formal relief and governmental

agencies during displacement. Yet, the authors suggested that this highlights a fundamental inequality – differential need is met with equal odds of formal assistance. During recovery, the odds of residents in the Lower Ninth Ward contacting their neighbours were significantly less than Lakeview residents, and residents surveyed from the Lower Ninth Ward attended neighbourhood recovery planning meetings one-third as much as residents in Lakeview. This study highlights the limits of social capital that's highly localized, such as bonding capital, as it is non-transferable spatially if it becomes displaced. A lack of translocal ties and the means to activate them also impede community recovery. Government initiatives that facilitate the cultivation of social capital will need to include other forms of capital (e.g., financial) to be effective in order to reduce community vulnerability and enable community capability.

Country: USA
Perspective: Human; social - community
Methodology: Telephone survey

Ganapati, N.E., (2012). In good company: why social capital matters for women during disaster recovery. *Public Administration Review*, 72, 419–427.

This study examines what kind of benefits, if any, social capital offers for women who are affected by disasters. Using the city of Gölcük, Turkey as a case study, the researcher conducted interviews with 40 earthquake survivors, 28 policy makers, and one local historian. The research found that social capital benefits women during disaster recovery because these networks provide psychological support and allow them to overcome trauma associated with the earthquake. Post-disaster emergent networks also enabled women to become more empowered in their homes and within larger social contexts. These networks also helped them to become more aware of their rights and offered opportunities for self-expressions. Furthermore, social networks, especially those that were informal, were instrumental in supporting women survivors to seek public assistance. The author suggested the following policy implications for creating social capital post-disaster: 1) enhance face-to-face interaction between disaster survivors and promote the creation and use of public spaces; 2) mobilise the potential for beneficial collective action through local leaders, as they could also strengthen pre-existing social capital and ensure the sustainability of emergent social capital; 3) create enabling institutions and policies relate to the voluntary sector, citizen participation and social inclusiveness, education, and equality, and local autonomy.

Country: Turkey
Perspective: Human; social

Methodology: In-depth, semi-structured interviews; participatory site observation; focus group

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George, B.P., (2008) Local community's support for post-tsunami recovery efforts in an agrarian village and a tourist destination: a comparative analysis. *Community Development Journal*, 43(4), 444–458.

This study examines the role of social capital in supporting tsunami recovery efforts in two different communities in India: one a tourist destination and the other an agrarian village. The author adopted a social capital measurement scale developed by Onyx and Bullen (2000) and conducted a social capital questionnaire on a total of 79 respondents from these two communities. Contrary to the assumption that an agrarian village would have higher levels of social capital than the tourist destination, and thus, higher support for recovery efforts, the results of the survey demonstrated otherwise. The study found that both communities possessed similar levels of social capital, but there was a significant difference in the willingness of residents to support recovery efforts. Residents in the agrarian village had higher levels of support for such efforts than their counterparts living in the tourist destination. Further analysis indicated that residents used social capital in divergent ways: one in support of recovery and the other to impede. The study indicated that pre-disaster local conditions facilitated post-disaster recovery efforts, in which residents in the agrarian village felt more connected to their community and felt recovery efforts would benefit them personally, as compared to those living in the tourist destination who felt they would be left behind because they perceive such efforts would benefit only

the tourists and vendors that cater to them. This study suggests the different ways in which social capital manifests in recovery efforts.

Country: India
Perspective: Social Capital
Methodology: Informal interviews, questionnaire, focus groups, non-probabilistic/convenience sampling

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Giordano, G. N., Björk, J., & Lindström, M. (2012) Social capital and self-rated health – A study of temporal (causal) relationships. *Social Science & Medicine*, *75*(2), 340–348.

This study clarifies the conceptual framework and measurements of social capital and how social capital influences health over time. It used data collected from a longitudinal survey of 8,114 randomly selected households between 2000 and 2007 in Britain. The dependent variable of the survey was self-rated health. The independent social variables included social capital – generalised trust, social participation, and frequency of talking to neighbours; socio-economic status – social class, education, and household income; social support – marriage status and frequency of meeting family or friends. Confounding variables included age, gender, smoking status, and time. The researchers found that low levels of trust and talking less with neighbours were associated with negative changes to health over time. For social participation, instead of being a determinant of health, good self-reported health influences active community participation. The authors argued that generalised trust (trust of strangers) and particularised trust (trust of known individuals or groups) – trust of strangers instead of known individuals or groups – is a proxy for social capital and that it is at the start of the causal pathway to health.

Country: England
Perspective: Human; health
Methodology: Longitudinal household surveys

Jordan, E. & Javernick-Will, A. (2012) Measuring community resilience and recovery: A content analysis of indicators (ASCE). *Construction Research Congress 2012: Construction Challenges in a Flat World*, 2190–2199.

This study seeks to address the questions of what indicators can be used to measure community recovery and what casual factors are critical to successful recovery. The authors analysed journal articles published between 2000-2010 from four disaster-focused journals (*Natural Hazards Review*, *The International Journal of Mass Emergencies and Disasters*, *Disasters* and *Earthquake Spectra*), which contain articles by engineers, social scientists, economists, and disaster practitioners. An in-depth content analysis on definitions and indicators of 202 articles was undertaken. The authors classified the recovery indicators within the social, economic, environment and infrastructure categories. The most frequently citied recovery indicators belong to the infrastructural category, and they include housing recovery and restoration of public facilities and lifelines. Across all the journals by discipline, housing recovery is widely cited. Social science articles cite social indicators such as population and emotional recovery more than other article types. Economic recovery indicators vary across the literature, but they usually include employment rates, income levels, government revenue received and number of businesses. The study also examined the types of indicators used to measure disaster resilience. Engineering-focused articles focused on structural elements and building codes and land use. Poverty was cited mostly in social sciences papers. Emergency preparedness was frequently cited in most article types. The authors also noted that few articles linked pre-event recovery planning to community resilience. The analyses of these articles provide researchers consistent framework of indicators for cross-case comparisons.

Definition of resilience: Resilience as the ability to withstand disaster impacts as well as to cope with those impacts and recover quickly. It can be thought of as a function of inherent resilience, the ability to withstand impacts without extensive losses, and adaptive resilience, the ability to adapt and access resources to cope with a disaster and recover.
Country: USA
Methodology: Content analysis of indicators

Kawachi, I., Kennedy, B.P. & Glass, R., (1999). Social capital and self-reported health: A contextual analysis. *American Journal of Public Health*, 89(8), 1187–1193.

This global assessment examined the contextual effect of self-rated health in relations to social capital indicators. This study delineated from investigations of social networks on health outcomes and focussed on the mechanisms of social capital, which includes trust, norms of reciprocity, and group membership. Telephone surveys were conducted with 167,259 people residing in 39 US states. Results of this study showed that states with low social capital had higher proportions of residents who reported their health as being only fair or poor (based on the following scale: poor, fair, good, very good, excellent). Through analyses of individual characteristics, there's no gender difference on the effects of social capital on perceived health. However, the effects of social capital on health were the greatest for those with the lowest income. All three indicators of social capital – trust, norms, and group membership – predict of self-rated health at the state level. A limitation to this study is that the results cannot rule out other compositional effects of social capital. That is, individual characteristics of people may have influenced where they live, such as social isolation of individuals living in socially isolated communities. The authors hypothesised that state level correlations between social capital and health could be attributed to egalitarian patterns of political participation that results in better policies for states with higher social capital. Low levels of interpersonal trusts may contribute to low levels of trust in public institutions and political participation, thus reducing efficacy of government institutions. At the neighbourhood level, the authors suggested three plausible ways in which social capital might influence individual health: 1) changes in health behaviours through diffusion of health information, promotion of healthy norms, and exertion of social control over ill-health activities; 2) increases in access to local services and amenities that are relevant to positive health outcomes; 3) provision of psychosocial support, such as affective support and serving as a source of self-esteem.

Country: USA
Perspective: Human; health
Methodology: Telephone surveys

Kawachi, I. et al., (1997). Social capital, income inequality, and mortality. *American Journal of Public Health*, 87, 1491–1498.

This study measured relationships between social capital, income inequality, and mortality rates at a state-level. It hypothesised that income inequality contributes to a decline in social cohesion and that disinvestment in social capital is in turn related to increased mortality. Using data from a national survey, the researchers averaged five year of cumulated data (from 1986-1990), representing 7,654 individual observations from 39 states. Indicators of social capital included measurements of civic engagement and levels of mutual trust among people. Civic engagement was measured by per capita number of groups and associations to which residents in each state belonged. Trust was measured by responses from two questions. Income equality was assessed using the Robin Hood Index. Mortality rates measured all-cause mortality, as well as other major causes of death and deaths from injuries. Results revealed significant negative correlations between income inequality and per capita group membership and trust. States with high levels of social mistrust had higher age-adjusted rates of total mortality and were associated with higher rates of most major causes of death, unintentional injury and infant mortality. Level of group membership levels was also found to have a negative significance on age-adjusted mortality and was a predictor of cause-specific deaths, after controlling for poverty levels. The study found that income equality was directly and strongly related to the causal factor of disinvestment in social capital, which in turn correlated strongly with mortality rates. When social capital is controlled, there was little association between income equality and mortality, suggesting that social capital exerts significant influences on positive health outcome.

Country: USA
Perspective: Human; social – health and social capital
Methodology: Secondary data sources - Nationally representative survey; US census; Centers for Disease Control and Prevention mortality data

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LaLone, M.B., (2012) Neighbors helping neighbors: an examination of the social capital mobilization process for community resilience to environmental disasters. *Journal of Applied Social Science*, 6(2), 209–237.

This study examines micro-level social capital mobilisation processes that occurred in tornado-stricken rural communities in eastern US. It discusses key processes, such as the types of labour and supply resources and how they were mobilised. The survey found an evolving disaster support network, which consists of various informal points of coordination, such as churches, businesses, schools, and other voluntary associations. Building upon previous work by Dynes (2006) and Murphy (2007), the study identified four types of social groups and networks that were engaged in disaster response efforts: established organisations (Type I); expanding organisations (Type II); extending organisations (Type III); and emergency organisations (Type IV). These different types of organisations are categorised based on their changing roles and tasks pre and post disasters. This paper also highlighted the different means in which social capital is manifested: bonding, bridging, and linking. In the tornado-impacted region, reciprocity of assistance between neighbours, family, and friends (bonding social capital) extended well beyond the impacted areas and the scope of those existence included clean-up labour, material donations, and psychological support from religious-based, job-based, and interest-based connections. Financial and material support also came from loosely connected outside networks (bridging social capital) through traditional and social media channels. Although there was an abundance of bonding and bridging social capital in rural communities, the author found these communities often lack meaningful linking social capital that can offer substantial long-term recovery assistance, such as rebuilding of homes. As such, the author stresses the importance that disaster planning needs to integrate a bottom-up, community and collaborative-based approach that takes into account of identifying and development social capital mobilisation capacities. These ad-hoc and 'on-the-ground social structures' can become valuable in procuring, coordinating, and distributing of post-disaster resources. Therefore, social capital capacity building should be a central focus of disaster management planning activities.

Definition of Resilience: Author emphasised *anticipation* and *preparation* of community disaster resilience.
Key words: Environmental disasters, social capital, community-based research, community resilience, emergency disaster planning
Country: USA
Perspective: Human; social capital
Methodology: Documentary research (written and online documentary sources), including sources from newspaper and television, internet, websites of local agencies and organisations, social networking sites, and reports from the state department of emergency management agency.

Okada, N., Yokomatsu, M. & Ikeo, H., (2010) Analyzing urban rituals with reference to development of social capital for disaster resilience. *2010 IEEE International Conference on Systems, Man and Cybernetics*, pp.3477–3482.

This study examines the role of social capital developed through ritual events in building a disaster resilience community. By assessing whether the annual ritual event – *Danjiri Matsuri* – in the city of Kishiwada contributes to the development of social capital and disaster resilience, 485 survey responses on bonding and bridging social capital, trust, disaster awareness and self-reliance were collected. The *Danjiri* comprises of various elements such as community participation, social inclusion, sharing of roles and responsibilities, and involvement of local organisations. The study found that the perceived gain from the rituals and trust are positively correlated with bonding and bridging social capital. Hazard awareness and self-reliance are positively correlated with trust. Thus, trust is the mediating factor for social capital and disaster resilience.

Key words: Rituals, social capital, resilience, disaster risk, multiple correlation analysis
Country: Japan
Perspective: Social capital, community
Methodology: questionnaire surveys

Onyx, J. & Bullen, P., (2000) Measuring social capital in five communities. *The Journal of Applied Behavioral Science*. 36, 23–42.

This paper develops an empirically grounded measurement of social capital, which is based in terms of participation in networks, reciprocity, trust, social norms, the commons, and collective efficacy. A questionnaire that includes 68 items related to social capital was administered to approximately 1200

adults in five Australian communities. There were also eight independent factors being measured: participation in the local community, social agency/proactivity in a social context, feelings of trust and safety, neighbourhood connections, family and friends connections, tolerance of diversity, value of life, and work connections. After an analysis of the results, 36 of the original 68 items were found to correlate to and account for a substantial amount of variance of the total social capital scale score. Generally, the survey found that social capital is not correlated with demographic variables, such as age, gender, work levels, income, and qualification levels, although with a few exceptions. The study also found different types of social capital factors between rural and urban areas, where rural communities possess considerable bonding social capital, while urban areas generate high levels of bridging social capital. The social capital scale developed in this study formed the basis of later disaster-related research, including the work of George (2008).

Country: Australia
Perspective: Social Capital
Methodology: Questionnaire, factor analysis

Kaniasty, K. & Norris, F.H., (1995) In search of altruistic community: patterns of social support mobilization following Hurricane Hugo. *American journal of community psychology*. 23(4), 447–477.

This study investigated patterns of social support following Hurricane Hugo in southeastern US, in particularly, whether perceived social support is associated with actual support received and provided. The variables under analysis included disaster impact in terms of loss (i.e., property damage or other financial or personal losses) and harm (i.e., injury or threat); person characteristics that included demographic indicators such as race, sex, marital status, age, and education; and social support. Two control variables were used, including network size based on respondent's relatives, friends, and neighbours, and the life events variable, which measures the number of other desirable, undesirable, and potentially traumatic life events occurring in the year preceding the hurricane. Social support was measured using the adapted version of the Inventory of Socially Supportive Behaivors (ISSB). The final assessment included 32 items that measure both received and provided supportive behaviours. There was a high level of correlation between receiving and providing support, and the data revealed three social support trends among residents impacted by the Hurricane. First, hurricane victims received more support than non-victims, and high-loss victims received more support than those who suffered fewer losses. Second, tangible (material) social support showed the most differences in receiving and providing between different groups, followed by informational social support, then emotional support, which was in absolute terms the most frequently received. Third, patterns of provision support were similar to that of receipt of support. Disaster victims provided support as much receiving support, and tangible support showed the greatest differences and emotional support the smallest. The predictors of and differential receipt of support included network size and life events. Residents with larger social networks received more tangible help. Whites reported receiving more tangible help than blacks, especially among the low- and high-loss victims. This result suggests that black victims experienced a pattern of neglect for all types of social support – tangible, informational, and emotional – as compared to their white counterparts, when network size and life events are controlled. This result was consistent with prior research from other disasters, including victims of Hurricane Andrew (Kaniasty & Norris, 1994). Furthermore, poor and minorities had also faced greatest difficulties securing adequate assistance and recovery from disaster (Bolin & Bolton, 1986). Women also received more tangible and emotional support. Age also plays a factor in terms of support received, with age shows an inverse relationship with support received. Disaster victims with less education received less tangible and emotional support, suggesting differential patterns of neglect. On the flip side, those with larger social networks and more life events provided more tangible help. Whites provided more tangible help than blacks, but blacks provided more informational help. The study revealed that community residents provided and received substantial help immediately following the disaster, but there exists significant differences between groups.

Key words: Social support; helping behaviour; disasters; major life events; traumatic stress
Country: USA
Perspective: Human; social support
Methodology: Interviews

Leykin, D. et al., (2013) Conjoint Community Resiliency Assessment Measure-28/10 items (CCRAM28 and CCRAM10): A self-report tool for assessing community resilience. *American journal of community psychology*. 52(3-4), 313–23.

The authors created the Conjoint Community Resiliency Assessment Measure (CCRAM), a tool that included different aspects of previous resilience measures (e.g. Cutter et al. 2008; Norris et al. 2012; Pfefferbaum et al. 2013) and used an inductive, exploratory, sequential mixed methods design. The development of the tool included three main phases – contextualization of resilience concepts, generation of resilience indicators, and validation of instrument. The study used the CCRAM tool to assess the attitudes and perceptions of 1,052 adults from 15 small to medium six communities throughout Israel. The tool measured five resilience factors with 21 indicators: leadership (6 indicators), collective efficacy (5), preparedness (4), place attachment (4), and social trust (2). It also included seven items requested from local and emergency management leaders, and they included items pertaining to perception of service continuity, quality of information received during emergency, and intentions to leave community during crisis. The tool and its factors are shown to demonstrate both internal and external validity. The results of the survey highlighted that the type of settlements is strongly correlated to overall community resilience and individual resilience factors. Leadership as a construct explained the most significant portion of the variance in the survey.

Key words: Community resilience, emergency preparedness, CCRAM
Country: Israel
Perspective: Community - all
Methodology: Mixed methods: key informant interviews, semi-structured interviews, meetings with subject matter experts, questionnaire

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Lochner, K. a. et al., (2003) Social capital and neighborhood mortality rates in Chicago. *Social Science and Medicine*, 56, 1797–1805.

The authors of this study examined the interconnection between neighbourhood social capital and mortality rates in 343 neighbourhood clusters in Chicago, USA. Using three indicators of social capital – residents' perceptions of reciprocity and trust, as well as associational membership, the authors sought to see how these factors relate to four different death causes – all-cause, heart disease, cancer, and other causes – across race (i.e., white and black) and gender (i.e., men and women). By controlling neighbourhood economic deprivation, which comprises of three components – proportion of residents 1) living below the poverty line, 2) on public assistance, and 3) unemployed, the study found that social capital was associated with lower neighbourhood death rates. The three indicators of social capital were positively correlated with each other, with the strongest correlation between reciprocity and trust. These three indicators were negatively correlated with neighbourhood deprivation. The correlation between social capital and death rates was most consistent for whites and for both men and women. For blacks, civic participation was significantly associated with total death rates for both black men and women, while trust showed marginally significant associations for the same group, with reciprocity showing significant correlation for black men only. A few variables were not controlled in this study, including household income or educational attainment, residential isolation. Additionally, this study cannot exclude reverse causation, in which higher death rates led to erosion of trust and other social capital indicators. The authors suggested that investing in social capital alone is unlikely to maximize health without addressing other inequalities of other types of capital – financial and human. Social capital is an essential, but not sufficient, aspect of health improvement.

Country: USA
Perspective: Human health; social capital
Methodology: Clustered random household interviews; secondary data (e.g. US census data)

Moore, S. et al., (2004) After Hurricane Floyd passed: investigating the social determinants of disaster preparedness and recovery. *Family & Community Health*, 27(3), 204–217.

This study examines how social factors including social capital; social cohesion and collective efficacy affect community preparedness, response, and recovery in five low-income North Carolina counties

after Hurricane Floyd and subsequent flooding. The authors hypothesised that social factors, such as social capital, social cohesion, and collective efficacy, act as moderating variables for community vulnerability. Conceptual definitions of these variables were discussed. This paper provided preliminary results (no subsequent publications of final results could be found). In terms of preparedness, the study found that a range of reactions from impacted residents and leaders regarding pre-hurricane preparation efforts and warnings. In retrospect, some residents had low sense of self-efficacy in dealing with incoming flood waters. Others blamed a lack of warning and wrong information from local authorities and the media. Socio-economic factors may have also played a role in people's vulnerability as the poor lived on lower ground. Residents also cited differential priorities by the government in community protective measures, with urban areas more protected than smaller towns, as well as biased warning information towards those living in urbanised, English-speaking populations. During the response and relief phase, residents, relief workers, and rescuers came together to offer support for each other. Local businesses, community organisations, and churches also contributed to the response efforts. However, a small number of cases of looting and businesses engaged in price gouging of relief supplies. Some interviewees also faulted relief agencies and government entities engaged in disaster relief for unfair allocation of aid or for having the wrong priorities. As residents recover from the floods, the 'feeling of togetherness' felt during the response phase subsided. Some residents relocated or forced to live in temporary housing accommodation away from their homes. Local authorities and organisations cited inadequate reconstruction volunteers and contractors as a result of government reimbursement policies. Additionally, residents cited a lack of general concern from fellow residents and the government during recovery. The idea of an 'altruistic community' following a disaster is therefore a temporary condition. The study argues that current measures of social capital, social cohesion, and collective efficacy reflect more of people's perceptions of community relations, rather than the resources that actually exist to those communities. By measuring actual resources, pre-existing inequalities and disparities among communities can be exposed and subsequently addressed. Furthermore, the authors argue for a reconsideration of current conceptualisations of social indicators such as social capital it is not equally distributed in society. Thus certain groups or neighbourhoods may have more resources to draw on during a disaster than others, allowing them to recover faster and more effectively.

Country: USA
Perspective: Human; social factors: social capital, social cohesion and collective efficacy
Methodology: Participatory research through focus groups, photo voice methods, key-informant interviews, participant-observation fieldwork, archival data and other secondary data (e.g. US census) and surveys

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Nakagawa, Y. & Shaw, R., (2004) Social Capital: A Missing Link to Disaster Recovery. ***International Journal of Mass Emergencies and Disasters*****. 22(1), 5–34.**

This study examines the role of social capital in the recovery process in Kobe, Japan and Gujarat, India. Using primary and secondary data to analysis the levels of bonding, bridging and linking social capital in two neighbourhoods – one in Kobe and one in Gujarat – the authors found that social capital contributed to both the quality and speed of recovery. In the community of Mano, Kobe, pre-existing community groups helped cultivate different forms of social capital which contributed to effective response and reconstruction activities, such as providing housing for the elderly and establishment of a day-care centre. Furthermore, leaders of these groups had worked previously with civic officials and other institutions, and thus in a post-earthquake environment, they were able to leverage these relationships to secure relief and recovery resources for the community. In Gujarat, the study examined the levels of social capital of four communities in the region. It found that the community of Soni recovered the fastest, despite having a lower income level. The authors attributed the speed of recovery and the satisfaction rate for the reconstruction plan to high levels of social capital, which included measures of collective decision-making, trust in community leaders, and the numbers of networks with government agencies. Through the examination of these two case studies, the study found that social capital played an important role in rescue and relief efforts. Moreover, high levels of social capital increased the speed and satisfaction of reconstruction planning.

Country: Japan and India
Perspective: Social – social capital
Methodology: Interviews, questionnaire, secondary data

Paton, D., (2013) Disaster resilient communities: developing and testing an all-hazards theory. *Journal of Integrated Disaster Risk Management*. 3(1), 1–17.

Because disaster preparedness plays an important role in increasing community and societal resilience, this paper assesses the validity of an all-hazard model of preparedness based on identifying the personal- and social-level processes. By examining the factors that facilitated decision making under conditions of uncertainty in different hazards (e.g. tsunami, earthquake, wildfire, and influenza pandemic) in three different countries (i.e., Australia, New Zealand, and the US), the author validated the personal-level processes (i.e., negative outcome expectancy, positive outcome expectancy, and intentions) and societal-level processes (i.e., community participation, collective efficacy, place attachment, empowerment, and trust) that contributed to individual preparedness. Results of this study have implications on risk communication and preparedness planning, including government strategies that encourage community members to identify and discuss potential hazards and empowering community members by engaging them to take preparation actions.

Keywords: Earthquake, tsunami, wildfire, pandemic, community, empowerment, trust, preparedness, all-hazard

Country: Australia

Sakamoto, M. & Yamori, K., (2009) A study of life recovery and social capital regarding disaster victims − a case study of Indian Ocean tsunami and central Java earthquake recovery. *Journal of Natural Disaster Science*, 31(2), 49–56.

Using the life recovery framework, the study examines the critical factors associated with life recovery in Indonesia in the aftermath of the Indian Ocean Tsunami in 2004 and the Central Java Earthquake in 2006. The study was conducted in Aceh, which was heavily damaged by the Indian Ocean Tsunami, and Yogyakarta, which was impacted by the Central Java Earthquake. Due to cultural and language differences, the framework's seven critical factors were adjusted to include eight factors: housing, social ties, neighbours, physical and psychological health, preparedness, economic and financial situation, relation to government, and religion. Forty semi-structured interviews were conducted – 20 in Aceh and 20 in Yogyakarta. The authors found discrepancies regarding recovery priorities associated with the eight critical factors between the two regions. The source of discrepancies centres on the presence of "neighbourly communications" and community-based activities (e.g. community meetings, community works, and fundraising) that foster reciprocity and trustworthiness among neighbours. In Yogyakarta, activities that facilitate communal reciprocity continue to exist post-disaster, but residents from Aceh, who were relocated to a new community of Tzu-chi (in Aceh), few community events occurred and due to differential damages experienced by residents there, few were hesitant to talk to each other. Thus, people in Yogyakarta considered that "neighbours" or "social ties" as important aspects in their recovery trajectory, while people in Tzu-chi saw them as less important and rely mostly on religion to aid their recovery. Self-reported recovery reflects recovery of different critical factors, including differences in the degree of hazard damages, quality of reconstructed houses and social background. However, the authors noted that the network between neighbours was considered the most critical in life recovery.

Keywords: Life recovery, social capital, Indian Ocean Tsunami, Central Java Earthquake
Country: Indonesia
Perspective: Social recovery
Methodology: Semi-structured interviews

Sherrieb, K. et al., (2012) Assessing community resilience on the US coast using school principals as key informants. *International Journal of Disaster Risk Reduction*. 2, 6–15.

Based on Norris et al.'s (2008) framework of community resilience as a set of networked adaptive capacities, this paper seeks to assess community adaptive capacities by surveying school principals as key informants to determine their opinions about the capacities of their communities. By using and expanding the CART (Communities Advancing Resilience Toolkit) survey, principals were asked about measures on social capital, economic development, information and communication, and

community competence of their communities (Pfefferbaum et al. 2013). The 37-item survey was completed by 968 school principals in 188 coastal US counties (excluding Alaska and Hawaii), and 165 of them made further comments about their communities. Of the 37 items in the survey, 27 of the items showed high internal consistency; the authors conducted factor analysis and found support for the construct validity of the survey items. No comparative analysis of community resilience between the coastal counties was discussed.

Key words: Community resilience, disasters, key informants
Country: USA
Perspective: Social – social capital
Methodology: Survey (quantitative and qualitative)

Sherrieb, K., Norris, F.H. & Galea, S., (2010) Measuring capacities for community resilience. *Social Indicators Research*. 99(2), 227–247.

This study operationalizes the sets of adaptive capacities for economic development and social capital in the Norris et al. (2008) community resilience model by using publicly accessible population indictors to measure resilience of 82 counties in Mississippi. A Community Resilience Index was created by using Mississippi county data and was validated the indicators against a well-established index of social vulnerability (Cutter et al. 2003) and an aggregated survey data on collective efficacy. Ten indicators for economic development and seven indicators for social capital were identified and validated for inclusion in the index. For the social capital dimension of the index, the seven indicators include those that measure social support (ratio of two-parent households and single-parent households), social participation (number of arts/sports organisations, number of civic organisations, voter participation rate, religious adherents) and community bonds (net migration rate and property crime rate). The resulting assessment of resilience in Mississippi offers knowledge about the spatial distribution of capacities and disaster risk, so that pre-disaster resilience interventions can be implemented to areas where needed.

Country: USA
Perspective: Economic and social
Methodology: Secondary data sources, survey data

Singh-Peterson, L. et al., (2014) Translation and evaluation of the Baseline Resilience Indicators for Communities on the Sunshine Coast, Queensland Australia. *International Journal of Disaster Risk Reduction*. 10, 116–126.

This study adapts to Baseline Resilience Indicators for Communities (BRIC) (Cutter et al. 2010) to the Sunshine Coast region. Due to differences in policies or in the types/formats of available data, the authors substituted a number of indicators. The authors of this study consulted with representatives from the Sunshine Coast Regional Council and Emergency Management Queensland in the selection of substitute indicators. Additionally, an evaluation of the BRIC indicators was undertaken by members of the Local Disaster Management Group (LDMG) and the District Disaster Management Group (DDMG), which represent key service provider in telecommunications, energy, water and health services, as well as emergency service operations and local government representatives. After applying BRIC in the Sunshine Coast region, the authors and members from LDMG and DDMG identified a number of key weaknesses in the measurement. First, health officials indicated that the medical capacity indicator underestimates existing resilience, as it does not reflect the ability of the health system to increase medical capacity as needed. Second, certain indicator, such as access/evacuation potential based on principle arterial miles was difficult to contextualize. Third, data deficiency for social capital indicators might underestimate the actual resilience of the study area. Last, the lack of ecological resilience indicators limited the usefulness of BRIC for the Sunshine Coast region. The LDMG and DDMG suggested subsequent measurement of resilience to include variables including the potential for available support, community's risk and resilience perception, level of community needs, and psychological and emotional wellbeing.

Key words: Community resilience, disaster resilience, emergency management, assessment community resilience
Country: Australia

Perspective: Community - all
Methodology: Secondary data

Storr, V.H. & Haeffele-Balch, S., (2012) Post-disaster community recovery in heterogeneous, loosely connected communities. *Review of Social Economy*. 70(3), 295–314.

Post-disaster community recovery is a collective action problem – individuals wait for others to begin recovery before starting the process themselves. This study highlighted how heterogeneous, loosely connected communities overcome this problem by focusing the recovery efforts of Broadmoor after Hurricane Katrina. A social capital perspective was used for this analysis. Based on interviews with residents, evacuees, and community leaders, the study found that a pre-existing organisation – Broadmoor Improvement Association (BIA), played a critical role in post-disaster recovery and redevelopment of the neighbourhood. After three years, more than 82% of the properties in this diverse community were either liveable or under repair. The key factor that enabled BIA to be effective was its ability to identify and leverage local knowledge and resources. Specifically, the organisation possessed strong leadership, organisational, and communication capacities, which allowed it to communicate and rally local residents to over the collective action problem – proving the neighbourhood's viability to city planners. It also used local resources such as local churches as operational centres in the aftermath of the disaster, as well as expertise of its members to reconnect residents and academic institutions to effectively engage in data collection and public discussions on community redevelopment. The knowledge recreated and individuals reconnected enabling the organisation to secure funding and to sway local politicians to support local recovery.

Key words: Social capital, post-disaster recovery, Hurricane Katrina, New Orleans
Country: USA
Perspective: Human; social capital
Methodology: Semi-structured interviews with residents and community leaders. Surveys and 'loosely structured' interviews with New Orleans evacuees.

Thornley, L., Ball, J., Signal, L., Aho, K.L., Rawson, E., (2014) Building community resilience: learning from the Canterbury earthquakes. *Kōtuitui New Zeal. J. Soc. Sci.* Online 37–41.

This paper explores community level resilience-building following the Canterbury earthquakes through qualitative research from interviews and focus groups with community leaders and residents across six diverse Canterbury communities. The authors build on Paton's previous work in New Zealand, Australia, and the Asia-Pacific Region, to identify individual, community, and societal level factors that promote resilience to disasters and post-disaster adaptation. The authors find that there is much international literature of individual resilience and factors of psychosocial recovery from disasters, but little publication of the factors that help and hinder resilience at the community level.

This research identified a number of factors of resilience by which indicators could be grouped: well-being of individuals and communities; community connectedness and infrastructure; community participation in disaster response and recovery; and community engagement in official decision making. The authors offer advice for other communities as communicated to them by participants in this research process. These related to actions that can be taken before disaster strikes, and the communication and support required in the event of a disaster.

Definition of resilience: The process of communities adapting

Key words: community resilience; community perspectives; disasters; New Zealand

Country: New Zealand

Perspective: Individual, community, and societal resilience to, and recovery from, disasters.

Methodology: Qualitative interviews and focus groups with community leaders and residents in six communities.

UNISDR (2013) *Towards the Post-2015 Framework for Disaster Risk Reduction - Indicators of success: a new system of indicators to measure progress in disaster risk management*. The United Nations Office for Disaster Reduction. Report (November 2013). Online, Available from http://www.unisdr.org/files/35716_newsystemofprogressindicatorsfordrr.pdf.

This paper reviews the indicators used to measure progress of five priority actions under the Hyogo Framework for Action (HFA). Some of the key weaknesses of the 22 core indicators implemented include a lack of assessment on whether risk reduction is addressing the underlying risk drivers; progress is not considered with respect to the disaster risk a country faces; indicators are input-oriented rather than output-oriented; duplication of indicators; and subjective, thereby eliminating a valid means for cross country comparison. The new set of indictors will focus on the underlying risk drivers, which include factors relating to economic and fiscal structure; poverty and social vulnerability; environmental degradation and climate change; urbanization; coping capacity; and overall governance. Each domain is accompanied by a set of variables. The social aspects of the indicators include gender inequality, health expenditures, education, health care capacity, and communication access. The new system of indicators was piloted in 49 countries, with the results inputted into the UN Global Assessment Reports 2015 (GAR15).

8 Psychological Resilience

In the 1980s psychological research started to shift from a focus on vulnerability to resilience. This shift is linked to the emergence of the field of positive psychology, further branching out into such fields as Positive Organisational Behaviour (POB), which refers to the application of this concept in a workplace setting, creating a new concept - employee resilience.

There are wide varieties of factors that determine an individual's level of resilience, with existing research suggesting that genetic, biological, psychological, and environmental factors all play significant roles. In addition, the interaction amongst these factors is likely to have a combined, varied effect on individuals. There is no one characteristic identified as resilience - rather; there are many traits, behaviours and actions associated with resilience.

The debate about whether resilience is a trait or state-like concept remains unresolved (in psychology and many other fields). The distinction is important as a trait-like approach suggests a given, fixed personality that is stable and enduring, while the state-like approach would argue for its developable nature. Both of these are important for organisations in such areas as recruitment, selection, management and development of employees.

The study of resilience enables us to determine the factors and processes that impact on the positive adaptation to stress, thus aiding us in understanding how to prevent or intervene in order to help individuals to recover from stressful situations or post-traumatic disorders (PTD).

This bibliography is organised in a chronological order, starting with the move from vulnerability studies to that of resilience mainly in developmental psychopathology until the emergence of Positive Psychology, in which resilience is identified as an integral part.

Avey, J. B., Luthans, F., & Jensen, S. M. (2009). Psychological capital: A positive resource for combating employee stress and turnover. *Human Resource Management*, *48*(5), 677-693.
This paper focuses on combatting occupational stress by applying the Positive Organisational Psychology concept of PsyCap. The intention was to gain better understanding of variation in perceived symptoms of stress, as well as intentions to quit and job search behaviours of employees. The empirical study uses a large sample of employees from various industries. Findings suggest an inverse relationship between PsyCap and employees' intention to quit and symptoms of job stress. Thus, with enhanced psychological capital employees' stress levels and their intention of voluntary turnover were reduced. Limitation, perhaps, is the lack of processes that these characteristics undertake in order to achieve the desired outcome.

KEYWORDS: positive psychological capital, stress, turnover intentions
DEFINITION OF RESILIENCE: "developable capacity to rebound or bounce back from adversity, conflict, failure, or even positive events, progress, and increased responsibility" (Luthans, 2002a, p. 702)
PERPSECTIVE: I/O research
METHODOLOGY: Exploratory, quantitative paper

Bonanno, G. A. (2004). Loss, Trauma, and Human Resilience: Have We Underestimated the Human Capacity to Thrive After Extremely Aversive Events? American Psychologist, 59(1), 20-28. doi: 10.1037/0003-066X.59.1.20

This short article provides a good summary of the various pathways to resilience in adulthood, through the traits of hardiness, self-enhancement, repressive coping and positive emotions\nces. In addition, the article offers a very useful section on the differentiation of recovery and resilience.

DEFINITION OF RESILIENCE: Resilience in this article pertains to the ability of adults in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event, such as the death of a close relation or a violent or life-threatening situation, to maintain relatively stable, healthy levels of psychological and physical functioning.

PERPSECTIVE : Developmental psychopathology

METHODOLOGY: Conceptual paper

Campbell-Sills, L., Cohan, S. L., & Stein, M. B. (2006). Relationship of resilience to personality, coping, and psychiatric symptoms in young adults. *Behaviour research and therapy*, *44*(4), 585-599.

This paper acknowledges, and tries to rectify, the long-standing focus of resilience studies on children by investigating resilient adaptation in adulthood. This study looks at understanding the relationship between resilience and the personality traits of neuroticism, extraversion, positive emotions, conscientiousness, self-efficacy and task-oriented coping styles and the outcome of psychiatric symptoms. The results demonstrated the expected relationships with the above, well established, personality constructs and coping and psychiatric symptoms. This paper used the resilience measure of CD-RISC by Connor and Davidson (2003).

DEFINITION OF RESILIENCE: “a dynamic process wherein individuals display positive adaptation despite experiences of significant adversity or trauma” (Luthar & Cicchetti, 2000, p. 858).

KEY WORDS: Resilience (psychological); Stress reactions; Emotional trauma; Five-factor personality model; Coping behaviour; College students

COUNTRY: US

PERPSECTIVE: Psychopathology

METHODOLOGY: Quantitative research

Campbell-Sills, L., Forde, D. R., & Stein, M. B. (2009). Demographic and childhood environmental predictors of resilience in a community sample. *Journal of Psychiatric Research*, *43*(12), 1007-1012.

This empirical paper uses a self-report scale that measures individual resilience (CD-RISC) in a community sample. The findings suggest such demographic characteristics of sex, education and income level are predictor of individual resilience to stress. In addition, childhood maltreatment has been identified as a significant predictor of this trait. Offers a good assessment of the influence of demographic factors in the outcome of resilience in a community sample.

DEFINITION OF RESILIENCE: Resilience refers to the ability to thrive in the face of stress and other adversity.

COUNTRY: US

PERPSECTIVE: Stress and mental health

METHODOLOGY: Empirical paper using regression analysis

K.M. Connor, & Davidson. J.R.T. (2003) Development of a new resilience scale: The Connor–Davidson Resilience Scale (CD-RISC). *Depression and Anxiety*, 18 (2003), 76–82

This article is important as to date there are view validated psychological resilience measurement scales that are applicable to the adult population. To this extent, the authors have developed a new self-report instrument, the Connor–Davidson Resilience Scale (CD-RISC). This measure was designed with the dual goals of establishing norms for resilience in normal and clinical samples and assessing the extent to which resilience scores change in response to treatment. The CD-RISC is made up of items reflecting several aspects of resilience including a sense of personal competence, tolerance of negative affect, positive acceptance of change, trust in one's instincts, sense of social support, spiritual faith, and an action-oriented approach to problem solving. The CD-RISC is a 25-item scale that measures the ability to cope with stress and adversity. Items include: "I am able to adapt when changes occur," "I tend to bounce back after illness, injury, or other hardships," and "I am able to handle unpleasant or painful feelings like sadness, fear, and anger." Respondents' rate items on a scale from 0 ("not true at all") to 4 ("true nearly all the time"). The scale demonstrates that resilience is modifiable and can improve with treatment, with greater improvement corresponding to higher levels of global improvement.

Keywords: Key words: resilience; stress coping; wellbeing; posttraumatic stress disorder; anxiety; depression
COUNTRY: US
PERPSECTIVE : Treatment of anxiety, depression, and stress reactions
METHODOLOGY: Empirical paper validated on a general population sample

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Luthans, F., Avolio, B. J., Avey, J. B., & Norman, S. M. (2007). Positive psychological capital: Measurement and relationship with performance and satisfaction. *Personnel psychology*, *60*(3), 541-572.

This study assesses the construct of PsyCap and its ability to predict job performance and satisfaction in a student as well as employee sample. While this research does not provide evidence for the predictive ability of resilience as an individual concept, the composite of the PsyCap construct, including optimism, hope, self-efficacy and resilience proved to predict job performance and satisfaction. This suggests the benefits stemming from the synergies between these construct. Shortcoming of this work may be the lack of consideration for situational-contextual factors that influence or interact with this relationship.

DEFINITION OF RESILIENCE: Resilience is characterized by positive coping and adaptation in the face of significant risk or adversity (Masten, 2001)
PERPSECTIVE : I/O research
METHODOLOGY: quantitative paper

Luthans, F., & Youssef, C. M. (2007). Emerging positive organisational behaviour. *Journal of Management, 33*(3), 321-349. doi: 10.1177/0149206307300814

Resilience in the management literature is an emerging topic and Luthans is one of the authorities of POB, including resilience. This review article examines selected representative positive traits (Big Five personality, core self-evaluations, and character strengths and virtues), positive state-like psychological resource capacities (efficacy, hope, optimism, resiliency, and psychological capital), positive organisations (drawn from positive organisation scholarship), and positive behaviours (organisational citizenship and courageous principled action). The article provides a summary of positivity (including resilience) in the workplace literature. Resilience is highlighted as a dimension of positivity and Psychological Capital (PSYCAP). The definition on p. 326 offers a very good theoretical description of positive capacities in the workplace on a continuum from pure states, to state-like characteristics, to trait-like characteristics and pure trait. POB perspective of resilience highlights this construct as a learnable capacity.
DEFINITION OF RESILIENCE: "the capacity to rebound or bounce back from adversity, conflict, failure, or even positive events, progress, and increased responsibility"
PERPSECTIVE : I/O research
METHODOLOGY: Conceptual paper

McCrae, R. R., & Costa Jr, P. T. (1997). Personality trait structure as a human universal. *American psychologist*, *52*(5), 509.

This seminal paper across the sub-fields of psychology hypothesised the universality of the Big-5 personality traits. The Big-5 structure includes the traits of e.g. neuroticism,

agreeableness, openness, consciousness and extraversion (McCrae and John, 1992). This paper is important because resilience has been found to be associated with openness, extraversion and emotional stability (not neuroticism), amongst others. However, if this association suggests that resilience may also be a trait-like concept, thus relatively enduring, fixed style of thinking feeling and acting, then the ability to develop and improve one's resilience can be questioned. This paper assessed the Big-5 traits in 6 culturally diverse countries, finding no contextual-cultural influence, thus supporting universality.

COUNTRY: Multinational comparison
PERPSECTIVE: Cross-cultural psychological
METHODOLOGY: Qualitative

McLarnon, M. W., & Rothstein, M. G. (2013). Development and initial validation of the Workplace Resilience Inventory. *Journal Of Personnel Psychology*, 12(2), 63-73. doi-10.1027/1866-5888/a000084

While Luthans' PSYCAP conceptualises resilience as an outcome, the measurement introduced in this paper builds on King and Rothstein's theory of resiliency. In this perspective resilience is a predictor of resilience-related outcomes, which can differ depending on the situational context and adversity experienced, terming the concept "resiliency process" by which well-being is restored. This is quite a notable distinction, suggesting that resiliency is a dynamic process that unfolds overtime influenced by situational and individual-difference variables, self-regulatory and protective processes where outcomes must be chosen to match the adversity experienced. Sounds like a more comprehensive approach to resiliency and a potentially useful measurement scale to explore employee resilience, however it's new and needs further validation.

KEY WORDS: resilience, test development, test validation, well-being, positive psychology, self-regulation, incremental validity
DEFINITION OF RESILIENCE: Resiliency is a dynamic process that unfolds over time involving self-regulatory and protective processes and situational variables as well as individual difference variables
COUNTRY: Canada
PERPSECTIVE : I/O research
METHODOLOGY: Empirical, quantitative study

Ozbay, F., Fitterling, H., Charney, D., & Southwick, S. (2008). Social support and resilience to stress across the life span: a neurobiological framework. *Current Psychiatry Reports*, 10 (4), 304-310.

This conceptual paper assesses resilience to stress from a neurobiological and genetic perspective. However, the paper also discusses the importance of contextual factors, mainly social support in this context. Along with acknowledging the role genetic and biological factors in stress vulnerability and resilience, this paper also highlights the mediators, through which social support exerts its positive effect, such as by preventing negative cognitive appraisal, providing positive appraisal support, leading to a higher use of active coping mechanisms and through supporting self-esteem of individuals. Interestingly, the authors also point to the limited research on stress inoculation and its benefits, such as lower blood pressure and heart rate in the case of children that have been exposed to mild stress in childhood or children who have been separated from their parents and stayed with grandparents often showed lower stress when hospitalised (p.307). This highlights the advantages of mild stress.

PERPSECTIVE: Stress and mental and physical health

METHODOLOGY: Small meta-analysis

Rutter, M. (1987). Psychosocial resilience and protective mechanisms. *The American journal of orthopsychiatry, 57*(3), 316-331. doi: 10.1111/j.1939-0025.1987.tb03541.x

One of the first works that lays down the foundations of early theories of resilience by highlighting identification of child characteristics associated with positive outcomes in the face of adversity. The author characterizes resilience as the positive end of the continuum of developmental outcomes among high-risk individuals, while the negative end being vulnerability. As most of the early works on human resilience, this article studies children and their coping abilities and builds on Garmezy's (1985) work where the author lists factors such as personality traits, family circumstances and external support networks as protective factors. Rutter however takes this a step further and suggests the need to look at the "hows" of resilience by assessing the processes that, through adaptive change, led to successful, sustainable coping. This research found that protective processes are those that reduce risk through altering exposure to it, reduces negative chain reactions, promote traits such as self-efficacy and esteem by utilizing supportive interpersonal relationships, amongst others.

Cited: Garmezy, N., Masten, A. S., & Tellegen, A. (1984). The study of stress and competence in children: A building block for developmental psychopathology. *Child development*, 97-111.

PERPSECTIVE: Developmental psychopathology

METHODOLOGY: Conceptual paper, similar to a meta-analysis

Seligman, M. E., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. ***American Psychological Association*****. 55 (1), 5-14.**

Seligman and Csikszentmihalyi are two influential thinkers that greatly contributed to the development of positive psychology (PS). This article is a good summary of works that, in the last decade up to 2000, have been influential in the evolution of this field. It also moves the reader through the history of psychology from the emphasis on pathology, to humanistic psychology and finally to PS, shifting the focus from weakness and damage to virtue and strength. Offering an insight into how negative wellbeing outcomes can be prevented, not just treated. There are plenty of references in this work to articles that deal with such buffers as courage, optimism, positive emotions, hope, work ethic, self-determination and capacity for flow. (Flow is perhaps the foundation of PS, for more on flow refer to Csiksentmihalyi (1975). The article suggests the potential for PS to help us build on qualities that aid individuals and communities not just to endure and survive but flourish – which would be consistent with resilience.

COUNTRY: US
PERPSECTIVE: Positive Psychology
METHODOLOGY: Conceptual paper

Shin, J., Taylor, M. S., & Seo, M. G. (2012). Resources for change: The relationships of organisational inducements and psychological resilience to employees' attitudes and behaviors toward organisational change. ***Academy of Management Journal*****,** ***55*****(3), 727-748.**

This paper is amongst the few to investigate the ability of employees' psychological resilience and organisational inducements to influence workers' attitude towards organisational change. The article deals with the very contemporary issue of dynamic organisational context, where change is normal, rather than an exceptional need and in doing so, contributes to the change literature by emphasizing the importance of employee resources as a potential determinant of change success. This study uses a longitudinal survey design and an employee sample from an IT company in South Korea. Resilience is viewed as a valued resource in this paper. The findings support the proposition that both predictors contribute to employees' normative and affective commitment to change, even though rather indirectly, through the positive emotion that they experience during change. This paper further strengthens the association between resilience and positive emotions.

DEFINITION OF RESILIENCE: n individual difference, defined as a "trait-like" (i.e., stable) ability to bounce back from adversity and hardship and to flexibly adapt to shifting demands (Block & Kremen 1996)
COUNTRY: South Korea

PERPSECTIVE: I/O research
METHODOLOGY: Quantitative paper

Werner, E. E. (1996). Vulnerable but invincible: high-risk children from birth to adulthood. *European Child & Adolescent Psychiatry*, *5*, 47-51.

This study originated as a study of risk factors, but shifted the focus on protective factors in child development, building in Rutter's work. This longitudinal study follows children that have been designated as high-risk because of being born into poverty, experiencing perinatal stress, and living amongst family discord. Still, many of these children grew up as successful adults. Werner (1996) designated 5 factors that helped this successful adaptation (see details on p. 49-50). Most importantly, this study highlighted that in cases where parental supports in unavailable, it can be provided for by other persons in the youngsters' lives, such as grandparents, teacher, youth worker, highlighting the role of community and kin.

KEY WORDS: Longitudinal study, protective factors, resilience

COUNTRY: US (Hawaiian Island of Kauai)

PERPSECTIVE: Developmental psychopathology

METHODOLOGY: Qualitative study

9 Social-Ecological Resilience

Adger, W.N. (2000). Social and ecological resilience: are they related? *Progress in Human Geography*. 24 (3), 347-364

Despite being widely used as a concept in ecological literature, the definition and measurement of ecological resilience is contested. However, Adger states it is established that the resilience of ecological systems relates to how they function, rather than stability. Adger argues changes in social regulation can directly alter how ecological systems function (e.g. through land-use change), and therefore alter ecological resilience. Therefore, ecological and social resilience are linked through the economies of institutions. Adger argues this is a circular linkage and that a change in ecological resilience may also impact social resilience, particularly for resource-dependent communities, where there is socio-economic dependence upon few resources. Here, partial loss of a dependent resource causes increased conflict as there are few opportunities to diversify. Adger uses economic theories to argue stable social systems promote innovation and development, and so diversification and resilience. Adger therefore argues that, counter to ecological resilience, stability is an indicator of socio-resilience. Adger concludes that the resilience of social systems results from a combination of socio-economic policies along with "surprises", or random disturbances inherent in any system, and a sustained period of stability will create a resilient system. Thus, stability is an indictor of resilience of social systems.

DEFINITION OF RESILIENCE: Social resilience is, "the ability of groups or communities to cope with external stressed and disturbances as a result of social, political and environmental change," (p. 347).
Ecological resilience is the, "characteristic of ecosystems to maintain themselves in the face of disturbance," (p. 347).

Adger notes ecological resilience has been defined variously: "It is the buffer capacity or the ability of a system to absorb perturbations, or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behaviour," (p. 349).

KEY WORDS: cultural geography, ecological resilience, human ecology, resource dependency, sustainable development

COUNTRY: United Kingdom

PERSPECTIVE: Human ecology, ecological economics, rural sociology

METHODOLOGY: "The origins of this interdisciplinary study in human ecology, ecological economics and rural sociology are reviewed, and a study of the impacts of ecological change on a resource-dependent community in contemporary coastal Vietnam in terms of the resilience of its institutions is outlined," (p. 347).

Berkes, F., Folke, C. (1994) Linking Social and Ecological Systems for Resilience and Sustainability. ***Beijer International Institute of Ecological Economics, Beijer Discussion Paper Series*** **52.**

Berkes and Folke (1994) provide two definitions of resilience in the ecological literature. The first, "concentrates on stability at a presumed steady state, and stresses resistance to a disturbance and speed of return to the equilibrium point. This is the conventional, equilibrium-centred, linear, cause-and-effect view of a predictive science as used in ecology, economics and some other sciences," (p. 5). Berkes and Folke disagree with this definition because they argue perturbations cannot be excluded from systems, stating the exclusion of smaller, more predictable perturbations from ecosystems to create a "steady" system does not build resilience, instead is causes larger, less predictable perturbations to accumulate to, "a level and scale which may threaten the functional performance of the ecosystem," (p. 5). Therefore, Berkes and Folke advocate the definition of (ecological) resilience, 'in which disturbances (or perturbations) can flip a system from one equilibrium state to another. In this case, the important measure of resilience is the magnitude or scale of disturbance that can be absorbed before the system changes in structure by changing the variables and processes that control behaviour' (p. 6). Understanding the absorption mechanisms is, therefore, key to building resilience.

Berkes and Folke argue "not all characteristics of ecosystems are equally significant," (p. 5) and only a small number of species create processes which contribute to the functional performance of systems. "Remaining organisms occupy niches in the system shaped by these processes. These organisms may seem to be redundant in the short term, but they are crucial in maintaining system resilience, and serve as a system insurance for unpredictable events," (p 5.). Thus, Berkes and Folke argue resilience, "is a measure of robustness and buffering capacity of the ecosystem to changing conditions," (p. 6).

Berkes and Folke do not distinguish between the functioning of social and ecological systems and argue functional performance and resilience mechanisms are well known for ecological systems, but have not been investigated in social systems. Berkes and Folke argue that, in pursuit of maximum output, modern socio-ecological systems have been reduced to functional performance, but that this has reduced resilience. Assuming systems that have survived for extended periods of time are resilient, Berkes and Folke propose investigation into traditional socio-ecological systems will distil the social resilience mechanisms, in line with Levi-Strauss' (1962) "savage thought". Berkes and Folke also argue the resilience of social and ecological systems are interdependent, and so argue increasing societal resilience will, in turn, help increase resilience in ecological systems, and so propose 'five sets of elements which can be used to describe social and ecological system characteristics and linkages: (1) ecosystem, (2) people and technology, (3) local knowledge, (4) property rights, and (5) institutions' (p. 5).

DEFINITION OF RESILIENCE: "The magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control their behaviour (Holling et al. 1994). Resilience is the ability of a system to absorb perturbations'" (p. 4).

COUNTRY: Sweden

PERSPECTIVE: Socio-ecological, Ecological

METHODOLOGY: Background paper and framework

Cretney, R. (2014). Resilience for Whom? Emerging Critical Geographies of Socio-ecological Resilience. ***Geography Compass.*** **8 (9), 627-640.**

This article presents a wide-ranging literature review considering theoretical and practiced definitions of resilience, arguing these have diverged. The review draws from social and ecological literature, although acknowledges psychology and the dominance of engineering, in particular the "bounce-back" notion, in defining resilience.

Cretney first introduces Holling's (1973) notion of "ecological equilibrium" as seminal in the socio-economic resilience field. This work suggests systems have a zone of equilibrium, rather than a static point, and so may reorganise when disturbed. Cretney states modern socio-ecological definitions still consider this zone of equilibrium, although combine the concept with the "bounce-back" notion, resulting in the increasingly prevalent rhetoric that disturbance offers opportunity.

However, Cretney argues this socio-economic thinking is too deterministic and the capacity for humans to affect system change through agency has been under-researched. This is not only due to a "lack of consideration but also epistemological constraints," (p. 632), whereby social systems are fundamentally equated to ecological systems, despite their differences. Cretney, along with authors drawing upon resilience theory in psychology, argues this has left the socio-ecological concept of resilience open to exploitation for political means, especially because the concept presumes all parties have equal power. Therefore, conversely, Cretney argues that through current resilience legislation, resilience may be decreasing by removing external support in the name of increasing internal resilience and adaptability, as well as through the normalisation of adaptability, which has caused crises to be conceptualised as inevitable.

Cretney argues the combined policy of considering disturbances inevitable and rhetoric of disturbance offering opportunity has reinforced power relations, allowing those with more power to further exert their influence when there is an (inevitable) disturbance. Cretney also notes grassroots campaigns use the term, acknowledging resilience has a variety of definitions, interpretations and applications, although suggests such alternative forms have not been explored in depth. Ultimately, Cretney argues context is required to define resilience, and more significantly, that resilience is not the answer to disturbances. Instead, the root causes should be tackled.

DEFINITION OF RESILIENCE: includes a 'Definition of resilience' table (p.629):

- 'Engineering resilience: The efficient stability of a stable state.
- 'Ecological resilience: The ability of a system to absorb disturbance, before resorting to a shift in system state, through changing variables and processes that control behaviour.
- 'Social resilience: The capacity for communities to cope with external disturbances resulting from social, political and environmental change.
- Socio-ecological: The interplay of factors involved in recovering from disturbances, re-organisation and the development of socio-ecological systems.
- Community resilience: A process of adaptation in a community following a disruption, distinguished by factors such as social capital and community competencies.
- Urban resilience: The network of structures, processes, infrastructure and community identity that both manages extreme stress and evolves into a more desirable state following a disturbance.'

COUNTRY: Australia
PERSPECTIVE: Socio-ecological
METHODOLOGY: Literature review

Curtin, CG & Parker, JP. (2014) Foundations of Resilience Thinking. *Conservation Biology,* 28 (4), 912-923.

Curtin & Parker analyse the applicability of socio-economic resilience thinking for conservation biology. They map out that ecological resilience diverged from mainstream ecological thought in the 1970s, and argue, "resilience thinking has not gone far enough," (p. 922) to ensure the paradigm shift required so social and ecological processes are co-managed, because the approach has been made in isolation from other mainstream fields. They argue the core lessons being learned from socio-ecological resilience thinking are cross-applicable to other fields: The power of resilience-based approaches to conservation and management lies in the inherent recognition that "historically, the pattern of co-evolutionary adaptations between social systems and natural systems must have been the norm, with the adaptations… driven by crises, learning and redesign (Holling et al. 1998)," (p. 922).

They argue management approaches are still adaptive, but need to be 'transformative approaches that design for inevitable and unpredictable change and seek to anticipate nonlinear behaviour, thresholds, and emergent outcomes of the interaction of multiple social and ecological factors' (p. 922).

KEY WORDS: adaptive management, complex systems, policy design resilience, stability, sustainability
COUNTRY: United States of America
PERSPECTIVE: Socio-ecological, Ecological
METHODOLOGY: Literature review

Folke, C. (2006) Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change*. 16, 253-267.

The purpose with this paper is outlined by the authors as providing, "an overview of the emergence of the resilience perspective and the context within which it has developed…The second part puts resilience research and the role of the perspective as a way for organising thought and inquiry are emphasized. The third section reports on-going efforts and explorative work in resilience research toward understanding social-ecological system dynamics and its implications for sustainability, a research integration that is still in its infancy. Research challenges and policy implications are raised in the concluding remarks," (p. 254).

Folke argues that, unlike mainstream ecology, the social-ecological resilience perspective included humans as agents of ecosystem change. Social-ecological research has shown while, "a lot of work on resilience has focussed on the capacity to absorb shocks and still maintain function… there is also another aspect of resilience that concerns the capacity for renewal, re-organisation and development, which has been less in focus but is essential for the sustainability discourse," (p. 253). "The resilience perspective shifts policies from those that aspire to control change in systems assumed to be stable, to managing the capacity of social-ecological systems to cope with, adapt to, and shape change," (p. 254). Efforts are now being made to elucidate effective management mechanisms.

KEY WORDS: Resilience, Social-ecological systems, Adaptive capacity, Transformations
COUNTRY: Sweden
PERSPECTIVE: Socio-ecological
METHODOLOGY: Literature review

Folke, C; Carpenter, S; Elmqvist, T; Gunderson, L; Holling, CS; Walker, B. (2002) Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *Ambio*, 31 (5), 437-440.

Folke *et al*. argue it is wrong to assume 'ecosystem responses to human use are linear', and 'human and natural systems can be treated independently' (p. 437). "Natural and social systems behave in nonlinear ways, exhibit marked thresholds in their dynamics, and… social-ecological systems act as strongly coupled, complex and evolving integrated systems' (p. 437). They state 'resilience, for socio-ecological systems, is related to (i) the magnitude of shock that the system can absorb and remain within a given state; (ii) the degree to which the system is capable of self-organisation; and (iii) the degree to which the system can build capacity for learning and adaptation," (p. 438). Folke *et al*. argue structured scenarios and active adaptive management, "require and facilitate a social context with flexible and open institutions and multi-level governance systems that allow for learning and increased adaptive capacity without foreclosing future development options," (p. 437). Scenarios, "envision alternative futures and the pathways by which they might be reached. By envisioning multiple alternative futures and actions that might attain or avoid particular outcomes, we can identify and choose resilience-building policies. Active adaptive management views policy as a set of experiments designed to reveal processes that build or sustain resilience. It requires, and facilitates, a social context with flexible and open institutions and multi-level governance systems that allow for learning and increase adaptive capacity without foreclosing future development options," (p. 439). Folke *et al*. conclude that resilience can be built through three policy strategies. Legislation should act to: (i) perceive humanity and nature as interdependent and stimulate development that enhances resilience, "recognising the existence of ecological thresholds, uncertainty and surprise;" (ii) create arenas for flexible system collaboration and management to explore management options; and (iii) 'develop

indicators of gradual change and early warning signals of loss of ecosystem resilience and possible threshold effects' (p. 440).

DEFINITION OF RESILIENCE: "The capacity to buffer change, learn and develop," (p. 437).
COUNTRY: Sweden, United States of America, Australia
PERSPECTIVE: Socio-ecological
METHODOLOGY: Synthesis of case studies and theories (summary of report)

Gunderson, LH (2000) Ecological Resilience – in Theory and Application. ***Annual Review of Ecology and Systematics*****. 31, 425-439.**

Gunderson introduces the concept of Adaptive Capacity to, "describe the processes that modify ecological resilience." Gunderson argues ecosystems function as a result of keystone species, and other species in the ecosystem provide resilience. Using Holling's (1973) definition of ecosystem resilience, Gunderson argues that ecosystems have a number of stability domains, and that the keystone species in each stability domain are different. So, although the majority of species are not integral to the functioning of the ecosystem in the present stability state, these species may be keystone species in other stability domains. Therefore, Gunderson introduces the concept of Adaptive Capacity to describe the ecological buffer that protects the system from failure: "Adaptive Capacity is described as system robustness to changes in resilience." Gunderson argues if a system's Adaptive Capacity is known, system managers will be able to maintain or increase the capacity for the system to renew when forced (i.e. resilience), rather than fail due to management actions taken on an incomplete understanding.

DEFINITION OF RESILIENCE: "Resilience in engineering systems is defined as a return time to a single, global equilibrium. Resilience in ecological systems is the amount of disturbance that a system can absorb without changing stability domains," (p. 435).
KEY WORDS: Resilience, stability, stable states, biodiversity, adaptive management
COUNTRY: United States of America
METHODOLOGY: Theory, Literature, Observation

Gunderson, L. (2009) ***Comparing Ecological and Human Community Resilience*****. Community & Regional Resilience Initiative (CARRI). Research Report 5.**

Thesis Statement: "The first section describes theoretical frameworks largely derived from study of ecological systems. That ecological literature describes different models and metaphors of change in systems over time, including resilience and adaptive capacity of ecological systems, and adaptive cycles and panarchy models. The second section describes how understanding of ecological resilience applies to human community systems and disasters, in context of anticipation of events, understanding vulnerabilities to change, developing adaptive responses, as well as robust renewal and recovery. The third section attempts to tie together these ideas by using a systems perspective on how community resilience could be fostered and maintained. The final section presents some insights on key similarities and important differences between the ecological and human community resilience," (p. 2).

Gunderson argues human communities and ecosystems, "are both systems in the sense of being comprised of internal structures and processes, which are in turn subject to external variation or perturbations. By conceptualising both as systems, then emergent, systematic properties such as resilience or adaptive capacity can be compared," (p. 1). Gunderson argues five ideas emerge from comparisons of ecological and human community systems, all of which 'have broad implications for attempting to manage complex systems with human and ecological components in the face of recurring natural disasters;

1. "Both systems demonstrate the multiple meanings of resilience – both in terms of recovery time from and capacity to absorb disturbances';
2. "Both systems recognise the role of diversity in contributing to resilience," (p. 11). "Numeric diversity (different types of entities) is probably less important [than] functional diversity," (p. 12);
3. The role of different forms of capital: "Capital is developed during phases of system growth and development. That capital, as well as the influx of capital from broader areas, is critical to system recovery and in determining system trajectories," (p. 13);
4. The importance of cross scale interactions: "Panarchy suggests that certain properties, such as connectivity, can lead to system vulnerability in the form of perpetuating or cascading

disturbances that can expand across wider spatial and temporal scales. Panarchy theory also suggests the critical importance for cross-scale interactions – when the broader and slower variables are critical to post-disturbance recovery and resilience," (p. 13);
5. "The need for experimentation and learning to build adaptive capacity," (p. ix).

DEFINITION OF RESILIENCE: Ecological systems resilience: "Two meanings; one is defined as return time following a perturbation, the other as the amount of disturbance to shift regimes." Human community resilience: "Multiple meanings, but primarily refers to return or recovery time. Limited application to regime shifts," (p. 12).
COUNTRY: United States of America
PERSPECTIVE: Socio-ecological
METHODOLOGY: Literature review

Holling, C.S. (2001) Understanding the Complexity of Economic, Ecological, and Social Systems. *Ecosystems*. 4 (5), 390-405.

THESIS STATEMENT: "The purpose of this paper is to summarize a theoretical framework and process for understanding complex systems. This concept has recently been developed and expanded into a book-length thesis (Gunderson and Holling, 2001). In its expanded version, it provides a means of assessing information about the internal factors and external influences that interact to determine systematic sustainability. To be useful, such a framework and process must satisfy the following criteria:

- Be "as simple as possible but no simpler" than is required for understanding and communication.
- Be dynamic and prescriptive, not static and descriptive. Monitoring of the present and past is static unless it connects to policies and actions and to the evaluation of different futures.
- Embrace uncertainty and unpredictability. Surprise and structural change are inevitable in systems of people and nature," (p. 391).

Holling applies ecological theory to the operation of organisations, arguing a small number of controlling processes self-organise systems and "can be categorized as a panarchy of hierarchies and adaptive cycles across scales," (p. 390). So, "there is a requisite level of simplicity behind the complexity that, if identified, can lead to an understanding that is rigorously developed but cannot be communicated lucidly," (p. 391).

Holling argues creating a framework from a number of case studies whilst acknowledging there will be inherent uncertainties is the best way to understand systems, and so facilitate sustainable development. Without any directed influence, the position of the system within the panarchy is dependent upon "accidents of history," and is one of multiple possible outcomes. Holling argues that by "fostering adaptive capabilities and creating opportunities," (p. 390) the movement of the position of the system within the panarchy of possibilities can be directed, so that the system self-organises to a desired state. (In order to direct, the position of each subsystem within its adaptive cycle must be defined; 'actions that would be appropriate at one phase of the cycle might not be appropriate at other phases' (p. 402)). Holling argues this is how sustainable development can be achieved, and so 'the era of ecosystem management via incremental increases in efficiency is over' (p. 404).

"Under conditions of crisis in a region, the elements of a prescription for facilitating constructive change are as follows:

- Identify and reduce destructive constraints and inhibitions on change, such as perverse subsidies.
- Protect and preserve the accumulated experience on which change will be based.
- Stimulate innovation and communicate the results in a variety of fail-safe experiments designed to probe possible directions in a way that is low in costs in terms of human careers and organisational budgets.
- Encourage new foundations for renewal that build and sustain the capacity of people, economies, and nature to deal with change.
- Encourage programs to expand and understanding of change and communicate it to citizens,

businesses, and people at different levels of administration and governance, engaging them in the process of change," (p. 404).

DEFINITION OF RESILIENCE: Holling defines "sustainable development", which for the purposes of this bibliography can be considered as interchangeable with "building resilience", as "the goal of fostering adaptive capabilities and creating opportunities," (p. 390).
KEY WORDS: hierarchy; adaptive cycles; multiple scales; resilience; sustainability
COUNTRY: United States of America
PERSPECTIVE: Ecological
METHODOLOGY: Theoretical framework from thesis, rooted in empirical reality

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Pickett, STA; McGrath, B; Cadenasso, ML; Felson, AJ. (2014) Ecological resilience and resilient cities. *Building resilience and resilient cities*. 42 (2), 143-157.

Thesis Statement: "The paper proceeds through five steps. The first step is to place urban resilience in the multi-scalar and changing regional and global contexts of urban systems. These contexts are summarised via a new integrated, ecological approach to cities that incorporates the mutability of cities, the failure of the modernist model of urban development to be universal, the explosive global growth and connectivity of cities, and the evolving vulnerabilities in the face of climate change. The second step is to recognise sustainability as a set of socially constructed, normative goals, emphasising process rather than stasis. Third, resilience is used as a non-normative conceptual scientific model for the process underlying sustainability. This leads to the forth step, disaggregating the process of resilience (Walker, Holling, Carpenter & Kinzig, 2004) into capacities for adaptation (Yohe & Tol, 2002). Finally, the four contextual and conceptual aspects of contemporary urban change are assembled into a framework to help inform ecological urban design. All the ecological concepts used in this paper are multidimensional (Pickett & Cadenasso, 2002), leading to conceptual complexity that must be disentangled to permit rigorous interdisciplinary dialogue and successful practical application," (143-144).

Pickett et al. investigate how socio-ecological resilience theory can be applied to increasing urban resilience. They argue 'resilience is a key concept for operationalizing sustainability' and, "the urban component of the global ecosystem can be made more sustainable by incorporating the ecological understanding of resilience into the discourse," (p. 143). Pickett et al. argue resilience can be built using the "adaptive cycle" concept as a template: the cycle "identifies potential traps of low capital or institutional inertia that may thwart resilience. In such cases, linkages with coarser or finer scale systems are levers for escaping the traps and promoting resilience," (p. 154). Pickett et al. argue the cycle can be combined with urban ecological science to "[envision] adaptive and resilient urban features," (p. 154).

DEFINITION OF RESILIENCE: "Resilience is a conceptual and modelling framework that indicates the phenomena that facilitate or inhibit the achievement of normative sustainability goals.' 'Ecological resilience emphasises the capacity of a site to adjust to external shocks and changes in controlling interactions, while engineering resilience emphasises its ability to return to a state that existed before perturbation," (p. 143).
KEY WORDS: adaptation, adaptive cycle, built environment, cities, ecological urban design, resilience, resilient cities, sustainability, urban systems
COUNTRY: United States of America
PERSPECTIVE: Ecological, Infrastructure/Built Environment
METHODOLOGY: Literature review

Tompkins, E.L. & Adger, W.N. (2003) *Building resilience to climate change through adaptive management of natural resources*. Tyndall Centre for Climate Change Research, Working Paper 27.

Tompkins & Adger argue that, "building resilience into both human and ecological systems is the optimal way to deal with future surprises, or unknowable risks' which could 'lie outside their experienced coping range," (p. 2), including predicted climate change. They particularly focus on communities that "rely on ecosystem health for their own well-being or livelihoods" (p. 4) and argue a system managed with traditional management processes has high adaptive capacity because it has already been proven to be highly resilient because the system has been successfully maintained

throughout periods of environmental change, and so resilience can be built by using traditional management processes. "Where full knowledge about a system does not exist and optimum productivity is not an obtainable goal, an iterative management process [("adaptive management")] that is informed and evolves through an on-going learning process is about the best that can be achieved," (p. 4). Tompkins & Adger conclude that in both cases, resilience can and should be increased through social networks, across all scales. "Hence management approaches need to be: iterative, to take account of new knowledge as it becomes available; inclusionary, to enable collective actions to feed intro the decision making process; and holistic, to take into account the whole spectrum of options that are available to individuals and communities," (p. 5).

DEFINITION OF RESILIENCE: "Social resilience is the ability of groups or communities to adapt in the face of external social, political or environmental stresses and disturbances (Adger 2000)," (p. 7).
KEY WORDS: Climate change, social-ecological resilience, natural resource management, Caribbean
COUNTRY: United Kingdom
PERSPECTIVE: Socio-ecological
METHODOLOGY: Theory and case study

Walker, B; Gunderson, L; Kinzig, A; Folke, C; Carpenter, S; Schultz, L. (2006) A Handful of Heuristics and Some Propositions for Understanding Resilience in Social-Ecological Systems. *Ecology and Society.* 11 (1), 13

Walker et al. summarise a number of ideas and "propositions" about resilience in social-ecological systems. These are summarised as follows:

1. "Multiple modes of reorganisation are possible during phases of release ad renewal in a social-ecological system. Because of this, managers need to consider multiple approaches during such periods" (p. 4).
2. "The four phases of the adaptive cycle appear to explain the dynamics of change in many systems. Nonetheless, exceptions to the adaptive cycle occur, particularly under the influence of large, external disturbances and a lack of critical forms of capital" (p. 5).
3. "Cross-scale interactions critically determine the form of the subsequent adaptive cycle at any particular focal scale" (p 5).
4. "Critical changes in social-ecological systems are determined by a small set of three to five key variables, i.e., the "rule of hand." To understand change in systems, it is important to identify this small set" (p. 5).
5. 'Slowly changing variables control ecological resilience, whereas social resilience is controlled by either fast or slow variables' (p. 6).
6. "The ecological and social domains of social-ecological systems can be addressed in a common conceptual, theoretical, and modelling framework" (p. 6).
7. "Two types of diversity are important for social-ecological systems: (1) functional diversity, which influences system performance, and (2) response diversity, which influences resilience" (p. 7).
8. "Adaptability is primarily determined by (1) the absolute and relative amounts of all forms of capital: social, human, natural, manufactured, and financial; and (2) the system of institutions and governance" (pp. 7-8).
9. "Mental models drive change in social-ecological systems, and adaptability is enhanced through partially overlapping mental models of system structure and function" (p. 8).
10. "Learning is a key component of adaptability and is enhanced by careful experimentation in the form of active adaptive management" (p. 8).
11. "Efforts to deliberately enhance adaptability can (unintentionally) lead to loss of resilience" (p. 9).
12. "Social-ecological systems have multiple interacting thresholds, giving rise to multiple pairs of alternate regimes, only a few of which are feasible" (p. 9)
13. "Transformation involves changing the state space of the system and the scales of the panarchy" (p. 9).
14. "Determinants of transformability include incentives, awareness, experimentation, reserves, and governance" (p. 10).

Walker et al. then offer a number of research questions to determine these scenarios.

DEFINITION OF RESILIENCE: "Resilience is the capacity of a system to experience shocks while retaining essentially the same function, structure, feedbacks, and therefore identity," (p. 2).

KEY WORDS: resilience; social-ecological systems; change; propositions; synthesis; theory; adaptability; transformability
COUNTRY: Australia, United States, Sweden
PERSPECTIVE: Socio-ecological
METHODOLOGY: Theoretical