

**CENTER FOR HAZARDS
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MITIGATING DISASTER THROUGH RESEARCH

**An Overview of Disaster Preparedness
Literature: Building Blocks for an
Applied Bay Area Template**

Jaeryl Covington and David M. Simpson

Working Paper 06-02

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UNIVERSITY OF LOUISVILLE

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Executive Summary

In support of the Fritz Institute's project "Assessing Disaster Preparedness in the Bay Area," the Center for Hazards Research and Policy Development at the University of Louisville conducted a review of the disaster preparedness literature. In doing so, the focus and intent was to understand the core concepts of preparedness, and more specifically, the measurement of these concepts. The overall goal is to create a measurement or comparison template to be applied in the San Francisco Bay Area.

The literature reveals that there are several issues to consider when devising disaster preparedness metrics, but that there is no general agreement on form format, or what is most important to measure. The key finding is that a successful template will need consensus development and careful application in order to accomplish the objective of improved preparedness in the long run. The recommendation section makes suggestions and identifies issues to consider in the application of a measurement framework in this area.

Introduction

The following report provides a general overview of disaster preparedness literatures, focusing particularly on the role of disaster preparedness for communities and organizations. The review is divided into four subsections: the fundamental features of disaster preparedness, existing disaster preparedness metrics, significant policy issues, and recommendations. Each subsection identifies different key issues in disaster preparedness, and is followed by a section of recommendations for developing and implementing a disaster preparedness measurement model.

The first section, fundamental features, describes disaster preparedness in terms of current best practices. This section reviews perspectives on disaster preparedness methods and frameworks as identified across literatures. The second section, existing disaster preparedness metrics, examines current indicators, frameworks, methodologies, and indices that seek to measure disaster preparedness. The third section provides an overview of key issues in disaster preparedness theory, practice, and policy, including a discussion of the ways they have been addressed by the disaster preparedness community. The final section provides recommendations for developing and implementing a disaster preparedness measurement model.

Disaster Preparedness Best Practice

Disaster preparedness, as an area of inquiry, is dynamic and in a state of constant flux. Each new event teaches researchers and practitioners more about community and individual responses to disasters. While experience with disaster and crisis events is considerable, the emergence of widely accepted “best practices” lags behind the need for

holistic approaches. The lag is due in part to the uniqueness of each event and the uniqueness of each community affected. As a result, a variety of practice options have emerged, leaving practitioners to choose the paradigms most fitting to their particular view of disaster preparedness. Disaster preparedness practitioners, whether in government organizations or private businesses, will seek out multiple models of disaster preparedness and tailor one to their specific needs. The phenomena tends to create rifts in the disaster preparedness profession, as no single theory, or set of theories, can be identified as the core concepts upon which disaster preparedness plans and practices are based. The following reviews a selection of approaches taken to disaster preparedness that have found acceptance among sets of practitioners.

Many stakeholders identify the need for a solid emergency management plan to guide the development of disaster preparedness. Much of the existing thinking about disaster preparedness plans has evolved and been developed from the “on-the-ground” policies and procedures of emergency management. Emergency management theory struggles to develop in much the same way as disaster preparedness, and thus has similar deficiencies. The result is that there is not a solid foundation of emergency management theory to guide the development of disaster preparedness planning.

McEntire has addressed key issues pertaining to emergency management and disaster preparedness in his research. McEntire, Fuller, Johnston, and Weber (2002) wrote a review article that examines emergency management and methods relevant to its formation. While the primary focus in the 2002 piece was on vulnerability, McEntire has also completed work in disaster preparedness. Through the International City/County Management Association (ICMA), he published a guide for emergency management and

emergency planning, complete with checklists, resources, and examples (2003). McEntire, et.al.'s focus on theory and application provide excellent reference points for the development of comprehensive emergency management theories and plans.

Similarly, Dynes also offers his consideration of emergency planning. Based on research, as opposed to military models, Dynes' problem-solving model advocates coordination and cooperation (1994). Several other models have developed including similar principles, moving the recognized best practices of emergency planning away from military-oriented models and closer to more discipline specific, research-based models. As the best practices in emergency management gravitate toward more discipline specific goals, so too do the best practices of disaster preparedness.

Considerable work has gone into identifying and evaluating the principles and concepts of disaster preparedness. A few contributions have been made to the theoretical development of comprehensive disaster preparedness measures, some with the goal of creating a "practice-based theory and a theory-based practice" (Gillespie & Streeter, 1987). Most of the contributions do not have the specific aim of creating a comprehensive approach to disaster preparedness, but through the individualistic research, make small contributions when combined as a comprehensive review. For example, much can be learned from Kirschenbaum's (2002) article on disaster preparedness. While Kirschenbaum's research is specific to Israel, the location of his research, and the indicators and conclusions drawn from it, have general applicability. Perry and Lindell (2003) approach disaster preparedness from the planning perspective, identifying ten guiding principles to be adhered to during the planning process. Perry and Lindell focus on the planning process, while Kirschenbaum focuses on localized

principles and applications. Each presents an aspect of disaster preparedness planning, but none completely encompasses the issue.

Individually, articles similar to the ones cited above provide little help to the development of a comprehensive measure. When combined, however, each contributes to a more holistic approach. Rather than addressing all aspects, each serves as pieces contributing to comprehensive disaster preparedness. Due to the decentralized nature of many of these contributions, the synthesis is a difficult task, particularly when trying to formulate a list of measures, a compilation of ideas, and a categorization of the many existing variables. While a review of the extant literature toward the identification of a template and its measures is a stride forward in this area, it is still a first step.

The number of disaster preparedness guides and plans that have been created are as numerous as the number of organizations that have created them. Many governments, organizations both public and private, and individuals have developed plans of action. They are developed in all levels of social and organizational units, from family plans to national plans. Some have an economic orientation, while others are more social and culturally-based.

There is little in the way of established theories to form the basis of such plans, and best practices tend to be idiomatic. The uniqueness of communities and individuals means that the measures of disaster preparedness are in flux, and can as unpredictable as the people and organizations that create them. In many ways, the desire to have a disaster preparedness plan has become the default driving force behind the creation. Thus the quality of the plan itself often is subordinated to the legislative or normative requirement for it.

While best practices and theoretical underpinnings are sometimes difficult to distinguish, measuring is still possible, with some metrics and “checklists” more readily available. Few “disaster preparedness specific” metrics exist, but there are a small set of indicators, indices, and similar measures that can be used to compare, and in some cases measure, the dimensions of disaster preparedness. The following section examines some of the relevant developments in this area.

Hazard Metrics Research

Recent catastrophic events such as hurricane Katrina and the Asian tsunami have created a greater awareness and need for disaster preparedness. For several communities, including the academic, government, and insurance industries, this has translated into devising methods that will allow for the measurement of different disaster preparedness dimensions. The purpose being that these communities can develop a greater understanding of their strengths and weaknesses with respect to preparedness, and determine more efficient allocation of resources to improve preparedness. Ultimately, the goal is to develop more resilient communities, ones that can withstand crisis events and disaster while minimizing the impacts.

Due to the high loss potential, the insurance industry has a vested interest in hazard metrics, which allow more accuracy in determining risk portfolios. Urban centers have high concentrations of capital and risk due to higher densities, which in turn translates into high insurance density (Munich Re, 2002). Munich Re is one such insurance company that has a long-standing interest in this area. The potential for a great loss is the primary reason that Munich Re developed a Natural Hazard Index for

Megacities in 2002. The intent of the index is to measure the potential loss due to a catastrophic event within a major urban area. The index is composed of three components that Munich Re believes encapsulates total risk: hazards, vulnerability, and exposed values. The index is both composite and multiplicative in nature. The hazard component is measured in average annual losses, and possible hazards include earthquakes, windstorms, floods, volcanic eruptions, bush fires, and winter damage (Munich Re, 2002). Vulnerability is measured through the quality of construction, building density, standards of preparedness, and building regulations. Exposed values are measured by average value of households, gross domestic product, and overall global significance. Based on these parameters, Tokyo had the highest risk because of high hazard risk and exposed value risk. Other cities that were also high on the index included New York, London, and Paris, not because of high hazards probabilities, but because of their exposed value concentration.

The United Nations (UN) also has done work within the area of hazard metrics. Under its Development Programme (UNDP), the UN created a Disaster Risk Index (DRI) that examines global risk factors. It allows for the calculation of fatality risk for countries experiencing earthquakes, hurricanes and floods. The index also allows for the identification of socio-economic and environmental variables that may contribute to, and be correlated with, disaster associated deaths (UNDP, 2004). The DRI is composed of two main subcomponents that include physical exposure and vulnerability. According to the UNDP (2004), physical exposure is calculated through the number of people in a country that are exposed on a yearly basis to earthquakes, floods, hurricanes, and droughts. The DRI calculates vulnerability using two methods. The first method is based

on manifest risk by dividing the total number of people killed in disasters by the total number of people that are exposed in a country (UNDP, 2004). The second technique used by the UNDP to calculate vulnerability is completed through the use of 26 vulnerability indicators and statistical analysis with multiple logistic regressions. Results indicate that several countries are highly susceptible and vulnerable to the various disasters named in the analysis. Included in the list are Iran, Afghanistan, India, Turkey, Bangladesh, Honduras, Nicaragua, Venezuela, Somalia, Morocco, Yemen, and several other African countries. Other notable indices that the UN has developed include the Human Development Index and Poverty Index.

The World Bank also has an interest in the area of hazard metrics, and commissioned a report to measure the risk death and economic loss. Although not in the traditional format of an index, the report *Natural Disaster Hotspots: A Global Risk Analysis*, assesses the disaster-related outcomes of death and financial loss. Estimated risk levels were calculated by combining hazard exposure with historical vulnerability for two indicators of elements at risk – gridded population and gross domestic product (GDP) per unit area – and for six major natural hazards: earthquakes, volcanoes, landslides, floods, droughts, and cyclones. Geographic Information Systems (GIS) was used to do sub-national level analysis for small grid levels. The index is designed as a multi-hazard index, and is calculated as the sum of all the single-hazards mortalities in the grid cell for all the hazard types.

The U.S. government, through its branches and agencies, has also done work within the area of hazard metrics. The National Oceanic & Atmospheric Association (NOAA) is currently in the early stages of research on a coastal community resiliency

index. It is taking a capital approach to the development of resiliency indicators. As another example, federal funding for homeland security is now allocated using a risk-based system by the Department of Homeland Security (DHS). DHS determines the level of hazards for a community, for both terrorism and natural hazards, based on asset-based risk and geographically-based risk (DHS, 2006). DHS defines risk by three sub categories: threat, vulnerability, and consequence (DHS, 2006). Specific formulations are not given due to the sensitivity of the nature of the topic. DHS does provide general insight into the factors considered in its risk-based methodology. There are several key elements that all the factors must have according to DHS: validity, relevance, reliability, timeliness, and availability. Factors that are considered in DHS risk based methodology include: homeland security capabilities, population and population density, critical infrastructure, transportation assists, and factors related to infrastructure such as educational institutions, border crossings, and similar factors.

The academic community is leading the way in the area of current hazard metrics. Several indices have been developed that target specific types of hazardous events, such as earthquakes, hurricanes, or floods. Two very similar indices were created by Davidson including the Urban Earthquake Disaster Risk Index (EDRI) and the Hurricane Disaster Risk Index (HDRI). Both indices take a multidimensional approach by combining information from a wide variety of sources. The HDRI is multiplicative in nature while the EDRI is additive. Both indices use subjective weighting to determine the relative importance of each component of the index. The appeal of this genre of indices is its ability to summarize large amounts of information into a simple form where experts from varying fields can understand the information (Davidson, 1997). Each index takes a

similar approach to the two types of disasters, where the overall risk is defined by four components: 1) hazard; 2) exposure; 3) vulnerability; and 4) emergency response and recovery capability. Each component in the index has subcomponents that are indicators related to hazards. For example, potential hazards from hurricanes include wind hazard, storm surge, and similar indicators. Once the scores are tabulated based on all the different indicators, a number is derived that allows for different communities to be compared to one another with respect to all the hazards that are associated with either hurricanes or earthquakes. The comparisons allow decisions makers within the local, state, and federal governments to make decisions regarding planning and resource allocations associated with risk (Davidson and Lambert, 2001).

In theory and practice, the goal of creating and applying hazard metrics is to aid the disaster preparedness community in developing disaster resilient communities. In order to increase resilience, there needs to be extensive collaboration within the preparedness community and with policy-makers. Thoughtfully done, communities can enhance their disaster preparedness based on empirical evidence and ongoing research.

Significant Disaster Preparedness Theory, Policy, and Practice Issues

While elements of disaster preparedness have long been a social adjustment to environmental hazards, both the art and science of disaster preparedness are relatively new courses of study in business, non-profit, government, and academic sectors (Fox, 2006). As with any new course of study, the beginnings of established practice will have inherent weaknesses and areas for improvement. To date, a multitude of issues that should be addressed by stakeholders have been introduced. Some of the issues pertain to

problems created by the theoretical aspects of disaster preparedness, while others relate to the practice and application. Some of these issues have been resolved, while others have been neglected or ignored.

John Twigg of Benfield Gregg Hazard Research Centre, University College London, presented eighteen disciplinary and institutional groups involved in disaster reduction during his presentation at the International Conference on Climate Change and Disaster Preparedness (2002). Each of these eighteen groups represents broad stakeholder classifications and can be further divided by disciplinary and institutional boundaries (Twigg, 2002). The many factions of independent researchers and stakeholders can complicate advancements where collaboration is an essential aspect. Cooperation and collaboration tends to lag when groups vie over limited available funding and strive to become the premier group of its respective area.

Each discipline and organization involved takes its own approach to disaster preparedness, tailoring its metrics, data, works, and products to its specific needs. In general, however, there is a lack of uniformity of data, which further decreases the potential for cooperation among the stakeholders.

The lack of cross-compatibility also affects the consistency of the language, as definitions are aligned with organizational needs (Kirschenbaum, 2002). Definitions are created that take on additional characteristics to make them more appealing to social, business, academic, or other groups. The variance in taxonomies makes it difficult to extract a particular topic, such as disaster preparedness, from the existing literature. Many authors use such terminology as disaster preparedness, hazard mitigation, and disaster reduction interchangeably where each term could be perceived as distinctive. Other

authors provide definitions that may suffice for one field, but would be fundamentally inadequate in another.

Examining the existing definitions of “disaster preparedness” demonstrates this point. The literature does not provide a “definition” of disaster preparedness the way that a dictionary might. Instead, the literature states what disaster preparedness entails from the perspective of the author/s. If taken literally, disaster preparedness would mean being satisfactorily prepared for a catastrophic event. However, a sufficient definition of disaster preparedness would also need to include ways in which persons and organizations can be satisfactorily prepared for such a circumstance. It is in this way that “definitions” of disaster preparedness can be extracted from the literature.

Several authors touch on potential “definitions” of disaster preparedness. Many of the definitions contain a piece of the meaning, without stating precisely what disaster preparedness should contain wholly. Christopolis, Mitchell, and Liljelund emphasize the importance of including “efficiency, effectiveness, and impact of disaster response” as a central goal of disaster preparedness (2001). The development of local response, such as early warning systems, is also a central part of disaster preparedness (Integrated Regional Information Networks, 2005).

McEntire, Twigg, and the United Nations Development Programme all have definitions with similar attributes, but add their own spin on disaster preparedness. The United Nations Development Programme views hazard mitigation as a core resource of disaster preparedness, but also includes planning in its descriptions (2004). McEntire and Twigg also view hazard mitigation as critical to disaster preparedness, stating that it should either coincide with disaster preparedness or be a part of it (McEntire, 2003 and

Twigg, 2002). McEntire continues by addresses other factors that may define disaster preparedness: it is a function of local government and it includes hazard and vulnerability assessments.

Other elements of disaster preparedness are less emphasized in the literature, but equally as important. Izadkhah and Hosseini stress education as “one of the best media to prepare a community for disasters (2005).” Individual levels of disaster preparedness are also discussed. This level includes preparing households through such means as emergency plans, securing heavy furniture to walls, and storing food, and through building inventories of stored food and equipment (Paton, Smith, Johnston, 2003 and Siembieda, 2001).

When examining the examples of what disaster preparedness entails according to the above authors and organizations, it becomes evident that the definition of disaster preparedness is loose and evolving. Disaster preparedness involves preparedness on personal, community, and national levels; it includes elements of both a private and public nature; and it is intertwined with hazard mitigation and vulnerability and requires each to be accurately assessed.

The inextricability of the terminology, as well as the lack of a common vocabulary among professions, is another of the great challenges facing policy makers. Several attempts have been made at creating universal definitions for the various terms of hazard research, but the lack of cooperation in and among the varying fields has thwarted these attempts. In addition, the general acceptance of using the terms interchangeably has discouraged further efforts to separate the terms’ different meanings. The terminology of hazards research remains confusing and vague. Without agreement on the definitions,

disaster preparedness study and experimentation will remain relatively unproductive (Gillespie & Streeter, 1987).

The development of an emergency management planning model of wide applicability is another issue that should be addressed by the disaster preparedness community. The premier models of emergency planning began from military models of command and control designed to handle enemy attacks and other non-civilian emergencies (Dynes, 1994). More recently, empirical and pragmatic models of emergency planning for civilian emergencies have been developed, but none of them have been accepted wholesale by the disaster preparedness community. Emergency planning paradigms for disaster resistant communities, disaster resilient communities, sustainable development, and sustainable hazard mitigation have provided stepping stones for a comprehensive emergency management plan (McEntire, Fuller, Johnston, & Weber, 2002).

The preceding brings to light some of the pressing problems with the theoretical development of disaster preparedness and disaster preparedness community synthesis. The aforementioned issues are not an exhaustive list of issues in the development of disaster preparedness theory, but do highlight recurring themes in the literature. The following set of issues emphasize the problems associated with disaster preparedness policy and practice.

Rapid urbanization is the center of several pressing issues in the practice of disaster preparedness. Several sources have noted the decennial increases in city populations, not only in the United States, but globally. One needs only observe the mega-city phenomenon of the last century to understand current population trends. City

growth is consistently on the rise in both developed and developing countries, and often in risk prone locations. The world is quickly becoming more urban (Boullé, Vrolijk, & Palm, 1997). Urban areas are attractive because they offer their inhabitants many benefits not available in non-urban areas: accessible medical facilities, markets, public transportation, various types of employment, and a variety of people and experiences. These benefits draw people to cities, creating greater urban densities, and inadvertently making them more hazardous places to live.

The sheer population, masses of infrastructure, and material assets of an urban area provide increasing opportunities for common natural events to have disastrous consequences (Munich Re Group, 2004). Urban areas place a large number of people, infrastructure, and capital enterprises into a small geographic area, increasing the potential for an ordinary natural event to become one that is exceedingly large and costly. In addition to hosting large populations, complex infrastructure, and large capital enterprises, urban areas are generally the regional centers of politics, economics, and technology. As financial leaders, urban areas often develop complex market relationships with other urban areas around the world. Thus, if an urban area is affected by a disaster, adjacent urban areas also suffer. The complex relationships between urban centers and its partners can cost billions of dollars in lost business, damaged products, delayed transactions, and missed work hours, in addition to the direct damages to people and infrastructure. Therefore, when urban areas are adversely affected by natural disasters, there are internal and external costs that can have global consequences.

Another problem is that the plight of urban areas is so noticeable and affects so many people that it draws attention from smaller, non-urban populations. The majority of

the time and effort in disaster preparedness is focused on solving preparedness issues for urban areas, leaving those who choose to remain in non-urban areas more vulnerable. Non-urban areas, although smaller in size, population, and infrastructure, lack the resiliency to recover when a disaster strikes. The lack of available assets, resources, and capital can make it very difficult for a non-urban area to recover from even isolated natural events. While urban areas present many problems for the disaster preparedness community, there are other issues that should be addressed.

An additional policy and practice issue is identifying and protecting vulnerable populations. Cortis and Enarson define vulnerability as “A condition wherein human settlements or buildings are threatened by virtue of their proximity to a hazard, the quality of their construction, or both. Degree of loss (from 0 percent to 100 percent) resulting from a potential damaging phenomenon.” The ability to correctly identify vulnerable population locations, characteristics, and special needs is a central issue in disaster preparedness. A discussion of vulnerable populations is difficult because, to some degree, all populations are vulnerable. However, there are certain factors that can be identified as playing a critical role in creating vulnerable populations. The following will examine what we know about vulnerable populations and what we can do to improve preparedness for vulnerable populations.

Each individual within a population is made vulnerable by a variety of personal factors, some of which *cannot* be controlled and some of which *may* be controlled. There are several factors that contribute to vulnerability that cannot be controlled. For example, the age of an individual is an uncontrollable potential vulnerability. Those persons that are young and elderly have a higher vulnerability than those who are middle-aged adults

(the phrase “middle-aged adults” suggests those people that are neither young nor elderly, but are in-between such life stages). Young and old people may not be as mentally capable of processing information as middle-aged adults, as strong as middle-aged adults, and may be completely or partially dependant on middle-aged adults to care for them. Mentally or physically handicapped persons are more vulnerable than persons in good mental and physical health. The mentally and physically handicapped have special requirements and needs that may require another person to help them when those requirements and needs are not accessible.

In addition to those uncontrollable personal vulnerability factors, there are factors that may be controllable that can make an individual vulnerable. For example, a lack of preparation for disasters can make a person more vulnerable than those that have prepared. Saving cash, storing clean water, creating food and tool caches, and developing emergency plans on an individual level all contribute to reducing a person’s vulnerability to disaster. Furthering education as much as possible also reduces a person’s vulnerability. The more highly educated a person is, the less vulnerable they become. Improving physical fitness is also an excellent way to reduce a person’s vulnerability. In most instances, a person has some degree of control over these issues, although they can be restricted. This is why these vulnerability factors *may* be controllable for some, but not for others. Identifying other factors that contribute to vulnerable populations requires examining socio-economic status, location, and social structure.

Perhaps the most condemning vulnerability causing factor is socio-economic status. This can be viewed in one of two ways; as a characteristic of a population or as a

characteristic of a nation. Socio-economic status as a characteristic of a population creates vulnerability in the poor fraction of the population. Vulnerability in poor populations manifests in several ways. First, poor populations do not have the financial support that the wealthy do, making it more difficult for them to prepare for, endure, and recover from disaster. Access to assets and entitlements in a pre and post disaster situation are critical to preparation for the disaster, protecting self and property, and in recovering from disaster. The availability of cash and savings, as well as access to entitlements such as insurance, stocks, and bonds, is often reserved for those who can afford them. Poor populations are often excluded from assets and entitlements because they lack the capacity to gain them. Therefore, the losses incurred as a result of a disaster can be absolute losses for poor populations.

Second, poor populations often locate in unsafe areas. Some poor populations locate on ancestral grounds that are prone to a particular disaster, but refuse to move because of the connection to their heritage. Other poor populations locate in or on “floodplains, riverbanks, steep slopes, reclaimed land, and highly populated settlements of flimsy shanty towns” (Cortis & Enarson). In some cases, such as locating on ancestral lands, the population chooses to live in a more vulnerable area. In other cases, the poor locate where they do because they are claiming the cheaper lands that the more wealthy population has discarded. And still in other cases, the poor are forced to live in a particular area by inability to afford to move or by force. Whether by choice, lack of choice, or by force, poor populations typically live in areas that are more prone to disaster. The lands that are readily available to them are the lands that belong to them by

ancestral rite and the lands that people with a choice have not chosen; these are the lands that flood, easily erode, are toxic, are dangerous to live on, etc.

Third, poor populations lack the resources to construct safe buildings and living structures. Many poor people's homes are made out of such flimsy materials as mud, sticks, cardboard, plastic (or variant of plastic) paneling, thin sheet metal, and paper. Such materials lack the quality necessary to withstand disasters and to protect the people within them.

Socio-economic status as a characteristic of a nation creates further population vulnerabilities. The economic inequality between industrialized and developing countries has proven to be one method of demonstrating the effects of poverty on disaster impact. In fact, "According to a statement by the relief organization Tearfund, 'ninety-eight percent of those killed and affected by natural disasters come from developing countries, underlining the link between poverty and vulnerability'" (Cortis & Enarson). A few problems in developing countries cause vulnerability to develop. First, over half the population in many developing countries is under the age of eighteen years old (Izadkhah & Hosseini, 2005). The lack of experience of such youthful populations, as well as adult dependence in some cases, makes these populations more vulnerable to disasters. Second, the fragile infrastructure of developing countries and the inability to support disaster preparedness projects financially also takes a toll on developing nations. Even disasters of a low magnitude can have extreme effects on ill prepared countries (Cortis & Enarson). Lastly, developing countries contain a disproportionate number of socio-economically challenged populations. All of the problems associated with these

populations, as previously discussed, further hinder the capacity of developing countries to reduce vulnerability.

Another factor that contributes to vulnerability is location. By virtue of the proximity to certain known hazards, some countries are made more vulnerable than others. The physical layout of a settlement or country is a very important factor in determining its vulnerability. For example, countries located along the ocean are more prone to hurricanes, typhoons, tsunamis, and coastal flooding than inland countries. Developments created along rivers are more vulnerable to floods and erosion. Places along the “Ring of Fire” can expect earthquakes to happen more frequently. Countries in the extreme north and extreme south are likely to have severe winter storms and heavy ice. By choosing to develop in areas with poor physical surroundings, populations can be made more vulnerable to hazards.

Location also has an impact on vulnerability when applied to urban areas. Urban areas present a large part of the vulnerability stemming from location. Boullé, Vrolijk, and Palm examine nine points that make urban areas more vulnerable to disasters: hazardous exposure of the location, economic and political relevance, physical vulnerability, urban management capacity, dependence on infrastructure, density of the population, poverty, informal settlements, and ecological imbalance (1997). Each of these nine points is examined in-depth in their article *Vulnerability Reduction for Sustainable Urban Development*. The purpose of presenting these nine points is to emphasize that urban areas create vulnerability in a variety of ways; environment, development, and socialization all impact the vulnerability associated with urban areas.

Social structure also contributes to population vulnerability. The structure of a society can heavily influence vulnerable populations, either unintentionally or systematically. In one instance, reasonable thinking assumes that time and money will be well spent on identifying the disaster preparedness needs of the most people possible. Therefore, the majority population receives the most attention by the policy community and practitioners of disaster preparedness. However, this leads to inadequacies in protecting the minority populations, which usually need the most help. This diversion of resources towards the majority has unintentionally created a greater vulnerability in the minorities.

In disaster planning, one often finds that those populations with the least social, political, and economic influence are the populations in the most danger when disasters occur (Wisner, Blaikie, Cannon, & Davis, 2003). In other cases, small factions of a population may be the population with the most political influence, economic power, or the population with the greatest social networks. In such circumstances, valuable disaster preparedness resources may be diverted away from the majority population and towards the more powerful few. In this way, the social structure has systematically excluded a population, enhancing their vulnerability.

The preceding are two ways that vulnerable populations are created by the social system that surrounds them. Time, resources, and money are all used to reduce vulnerability to disasters. However, it is often the social system that dictates where time, resources, and money should be utilized. Therefore, a social system that is exclusive and constructed poorly may be more apt to create population vulnerability than a social system that is inclusive and well-constructed.

The last major issue that should be highlighted as a policy and practice issue is convincing those with policy-making capabilities of the benefits of disaster preparedness. This has proven to be an exhausting task for the disaster preparedness community. Many reasons underlie this difficulty, some of which relate to internal disaster preparedness community problems already addressed. However, the primary difficulty in convincing policymakers that disaster preparedness works is that, like hazard mitigation, one is attempting to measure the absence of an event.

In order to convince policymakers that disaster preparedness works, it would facilitate the process if one could show just *how* it has worked. Yet, if disaster preparedness has worked, nothing noteworthy should have happened. Proving the absence of an event is often difficult because the factual basis for the absence of an event requires years of observation. Estimates of saved lives, saved properties, and saved monies have been produced, but none can be guaranteed as necessary to convince policymakers of the immediacy of action. The disaster preparedness community can demonstrate the success of drills and provide written plans, but none will accurately demonstrate the cumulative effectiveness of these measures.

Convincing the policy makers to act on recommendations from the disaster preparedness community is crucial to the success of disaster preparedness. Disaster preparedness is a multi-disciplinary activity, but the most implementation takes place at the local governmental unit. Disaster preparedness occurs on both a horizontal and vertical plane (Institute of Medicine, National Research Council, 2005). Horizontally, it requires the cooperation and integration of public services, healthcare centers, emergency management, academic, and public, not-for-profit, and private enterprises. Vertically, it

requires the cooperation of all levels of organizations and all levels of government (Institute, 2005). The permanence of government in the disaster preparedness equation means that the disaster preparedness community needs the policy-making community in order to be effective. Therefore, it is critical for actors in the disaster preparedness community to unite and collaborate to adequately measure disaster preparedness. Once consensus is reached on the measurement, then the findings can be presented to policymakers, who can in turn move it toward an enforceable directive.

Thus far, the underlying theories and best practices have been addressed, the metrics available to disaster preparedness practitioners have been discussed, and a discussion of the issues from different aspects of disaster preparedness has been developed. Each of the preceding sections served to form a picture of the current state of disaster preparedness from which stakeholders can move forward. The following section suggests recommendations for improving disaster preparedness and facilitating its continued growth.

Recommendations

Recommendations for the creation of a comprehensive disaster preparedness measure can be broken down into two separate, but linked, phases. The first phase involves constructing a model for measuring disaster preparedness and the second phase is implementing the model. An examination of current advancements in these two phases provides a starting point for the development and implementation of a disaster preparedness “template” of general applicability.

The construction of a model for measuring disaster preparedness is primarily associated with the creation of measurements, or metrics. Considerable gains have been made in the development of metrics that can be used for disaster preparedness, although few have been specifically developed for disaster preparedness. For example, one of the goals in the development of these metrics has been to create more disaster resistant communities. In the pursuit of this goal, several topics have been addressed: clarifying the dynamic of community preparedness, efficiently allocating scarce resources, effectively pricing risk, and lobbying for mitigation in preparedness-deficient communities with high levels of vulnerability. The development of the existing metrics has definitely been a step forward for disaster preparedness in opening up debate on related issues. However, two areas of primary concern should be analyzed: the use of data and the development of objective measures.

For hazard metrics to be accepted by different groups of practitioners and policy makers, several “needs” pertaining to the collection and use of data should be addressed. First, there needs to be consistency and accuracy with any data that is used. Second, data needs to be used to create methods and metrics that produce valid and reliable (defensible) results. Lastly, a level of consensus needs to be developed among all the various persons and groups involved in the disaster preparedness process.

Consistency and accuracy in using data is crucial when multiple interests are involved. Maintaining consistent and accurate data allows for different parties to have a common foundation when building various practices, methods, and measurements. Therefore, when viable, the use of primary data sources should be replaced by the use of (reliable) secondary data sources that have found broad acceptance. The availability of

data and the timeframe in which the data was collected should also have weight in the decision on what data to use.

Data on disaster preparedness often comes from a variety of sources and may require multiple database synthesis to produce valid and reliable results. To further the problem, many datasets have a half-life. This means that researchers and practitioners must use caution and judgement when discerning the “best” data. Researchers and practitioners should ensure that a variety of sources are examined when developing metrics and that those sources provide the most up-to-date information. If an excessively far-reaching effort must be made to create a specific metric, researchers and practitioners should consider creating a new data set prior to the metric’s completion or the metric should be deleted. The results of metrics created from too many sources or from very old and/or bad data will be self-defeating. Consensus among the many participants in disaster preparedness on the best data resources should assist in improving both the consistency and accuracy of data and the production of valid and reliable results.

The formation of objective indicators and index numbers and improving the manageability of indicators may create more problems in the construction of a disaster preparedness model. All indicators, no matter how scientific, contain a degree of subjectivity and values. Selecting which indicators to use, selecting how to weight the indicators, developing mathematical formulas, and determining the scale and level of detail in the index provide ample opportunities for subjectivity and values to be integrated into the development process. Consequently, indicators may become proxies for what is truly being measured and index numbers may take on a more symbolic, as opposed to literal, meaning. While objectivity is typically sought in the construction of

models, methods, and metrics, subjectivity and value judgments do not necessarily reflect poor scientific construction. Subjective interpretations and value judgments can arise from countless years of field experience in which the product benefits most from a lack of objectivity. Either way, researcher and practitioner experience and expertise should prove to be the most valuable resource in the development of disaster preparedness metrics.

Selecting indicators for a comprehensive disaster preparedness model can also pose problems, particularly when in the process of selecting indicators. Attempting to include all viable indicators can easily become an overwhelming undertaking as innumerable indicators are available, many of which would provide a comprehensive measure. Therefore, maintaining a manageable selection of indicators becomes a crucial component of creating a comprehensive disaster preparedness measure. Grouping the indicators into different types and selecting the best of the groups, as opposed to selecting as many indicators as possible, may provide an equally excellent disaster preparedness measure.

The formulation of disaster preparedness metrics and the construction of disaster preparedness models should be approached cautiously. The selection of data, indicators, index numbers, mathematical formula, and model development can be very difficult if experience and aptitude are not equally utilized. The difficulty of creating a model is perhaps one factor contributing to the lack of advancement in the development of a generally applicable disaster preparedness model. In fact, a generally applicable disaster preparedness model has yet to be accepted by the entire disaster preparedness community, though multiple efforts are underway.

Recommendations resulting from the implementation of disaster preparedness models are virtually nonexistent. In fact, making a single recommendation in regard to disaster preparedness practice and application is extremely difficult. The problem stems from the inability of the field to decide on a comprehensive disaster preparedness paradigm, or set of metrics, with which disaster preparedness stakeholders can look to for guidance, or implement without alteration. To date, no field-wide disaster preparedness models have been tested and no results can be examined to provide recommendations.

Without any successful disaster preparedness models to provide results, the only realistic recommendation for the implementation of a disaster preparedness “template” is to develop one. Providing a venue where stakeholders involved in disaster preparedness can interact, share experiences, and develop a disaster preparedness model together, is perhaps the best method of ensuring a disaster preparedness model of general applicability and broad acceptance.

Annotated Bibliography

1. Adger, W.N., Brooks, N., Bentham, G., Agnew, M., & Eriksen, S. (2004). *New indicators of vulnerability and adaptive capacity* (Technical Report 7). Tyndall Centre for Climate Change Research.

This research is intended to provide a robust set of indicators with which to measure the adaptability of environments to climate change. The report develops a framework in which risk, vulnerability, and adaptive capacity can be related to one another. A key focus of this report is on improving how to measure the adaptability of persons based on social, economic, political, health, and environmental factors.

2. Adger, W.N., Hughes, T.P., Folke, C., Carpenter, S.R., & Rockstrom, J. (2005). Social-Ecological Resiliience to Coastal Disasters. *Science* 309.

The authors of this piece content that human settlement patterns are concentrated along the coastlines and that our actions have severely altered and impacted the natural ecosystems. This as a consequences has led to vulnerability to extreme events such as hurricanes. This article examines how a greater link between human social systems and ecosystems can reduce vulnerability and enhance the resilience to resist the impact of catastrophic events.

3. Alexander, D. (2005). Towards the development of a standard in emergency planning. *Disaster Prevention and Management*. 14(2), 158-175.

This journal article sets out to provide a set of comprehensive, generally applicable guidelines for the creation of an emergency management plan. The chosen guidelines and models are provided in conjunction with eighteen principles to judge the quality of the plan. The author takes an all-hazards approach and focuses on a local level plan.

4. American National Government: Government and Finance Division. (2006). *FY2006 homeland security grant distribution methods: Issues for the 109th congress* (CRS Order Code RL33241). Washington, D.C.: Shawn Reese.

This report addresses the implemented changes in the DHS for security assistance based on risk and need. The report discusses the methods for determining funding based on risk and need, as well as proposes issues that may arise from the implemented changes.

5. American National Government: Government and Finance Division. (2005). *FY2006 homeland security grant guidance distribution formulas: Issues for the 109th congress* (CRS Order Code RS22349). Washington, D.C.: Shawn Reese.

This report provides a summary of the implemented changes in the DHS from granting funding for security assistance based on population to granting funding based on risk and need. It discusses the method that the DHS anticipates using to determine funding for FY2006 as well as potential issues stemming from the proposed change.

6. American National Government: Government and Finance Division. (2005). *Homeland security and grant formulas: A comparison of formula provisions in s. 21 and h.r. 1544, 109th congress* (CRS Order Code RL32892). Washington, D.C.: Shawn Reese.

This report discusses the fiscal year 2005 Department of Homeland Security (DHS) appropriations for security assistance programs at the state and local level. During 2005, Congress passed two bills that would affect the way that DHS distributes funds to states and localities for security assistance, particularly focusing on the use of risk factors in determining final awards. This report summarizes and compares those two bills, S. 21 and H.R. 1544, by providing a sectional comparison of the two bills, generating estimated guaranteed funding amounts, and by showing the stages in the process of monetary distribution.

7. American National Government: Government and Finance Division. (2005). *Risk based funding in homeland security grant legislation: Analysis of issues for the 109th congress* (CRS Order Code RL33050). Washington, D.C.: Shawn Reese.

This report raises potential questions that policy makers may encounter when determining how to address the discrepancies between the House and Senate versions of the distribution of security assistance funds. It discusses the conceptual difference between *minimum* and *base* funding guarantees, the risk-based factors and how they should be evaluated, and who should have the authority to select the risk factors. This report also includes a detailed summary of select risk-based factors in its appendix.

8. Anielski, M., Winfield, M., & Pembina Institute. (2002). *A Conceptual Framework for Monitoring Municipal and Community Sustainability In Canada*. Ottawa: Pembina Institute

The intent of this report was to develop a set of indicators for Canadian communities by providing a framework to measure environmental quality and sustainability of natural, social and produced capital. The report investigates efforts that are taking place to examine various environmental and quality-of-life indicators and reporting systems across Canada at the national, regional and local scale. Their report indicates several key sustainability indicator research initiatives across Canada that they believe to be the most import. which include: Virginia Maclaren's urban sustainability indicator evaluation framework, the Federation of Canadian Municipalities Quality of life reporting system, The National Round Table on the Environmental and Economy's (NRTEE) environmental and sustainable development indicators, Statistics Canada new Cities indicator project. Based on their research they advocate the development of a national

database that inventories environmental and sustainability datasets. The conclude report with a conceptual model of community sustainability measurement that takes a capital approach by using social, produced and natural capital all tied in to quality of life and sustainability indicators.

9. Benson, C., & Twigg, J. (2004). *Measuring mitigation: Methodologies for assessing natural hazard risks and the net benefits of mitigation – a scoping study*. Switzerland: The International Federation of Red Cross and Red Crescent Societies / ProVention Consortium.

This is the first phase in a study being conducted by the ProVention Consortium to facilitate the development of tools to measure and assess natural hazard mitigation. This phase of the project reviewed current practices and documentation, drawing conclusions and making recommendations for further improvements. Through this research the authors hope to raise awareness of hazard and vulnerability issues in the planning and aid arenas, increase the number and use of appropriate tools, and increase dialogue among mitigation participants.

10. Besleme, K., Maser, E., & Silverstein, J. (1999). A community indicators case study: Addressing the quality of life in two communities. *Redefining Progress*.

This paper observes the use of indicators in two communities with well-established quality of life indicator projects: Jacksonville, FL, and Truckee Meadows in Reno, NV. Through examining these programs the authors intend to show how indicator projects function, demonstrate the success and failures of the programs as learned through experience, and emphasize how the two communities are progressing in their use of indicators. The paper concludes by stating five lessons learned from the project.

11. Biswanath, D., & Sharma, V.K. *Indicators for disaster preparedness*. (ProVention Consortium working paper). Retrieved July 24, 2006, from <http://www.proventionconsortium.org/themes/default/pdfs/AG/biswanath.pdf>.

These working papers review a project by Dash Biswanath to develop a set of indicators that can be used to determine preparedness on a community or micro-social level. A main focus of the indicators is to provide a wide representation of preparedness through mirroring the vulnerabilities of economic and social conditions in the indicators.

12. Blaikie, P., Cannon, T., Davis, I., & Wisner, B. (1994). *At Risk Natural hazards, people's vulnerability, and disasters*. New York: Routledge.

This group of authors explores how natural hazards, including meteorological, geotectonic, and biological are made worse by vulnerable populations. Natural hazards alone do not pose a risk; it is when they are introduced to vulnerable dimensions of our society that do we see their full impact and devastation. The book seeks to explore the link

between different aspects of human society such social, political, economic and disasters and to explain their vulnerability to various natural disasters. Two models are explored to explain vulnerability which includes the disaster pressure model and the release model. The models discuss the root causes of vulnerability and why some individuals are more susceptible to disasters than others.

13. Boullé, P., Vrolijk, L., & Palm, E. (1997). Vulnerability reduction for sustainable urban development. *Journal of Contingencies and Crisis Management*. 5(3), 179-188.

This article discusses the effects of increased urbanization on hazard events and the need for disaster reduction. The authors contend that the International Decade for Natural Disaster Reduction (IDNDR) persons, and their partners, helped to raise much needed awareness on the importance of natural disaster reduction globally.

14. Bruneau, M., Chang, S.E., Eguchi, R.T., Lee, G.C., O'Rourke, T.D., Reinhorn, A.M., Shinozuka, M., Tierney, K., Wallace, W.A., & von Winterfeldt, D. (2003). A framework to quantitatively assess and enhance the seismic resilience of communities. *Earthquake Spectra*. 19(4), 733-752.

“This paper presented a framework for defining seismic resilience and specifying quantitative measures of resilience that can serve as foci for comprehensive characterization of the earthquake problem to establish needs and priorities. The keys to this framework are the three complementary measures of resilience: ‘Reduced failure probabilities,’ ‘Reduced consequences from failures,’ and ‘Reduced time to recovery.’ Dimensions of resilience, examples of which have been discussed here, include the quantitative measures of the ‘ends’ of robustness and rapidity, as well as the ‘means’ of resourcefulness and redundancy. The framework integrates those measures into the four dimensions of community resilience—technical, organizational, social, and economic—all of which can be used to quantify measures of resilience for various types of physical and organizational systems. Systems diagrams then establish the tasks required to achieve these objectives.”

15. Buckle, P., Marsh, G., & Smale, S. (2001). Assessment of personal and community resilience and vulnerability (Report: EMA Project 15/2000). Emergency Management Australia.

This report serves as a starting point in Australia for addressing the issues of vulnerability and resilience. This report develops guidelines and definition, examines events, and tests the guidelines in areas of Australia, all of which is presented in this report.

16. California Community Indicators Conference. (1998). Proceedings of the California community indicators conference. *Redefining Progress*.

This report takes the reader through the two day conference, highlighting discussion topics and important results emanating from the discussions on community indicators. Many facets of community indicators, past and present, are discussed within.

17. Cannon, T. (2000). Vulnerability analysis and disasters. In D.J. Parker(Ed.), *Floods* (45-55). London, England: Routledge.

In this piece, the author argues that because vulnerability is widely viewed as a social and political construction, it is highly ignored in other appropriate arenas. The concept of vulnerability is devolved into five components: initial well-being, self-protection, social protection, livelihood resilience, and social capital; each component is discussed in depth. The author also presents a vulnerability evaluation matrix to help guide the evaluation of vulnerability data collection.

18. Cardona, O.D. (2005). *Indicators of disaster risk and risk management: Program for latin america and the caribbean*. Inter-American Development Bank, Sustainable Development Department.

This report, focusing on Latin America and the Caribbean, discusses the Disaster Risk Management Indicators Program. This program is a methodology containing a series of indicators, incorporated into indices, designed to demonstrate disaster risk at a national level. The information that is presented is intended to highlight several risk factors that should be reduced through public policy and mitigation to improve resilience and the ability to return to normalcy. The methodology could also be applied at regional and local levels.

19. Chakraborty, J., Tobin, G.A., & Montz, B.E. (2005). Population evacuation: Assessing spatial variability to natural hazards. *Natural Hazards Review*. 6(1), 23-33.

This article addresses spatial variances in geophysical risk and social vulnerability, mainly in relation to the hurricane hazard. The article discusses two indices, the geophysical risk index (GPRI) and a social vulnerability for evacuation assistance index (SVEAI), and how these indices demonstrate the special evacuation needs of Hillsborough County, Florida. This research demonstrates the need for using multiple variables and several methods of evaluation when assessing risk and vulnerability.

20. Chang, S.E., & Shinozuka, M. (2004). Measuring improvements in the disaster resilience of communities. *Earthquake Spectra*. 20(3), 739-755.

This article proposes a conceptual framework for measuring the disaster resilience of communities, particularly in relation to earthquakes. Using the guidance of the Bruneau et al. article, this article develops a resilience measurement framework and applies it to

the Memphis, Tennessee water system. The authors suggest that this framework can be applied to a broad range of infrastructure, communities, and disasters. The author also suggests areas for further research that would improve the ability of researchers to determine the disaster resilience of communities.

21. Christopolis, I., Mitchell, J., & Liljelund, A. (2001). Re-framing risk: The changing context of disaster mitigation and preparedness. *Disasters*. 25(3), 185-198.

This article discusses the relationships that exist between disaster mitigation and disaster preparedness and political structures, social organizations, development, and humanitarianism. The article highlights how the different actors and actions are connected to one another to create an environment of disaster mitigation and preparedness.

22. Cobb, C.W. (2000). Measurement tools and the quality of life. *Redefining Progress*.

This report is intended to address two issues with quality of life indicators: the difficulty in revealing the values of a society and the ineptness of indicators that avoid controversy or conflict. The author discusses each of these issues in depth, concluding that if indicators are to play an important role in the creation of better policies and societies, these problems must be avoided.

23. Cobb, C.W., & Rixford, C. (1998). Lessons learned from the history of social indicators. *Redefining Progress*.

This article discusses the history of social indicators, primarily in the United States, in order to help improve the selection of social indicators and prevent repeat mistakes. The article discusses conflicting principles in the history of social indicators, the history of indicators, and twelve lessons that can be learned from the history.

24. Colley, D.G. (1975). A social change index – an objective means to discern and measure the relative current social conditions of cities, towns, and their sub-communities. *Social Indicators Research*. 2, 93-118.

This article presents a social change index, based on Rhode Island census data, to objectively identify the social needs and problems of communities, mainly in the years between the decennial censuses. The index could be used for forecasting social costs and conditions and prioritizing community projects and programs.

25. Commission on Geosciences, Environment, and Resources. (1999). *The impacts of natural disasters: A Framework for loss estimation*. Washington, D.C.: National Academies Press.

This book provides insights into variables and methods for estimating direct and indirect losses caused by natural disasters. The Commission suggests that that value of economic losses caused by disasters are poorly understood and that preparedness and mitigation measures cannot be accurate until better estimates can be made.

26. Committee of International Development Institutions on the Environment (CIDIE). (1988). *Incorporating natural hazard assessment and mitigation into project preparation*. Washington, D.C.: CIDIE.

This paper serves to emphasize the relationship between development and hazard assessment and mitigation in preparing for projects and in implementing projects. The paper's primary purpose is to assist international development assistance agencies in their endeavors. It reviews policies and procedures for such endeavors and is intended to stimulate debate on improving hazard assessment and mitigation.

27. Cortis, R.B., & Enarson, E. Socio-economic disparities in community consequences to natural disasters. Retrieved July 13, 2006, from http://www.ifed.ethz.ch/events/Forum04/Corotis_paper.pdf.

This paper discusses the effects of social conditions on commercial and residential building codes. They discuss how building code enforcement, engineers, etc., should take population vulnerability into consideration when making decisions.

28. Cross, J.A. (2001). Megacities and small towns: Different perspectives on hazard vulnerability. *Environmental Hazards*. 3, 63-80.

This article serves to draw attention to the plight of smaller cities and towns in hazard mitigation and preparedness. The author contends that much has been done to draw attention to these issues in larger cities, such as the Decade for Natural Disaster Reduction, but that smaller cities and towns have not been afforded similar attention. The author argues that finding a connection between the vulnerabilities of urban and rural residents will enhance the overall understanding of hazards issues.

29. Cutter, S.L. (1996). Societal responses to environmental hazards. *International Social Sciences Journal*. 48, 525-536.

This article looks at the increasing consequences of natural disasters through examining global disaster trends in natural and technological contexts. A set of six fundamental questions for hazards research are presented as well as detailed data on environmental hazards on varying social levels.

30. Cutter, S.L. (2003). The vulnerability of science and the science of vulnerability. *Annals of the Association of American Geographers*. 93(1), 1-12.

This article examines the issue of vulnerability from two perspectives. The first provides an examination of the defects in current vulnerability comprehension, involving a discussion of objectivity and rationality, expert versus lay judgments, capturing surprise and unintended consequences, and social construction of scientific and scientific practice. The second perspective focuses on an integrated approach to comprehension and reaction to hazards through an examination of driving forces that amplify or attenuate vulnerability, risk relocation, forecasting losses and their impact, better integrative models, comparative indicators, visualization and representation, and decision-making in response to threats.

31. Cutter, S.L., Boruff, B.J., & Shirley, W.L. (2003). Social vulnerability to environmental hazards. *Social Science Quarterly*. 84(2), 242-261.

This article examines eleven independent factors that account for three-fourths of the variance in a 1990 United States data set. Using these factors, the authors constructed a Social Vulnerability Index (SoVI) that could be used to predict disaster impacts. The authors conclude that contributing factors differ by location and have varying effects.

32. Cutter, S.L., Mitchell, J.T., & Scott, M.S. (2000). Revealing the vulnerability of people and places: A case study of georgetown county, south carolina. *Annals of the Association of American Geographers*. 90(4), 713-737.

This paper presents a framework for evaluating biophysical and social vulnerability issues. The authors provide a case study of Georgetown County, South Carolina using their method, which evidences a lack of intersection between biophysical vulnerability and population vulnerability. The authors conclude from this that high population density areas may be better equipped to handle hazard events than less populated areas.

33. D'Agostino, R.B. (1975). Social indicators: A statistician's view. *Social Indicators Research*. 1(4), 459-484.

This article examines the statistician's role and insights in the topic of social indicators. The author lists and describes the role of statisticians in four problem areas; discusses indicators, index number, and time series; and discusses the combining of distinct indicator variables. A bibliography of references for various statistical topics is included.

34. Davidson, R.A., & Lambert, K.B. (2001). Comparing the hurricane disaster risk of u.s. costal counties. *Natural Hazards Review*, 2(3), 132-142.

Author Davidson, of Cornell University, and author Lambert, a professional engineer, wrote this paper to describe the Hurricane Disaster Risk Index (HDRI) they developed to compare the hurricane disaster risk of United States costal counties. Through this index, the authors expect to create an easily understood and applied index that will allow policy makers, from local to national levels of government, to better legislate and inform in the matter of hurricane risks. The paper provides a brief background of disaster risk indices,

descriptions of variables, the formula for the HDRI, and sample applications from United States coastal counties.

35. Davidson, R.A., & Shah, H.C. (1997). *An urban earthquake disaster risk index* (Report No. 121). John A. Blume Earthquake Engineering Center. Department of Civil and Environmental Engineering: Stanford University.

The authors in this report discuss the development of the Earthquake Disaster Risk Index (EDRI), an index designed to allow comparisons of the earthquake disaster risk of different cities and identify risk factors. The authors' report states that the development of the EDRI will provide a useful tool for inter-city mitigation resource allocation, identify important indicators and factors in earthquake disaster risk, and, through periodic re-evaluation, observe trends over time. This report discusses in great detail the six step process used in the creation of the EDRI, including an example of its application in ten cities.

36. Davidson, R.A., Zhao, H., & Kumar, V. (2003). Quantative model to forecast changes in hurricane vulnerability of regional building inventory. *Journal of Infrastructure Systems*, 9(2), 55-64.

The authors of this article developed a method for examining the change in vulnerability of the building inventory of a region to hurricane winds, based on changes in the building codes of the region. The authors termed their model a "Markov-based model" because it was developed using the mathematical Markov-chain process. The model has a small scope of application and is intended to be incorporated into existing loss estimation models as it is limited to specifically measuring wind damage from hurricanes due to changes in building codes. The article includes a sample application of the model.

37. Diewert, W.E., & A.O. Nakamura (Ed.). (1993). *Essays in index number theory: Volume 1*. Amsterdam, North Holland: JAI Press.

As the title mentions, this book reviews several index number theories. It is a very complex compilation and should be considered discipline specific.

38. Dilley, M.R.S., Chen, R.S., Deichmann, U., Lerner-Lam, A., & Arnold, M. (2005). *Natural disaster hotspots: A global risk analysis*. Washington, D.C.: The World Bank, Hazard Management Unit.

This report by the World Bank and Columbia University highlights the disaster risk for the world through an examination of several natural disasters: earthquakes, volcanoes, landslides, floods, droughts, and cyclones. This report is intended to spotlight high-risk areas in hopes of improving information and reducing future disaster losses. This document contains the formulas used to determine disaster risks, as well as color coded maps to help the reader visualize the data.

39. Dolan, A.H., & Walker, I.J. (2003). Understanding vulnerability of coastal communities to climate change related risks. *Journal of Coastal Research. SI 39 (Proceedings of the 8th International Coastal Symposium)*.

This paper discusses how vulnerability has been classified in the past and how that has influenced current assessments of coastal vulnerability. The author examines the past national level vulnerability assessments and presents a framework for measuring them on community levels. The paper also presents a case study of Canada's Graham Island, Haida Gwaii, British Columbia.

40. Douglas, M., Wildavsky, A. (1982). *Risk and Culture*. Berkeley: University of California Press.

This book provides an in-depth analysis of risk perception from a cultural perspective. The authors contend that the creation of risk is a social process based on ones political or cultural inclinations. Similar values within a culture will lead to similar fears. According to the authors risk will not be perceived based on danger but more on public concern and social criticism. The book seeks to prove with a lack of empirical evidence that risk is based less on scientific knowledge and more social dimensions created by culture.

41. 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 from Geoscience Australia aims to assess the vulnerability of individuals within households to certain types of natural hazards. The report takes the reader step-by-step through the researcher's methodology, ending with an assessment of the project and recommendations for future research. The report provides definitions of several key hazard words, useful indicators, indices, and methodologies. While it is a good report, its application to Australia takes precedent over any other potential applications and the information used to complete the project was limited to available information from the Australian government.

42. Dynes, R.R. (1994). Community emergency planning: False assumptions and inappropriate analogies. *International Journal of Mass Emergencies and Disasters*. 12(2), 141-158.

This article begins by discussing the roots of emergency planning in military models of "command and control." This model is intended to handle enemy attacks, as opposed to civilian emergencies. The author discusses several assumptions and consequences stemming from the model's military roots in an attempt to debunk it for community emergency planning purposes. The article then introduces a counter model of emergency planning termed the "problem solving" model. The author argues that the problem solving model of planning is a more appropriate model of emergency planning for community emergencies.

43. Edgeworth, F.Y. (1925). The plurality of index numbers. *The Economic Journal*. 35(139), 379-388.

This article discusses index numbers, presenting a definition of index numbers, varying theories of indices, and best methods. The author intended to provide ideas to mathematicians that had already created indices to help them consider alternative theories and ideas.

44. Ferriss, A.L. (1988). The uses of social indicators. *Social Forces*. 66(3), 601-617.

This article discusses social indicators, emphasizing the importance of including social indicators in time series. The author draws three relevant conclusions: the time dimension should be included in more studies, ecological variables should be measured, and an attempt at predicting the future based on the data should be encouraged.

45. Flynn, P., Berry, D., & Heintz, T. (2002). *Sustainability & quality of life indicators: Toward the integration of economic, social and environmental measures*. The Journal of Social Health. 1(4).
[Http://www.flynnresearch.com](http://www.flynnresearch.com).

This article brings attention to three sustainability and quality of life indicators: economic, social, and environmental indicators. It contains a brief history of the indicators, an examination of how social science is attempting to expand their definitions, and a conversation about the benefits of an integrated approach. The article also contains the Calvert-Henderson quality of life indicators organized by domain.

46. Fox, A. *Planning for improved resilience*, Retrieved July 15, 2006 from <http://www.corporate.coventry.ac.uk/content/1/c6/01/02/90/PLANNING%20FOR%20IMPROVED%20RESILIENCE.pdf>.

“Disasters and development are inextricably linked, and while development planning has a long and well-established tradition, its ability to learn from disasters seems limited. Disaster planning by contrast is a relatively new field and its multidisciplinary approach has brought it to the boundaries of development planning. Disaster planners have recognized the importance of greater integration with development planning in order to mitigate the effects of future disasters and to build greater resilience into urban communities. But, implementing any change to the development planning process must overcome entrenched views and the vested interests belonging to those that control the development process. The first I-Rec conference on Post-Disaster Reconstruction provided a forum within which the elements for an integrated planning could begin to be identified. This paper provides an analysis of the I-Rec contribution and elaborates on a system for testing compliance with any new planning framework.”

47. Frisch, R. (1936). Annual survey of general economic theory: The problem of index numbers. *Econometrica*. 4(1), 1-38.

This article provides an analysis of index numbers concerning purchasing power through examining the relevant works and methods of the time on the subject. The article is very subject specific and contains many methods and formulas.

48. Gillespie, D.F., & Streeter, C.L. (1987). Conceptualizing and measuring disaster preparedness. *International Journal of Mass Emergencies and Disasters*. 5(2), 155-176.

This article offers an empirically based measure of preparedness in an attempt to provide conceptual clarification of preparedness and to promote “practice-based theory and theory-based practice.” A set of variables to test preparedness are introduced with a specific focus on how they measure preparedness within organizations. This paper is not intended to be a comprehensive measure of preparedness, but a contribution to the development of a comprehensive measurement.

49. Global Reporting Initiative (GRI). (2002). *Sustainability reporting guidelines*. Boston: GRI.

This report is the second cyclical report produced on sustainability reporting guidelines from the Global Reporting Initiative. It contains information and processes to aid organizations in “reporting on economic, environmental, and social dimension of their activities, products, and services.” The document is for voluntary use and contains information on who should use the guidelines and how to use them.

50. Godschalk, D.R. (2003). Urban hazard mitigation: Creating resilient cities. *Natural Hazards Review*. 4(3), 136-143.

“This paper proposes a strategy of urban hazard mitigation aimed at the creation of *resilient cities*. It reviews hazard mitigation practice, defines a resilient city, and discusses why resilience is important and how to apply its principles to physical and social elements of cities. It concludes by proposing reforms to disaster policy to increase resilience.”

51. Granot, Hayim (1995). Proposed scaling of the communal consequences of disasters. *Disaster Prevention and Management*. 4(3), 5-13.

The author of this article suggests that a rapid assessment of a community’s capacity to handle post-disaster efforts is necessary to prevent the misguidance of relief effort. Three criteria are suggested important factors in determining a community’s post-disaster capacity: community background, event factors, and impact factors. Each of the factors and other pertinent information are discussed in this article.

52. Granot, Hayim (1996). Disaster subcultures. *Disaster Prevention and Management*. 5(4), 36-40.

This article examines the largely ignored topic of disaster subcultures. It reviews the history, works to create a definition, provides examples of, and provides characteristics of a disaster subculture. The author concludes that disaster subculture behavior should come be brought in with generally accepted usage.

53. Green, W.G., Walk, E.M., & Altay, N. A simplified hurricane index model for coastal jurisdictions. *Notes on the Science of Extreme Situations, Paper No. 9*, Retrieved June 15, 2006, from [http://www.richmond.edu/~wgreen/Paper9\(4\).pdf](http://www.richmond.edu/~wgreen/Paper9(4).pdf).

This article addresses how to compare hurricane threats to different coastal states and how to compare hurricane threats to jurisdictions within the same state. This article provides a description of hurricanes, the methodology used to create and apply the index, and sample applications. The article also addresses areas where improvements could be made in the method. A particularly useful component of this article is the cross-jurisdictional index, where intrastate hurricane threat comparisons can be created.

54. Hahn, H., Villagrán De León, J.C., & Hidajat, R. (2003). *Component III: Indicators and other disaster risk management instruments for communities and local governments*. Inter-American Development Bank / German Technical Cooperation Agency (GTZ).

This report created a framework consisting of forty-seven indicators broken down into various groups, designed to allow data-poor areas to arrange useful results for determining disaster risk. Two countries, Guatemala and Switzerland, were used as case studies, both to examine current systems and to apply the new framework. The authors suggest that the framework could also be used as the basis for an index.

55. Henstra, D., & McBean, G. (2004). *The role of government in services for natural disaster mitigation*. Institute for Catastrophic Loss Reduction.

This article discusses natural disasters in Canada while attempting to answer the questions “Should disaster mitigation be primarily a government responsibility? What is the appropriate role for government in this endeavor? What are the services for disaster mitigation that a government can provide and what form should they take?” They authors discuss the results of these questions in different perspectives: economic, legal, and moral. Four tools that contribute to disaster mitigation are also discusses: planning, hazard assessment and monitoring, prediction and warning systems, and public education and research. All of these discussions are used to draw the conclusion that disaster mitigation is a government function and should be a high priority government function in Canada.

56. Henstra, D., & Sancton, A. (2002). *Mitigation catastrophic losses: Policies and policy making at three levels of government in the united states and canada* (Paper Series No. 23). Institute for Catastrophic Loss Reduction.

This paper examines the United States and Canada in an attempt to determine which factors help or hinder disaster mitigation efforts. The authors take the approach that the United States' methods are more progressive and comprehensive. Each country is examined based on different policies and policy-makers.

57. Institute of Medicine, National Research Council. (2005). W.H. Hooke & P.G. Rogers (Eds.), *Public health risks of disaster: Communication, infrastructure, and preparedness*. Washington, D.C.: National Academies Press.

This workshop summary provides the professional considering on several issues dealing with disaster planning. While the workshop summary offers no formal recommendations, it does provide a professional overview of disaster related topics, including a good overview of preparedness.

58. Integrated Regional Information Networks (IRIN). (2005). *Disaster reduction and the human cost of disaster: IRIN web special*. IRIN.
[Http://www.IRINnews.org](http://www.IRINnews.org).

This article discusses natural disasters in terms of the unequal burden they place on poor populations and the powerful effects of mitigation efforts. It discusses a multitude of issues related to disaster preparedness including discussion of costs, pre-disaster efforts, mitigation, and disaster response. The article also contains minimal case examinations and interviews with key preparedness stakeholders.

59. Izadkhah, Y.O., & Hosseini, M. (2005). 'Towards resilient communities in developing countries through education of children for disaster preparedness', *International Journal of Emergency Management*. 2(3), 138–148.

This article focuses on disaster preparedness in developing countries through the education of children. The authors state that there is a lack of education in developing countries among adults, that parents generally accept information from their more educated children, and that the majority of the population in developing countries is under the age of 18. Therefore, according to the authors, the target group for disaster preparedness education in developing countries should be the youth.

60. Jenkins, L.A., & Konecny, R.T. (1994). Creating a vitality index as an effective citizen participation tool. *Journal of the Community Development Society*. 25(2), 213-228.

This journal article serves primarily to introduce the authors' vitality index. This index uses twenty-four different measures to examine citizen participation in economic development activities.

61. Kaly, U., Briguglio, L., McLeod, H., Schmall, S., Pratt, C., & Pal, R. (1999). *Environmental Vulnerability Index (EVI) to summarise national vulnerability profiles*. South Pacific Applied Geoscience Commission (SOPAC), SOPAC Technical Report 275.

This report by SOPAC provides an index (EVI) that allows for the comparison of the environmental vulnerability of different states. SOPAC has categorized environmental vulnerability into 3 separate aspects that are risk to the environment, the resilience of the environment and ecosystem integrity. The EVI is a weighted composite index that has 3 sub-indices, which correspond to the 3 different aspects of vulnerability, and include the risk exposure sub-index (REI), Intrinsic Resilience sub-Index (IRI) and the Environmental Degradation sub-index (EDI). EVI is comprised of a total of 57 indicators that range from metrological to biodiversity in nature. SOPAC provides an application of their index by examining 3 states which include Australia, Fiji and Tuvalu. Tuvalu was found to be the most environmentally vulnerable while Australia was the least.

62. Keller, A.Z., Meniconi, M., Al-Shammari, I., & Cassidy, K. (1997). Analysis of fatality, injury, evacuation and cost data using the Bradford disaster scale. *Disaster Prevention and Management*. 6(1), 33-42.

Using data from the Major Hazard Incidents Data Service database (MHIDAS), the authors selected particular incidents to convert into magnitudes through use of the Bradford Disaster Scale. All the information is figured in separate datasets that are then compiled into a comprehensive analysis of several countries based on the indicators.

63. Kelly, C. (1995). A framework for improving operational effectiveness and cost efficiency in emergency planning and response. *Disaster Prevention and Management*. 4(3), 25-31.

This article presents an adaptable framework for managing the costs associated with efficient disaster response operations. This framework provides a method for improving the cost efficiency and response effectiveness of disaster management.

64. Keown-McMullan, C. (1997). Crisis: When does a molehill become a mountain? *Disaster Prevention and Management*. 6(1), 4-10.

This article examines crisis management, with a particular focus on how a crisis develops. The author examines several different definition and descriptions of “crisis” and provides three elements that must exist for a crisis to develop: a triggering event, a perceived inability to cope, and a threat to survival.

65. Keys, C.L. *Community analysis: Some considerations for disaster preparedness and response*. New South Whales State Emergency Service.

This paper discusses the reactive nature of Australian emergency response and the ways in which preparedness would be more effective. The paper focuses on preparing the whole community and altering current practices and behaviors to be more preparedness oriented.

66. King, D. (2001). Uses and limitations of socioeconomic indicators of community vulnerability to natural hazards: data and disasters in northern Australia. *Natural hazards*, 24, 147-156.

Focusing on Northern Australia, this article discusses the immense increase in the availability of data through the use of technology. The author cautions that utilizing existing databases of convenience does not always generate quality results as databases are full of quantifiable data. When classifying a community's vulnerability, many types of data, not just quantifiable data, should be used.

67. Kirschenbaum, A. (2002). Disaster preparedness: A conceptual and empirical reevaluation. *International Journal of Mass Emergencies and Disasters*, 20(1), 5-28.

This article devises a method to evaluate the conceptual and empirical validity of preparedness measures through a statistical study of Israel. The author suggests that preparedness must be measured through a variety of variables derived from the various constructs of preparedness; primary focus is given to variables resulting from the categories provisions, skill level, planning, and protection.

68. Kunreuther, H., Meyer, R., & Van den Bulte, C. (2004). *Risk analysis for extreme events: Economic incentives for reducing future losses* (NIST GCR 04-871). National Institute of Standards and Technology/United States Department of Commerce.

This report discusses the need to connect risk assessment, risk perception, and risk management to develop strategies for handling extreme events. The report concentrates on the use of economic incentives, events requiring interdependence, and public-private sector cooperation. A conceptual framework for connecting risk assessment, risk perceptions, and risk management is presented. The report includes detail discussion on the aforementioned issues as well as the results of an earthquake simulation.

69. Kwatra, A. (2005). *Don't be scared, be prepared: How disaster preparedness can save lives and money*. Christian Aid.

This article argues primarily for disaster preparedness measures to be taken in poorer areas of the world. The author cites several examples of recent high-profile natural disasters, mainly in the eastern hemisphere, and suggests ways that lives could have been saved by disaster preparedness. The article makes evident that small, relatively inexpensive measures, can save many lives in poorer countries.

70. Land, K.C. (1983). Social indicators. *Annual Review of Sociology*. 9, 1-26.

This article discusses the history of social indicators from the 1960s to the 1980s. Three classes of social indicators are discussed: normative welfare indicators, satisfaction indicators, and descriptive social indicators. The author examines theoretical approaches in social indicators, sociological contributions to social indicator research, and current research problems. The conclusion argues that social concerns change, but the need for statistical information on trends and conditions will not change.

71. Lavell, A. (2003). *Indicators for disaster risk management. Some results, conclusions, and recommendations following the first expert meeting on disaster risk conceptualization and indicators modeling*. Inter-American Development Bank. IDEA: Information and Indicators Program for Disaster Risk Management.

This document discusses the information generated from the Expert Meeting on Disaster Risk Conceptualization and Indicators Modeling as a part of the Indicators Project. The Indicators Project is designed to “construct an index or model of indicators that describes the comparative level of disaster risk in different countries and allows the identification of the principal factors that contribute to the configuration of risk in each country.” Many meeting-related themes, topics, and papers are briefly discussed within the document.

72. Lindell, M.K., R.W. Perry, & K.J. Tierney (2001). *Facing the unexpected: Disaster preparedness and response in the united states*. Washington, D.C.: Joseph Henry Press.

This book focuses on preparedness and pre-disaster planning as well as post-disaster emergency response. It is one in a series of books based on research conducted by the authors, their colleagues, and a multitude of others. The authors seek to answer several key questions dealing with preparedness and response. Taking the reader through 25 years of natural disasters and the lesson that they have taught, this book accurately frames the issues involved in disaster preparedness and response and suggests methods for improvements.

73. Lloyd, D.W., & Wilson, H. (2002). Interpretation of subjective ratings: Some fundamental aspects. *Disaster Prevention and Management*. 11(4), 308-311.

This article reviews the basic principles underlying the use of subjective measures in research. The authors intend to show the core assumptions made about subjective measures to prevent misapplication, misinterpretation, and to maintain credibility.

74. Loy, Admiral J. (2005). *National preparedness goal – Homeland security presidential directive 8: “National preparedness”*. Washington, D.C.: Department of Homeland Security.

This is the final draft of the National Preparedness Goal, established by Presidential Directive 8, to address the United States' need for disaster preparedness. The draft discusses methods of defining, assessing, prioritizing, and implementing preparedness measures. It also highlights six national priorities: National Incident Management System (NIMS) and National Response Plan (NRP) implementation; National Infrastructure Protection Plan (NIPP) implementation; chemical, biological, radiological, nuclear, and explosive (CBRNE) detection capabilities; interoperable communications capabilities; and medical surge capabilities.

75. McEntire, D.A. (2001). Triggering agents, vulnerabilities and disaster reduction: Towards a holistic paradigm. *Disaster Prevention and Management*, 10(3), 189-196.

This article argues that vulnerability should be the central concept of disaster study and disaster reduction. The author examines the historical perspectives of disaster, the nature of disaster, reasons why vulnerability is increasing, and future implications. These sections serve to prove the main argument, as well as to put forth models, factors, and methods of vulnerability management.

76. McEntire, D.A. (2003). *Disaster preparedness* (Item No. 42869). International City/County Management Association, 35(11).

This report provides a guide for emergency administration and emergency planning. Aimed mostly at emergency managers, the report provides information on risk assessment, emergency training, public education, and other information that is informative and helpful in disaster preparedness. This report also provides sample checklists, resources, and examples from local governments.

77. McEntire, D.A. (2005). Why vulnerability matters: Exploring the merit of an inclusive disaster reduction concept. *Disaster Prevention and Management*, 14(2), 206-222.

This article provides an overview of disaster reduction in terms of research, debate, and policy. This article provides pros and cons for differing perspectives of disaster reduction methods and approaches. It also provides a brief history of the issues surrounding disaster reduction, including past and present focuses, and the various views and recommendations of the disciplines involved in disaster reduction.

78. McEntire, D.A., Fuller, C., Johnston, C.W., & Weber, R. (2002). A comparison of disaster paradigms: The search for a holistic policy guide. *Public Administration Review*, 62(3), 267-281.

This article focuses on emergency management and the need for a new paradigm to guide the future of emergency management. It begins with an overview of emergency management, providing insights into its history and exploring some of its characteristics,

strengths, and weaknesses. The article continues by examining disaster-resistant communities, disaster-resilient communities, and sustainable development and sustainable hazards mitigation. The author stresses that these, along with invulnerable development and comprehensive emergency management amalgamate to form a more holistic view of emergency management. The authors also incorporate sub-issues such as preparedness, response, and recovery into the article.

79. Meade, C., & Abbott, M. (2003). *Assessing Federal Research and Development for Hazard Loss Reduction*. Santa Monica, CA: Rand.

This book, based on a study conducted by the RAND Corporation, examines the efforts of the United States federal government for research and development in hazard loss reduction. The following four questions provided a guide for the research: What is the distribution of federal R&D funding across various types of hazards? What types of research activities are supported by federal funding? What criteria determine the allocation of these funds? How do these R&D efforts contribute to hazard loss reduction? Throughout the book, these questions are answered as effectively as possible and conclusions about federal research and development are drawn from them.

80. Menoni, S., Meroni, F., Pergalani, F., Petrini, V., Luiz, L., & Zonno, G. (2000). Measuring the seismic vulnerability of strategic public facilities: Response of the health-care system. *9(1)*, 29-38.

This article looks at the potential of critical buildings to return to functionality post disaster, with a heavy emphasis on hospitals. Factors are presented to assist in developing a framework to determine the likelihood of a rapid return to service under duress and with physical damage.

81. Michalos, A.C. (2003). Observations on key national performance indicators. *Forum on National Performance Indicators*. Washington, D.C..

“The purpose of this paper is to compare and contrast the leading integrated performance systems on a national, international and state level. This analysis covers organizational, procedural, technological, methodological, political and other relevant dimensions; relative strengths and weaknesses; breadth and depth of coverage; as well as assessing aggregation strategies. The paper concludes with some high level observations about implications for the U.S. of the experiences of these other systems and potential areas for further research.”

82. Miller, M., Paton, D., & Johnston, D. (1999). Community vulnerability to volcanic hazard consequences. *Disaster Prevention and Management*. *8(4)*, 255-260.

“This paper explores some psychological aspects of community vulnerability following the 1995 and 1996 eruptions at Ruapehu volcano, New Zealand. A model comprising three psychological factors (sense of community, coping style and self-efficacy) is used

to investigate this issue. The results suggest that self-efficacy and problem-focused coping reduce vulnerability and that this model has a role to play in identifying vulnerable communities. The differential implications of physical and economic hazard consequences for community vulnerability were also examined. Data is presented that reinforces the view that the salience of volcanic hazard consequences is a result of their implications for community functions and resources. The implications for mitigation, threat communication and the development of resilient communities are discussed.”

83. Moberg, D.O. (1979). The development of social indicators for quality of life research. *Sociological Analysis*. 40(1), 11-26.

This article discusses the social indicator “spiritual well-being.” At the time this article was written, the word and concept of “spiritual” was becoming socially accepted. This article examines the research of the time that was leading to the development of an index of spiritual well-being as well as anticipated problems.

84. Morrow, B.H. (1999). Identifying and mapping community vulnerability. *Disasters*. 23(1), 1-18.

This article discusses vulnerability as it is socially constructed. According to the author, mapping vulnerable populations, and focusing intensive disaster preparedness and response efforts on these populations, is critical to emergency management effectiveness. This article provides examples of vulnerable populations to help develop a vulnerability map.

85. Moulder, E.R. (2004). *Profile of individual cities: Indicators of comparability* (Special Data Issue No. 1). Washington, D.C.: International City/County Management Association.

This report is a collection of data on nine different factors that the author thinks are important in determining if local governments are comparable; the factors are: services provided, number of full-time employees, economic-health, population change, unemployment rate, average per capita income, total taxable value of real estate, and fund balance as a percentage of operating budget revenue. A survey to collect the various data was sent to all city governments in the United States with a population over 10,000 and 33.3% responded. The report contains the data provided in received responses.

86. Munich Re Group. (2003). Topics Annual Review: Natural Catastrophes 2002. (2003). Munchen: Munich Re Group (302-03631).

This report, composed by the Geo Risks Research Department of Munchener Ruckversicherungs-Gesellschaft Central Division, examines the natural catastrophes of 2002. According to the research group, the natural hazard phenomena in 2002 were more pronounced than in previous years. The article cites several examples of global natural hazard issues and explains the Natural Hazard Index, an index created to measure the risk of material losses in megacities across the world.

87. Munich Re Group. (2004). *Megacities – megarisks: Trends and challenges for insurance and risk management* (302-04271). Germany: Münchener Rückversicherungs-Gesellschaft.

The goal of this document is to present the major risks associated with megacities, particular in how they relate to large capital enterprises and the insurance industry. It also presents the Natural Hazards Risk Index for Megacities, an index that takes a comprehensive approach to measuring the loss potential from hazards. All components of the index are discussed within the document.

88. National Research Council. (2006). *Facing hazards and disasters: Understanding human dimensions*. Washington, D.C.: National Academies Press.

This book delves into hazard and disaster research from a social science perspective. It presents opportunities and challenges of the two types of research, and provides recommendations for improving studies in the field.

89. National Task Force on Interoperability. (2003). *Why can't we talk? Working together to bridge the communications gap to save lives*.

This document is for elected and public officials and officers, providing a guide for assessing and improving interoperability. It discusses why there are problems with communication, how to assess for interoperable preparedness, and the importance of and ways to improve interoperability. While this is the primary document in the series, there are also supplemental readings that coincide with this guide that contain further analysis and case studies in the issue area.

90. O'Leary, M. (2004). *Measuring disaster preparedness: A practical guide to indicator development and application*. Lincoln, NE: iUniverse, Inc.

This book describes the process of indicator development for measuring disaster preparedness, discusses data management, and provides an analysis of useful indicator theories. The goal of the author is to help those involved in disaster preparedness to develop better measurements and, ultimately, to assist in the continual improvement of disaster preparedness.

91. Paton, D., & Johnston, D. (2001). Disasters and communities: Vulnerability, resilience, and preparedness. *Disaster Prevention and Management*. 10(4), 270-277.

This article focuses mainly on an individual level of preparedness, but contains pertinent information that can be applied on a community and/or organizational level. The authors discuss the ineffectiveness of traditional approaches to public education and risk perception in the contexts of public education, vulnerability analysis, and community resilience. The article also suggests that preparedness and resilience are linked to

community development. It presents a model of resilience to hazard effects as well as a model of the risk perception-risk reduction behavior process. The authors conclude that resilience and preparedness can be promoted through the use of mixed approaches by risk management.

92. Paton, D., Smith, L., & Johnston, D. (2003). When good intentions turn bad: Promoting disaster preparedness. *Proceedings of the 2003 Australian Disaster Conference*.

This literature presents a social cognitive model of disaster preparedness that can be broken into three linked, but separate phases: factors that motivate preparation, intentions formation, and the movement from intentions to actions. The literature also defines variables at each of the three stages, demonstrates an application of the developed model in earthquake preparedness, and presents an assessment of the chosen model.

93. Paton, D., Smith, L., & Violanti, J. (2000). Disaster response: Risk, vulnerability, and resilience. *Disaster Prevention and Management*. 9(3), 173-179.

“The assumption of an automatic link between disaster exposure and pathological outcomes is increasingly being questioned. Recognition of the possibility of positive reactions and growth outcomes in this context necessitates the development of alternative models and, in particular, the accommodation of the resilience construct in research and intervention agenda. Reviews possible vulnerability and resilience factors and adopts a risk management framework to outline its potential for modelling the complex relationships between these variables and both growth and distress outcomes. Resilience and vulnerability is discussed at dispositional, cognitive and organisational levels. The paradigm developed here focuses attention on facilitating recovery and growth in professionals for whom disaster work and its consequences is an occupational reality.”

94. Pelling, M. (2003). *The Vulnerability of Cities: Natural Disasters and Social Resilience*. London: Earthscan.

This book by Pelling examines the social dimensions of cities that are vulnerable and at risk to disaster. An effort is taken to explain why many urban areas within the developing world are progressively more affected by environmental hazards and risks. Social dimensions such as power are discussed and how a lack of power leads to greater vulnerability within cities.

95. Perry, R.W., & Lindell, M.K. (2003). Preparedness for emergency response: Guidelines for the emergency planning process. *Disasters*. 27(4), 336-350.

The primary purpose of this article is to examine the relationships between planning, training, and written plans in the context of emergency preparedness, with a particular focus on the role of the planning process. The article introduces ten guidelines to be

adhered to in the emergency planning process. The authors take the position that appropriate planning principles are a critical foundation for preparedness.

96. Phillips, D., & Berman, Y. (2003). Social quality and ethnos communities: Concepts and indicators. *Community Development Journal*. 38(4), 344-357.

This article focuses on a community's internal social quality and how it interacts with national institutions. Special attention is given to the areas of socioeconomic security, social inclusion, social cohesion, and empowerment. The conclusion explains indicators of external aspects of a community's social quality in the areas of social cohesion and social inclusion.

97. Rashed, Tarek. (2005). *Sustainable hazards mitigation*. GIS for Sustainable Development. Ch.17, 287-310.

This chapter discusses the possibilities that GIS and remote sensing technologies hold for analyzing vulnerability and incorporating it into hazard mitigation. This chapter lays the basic groundwork for the development of a methodology that will accomplish the overarching goal.

98. Roberts, V. (1994). Flood management: Bradford paper. *Disaster Prevention and Management*. 3(2), 44-60.

This paper is essentially a case study of the events that unfolded in Towyn, Britain as the result of severe storms in the seaside town. The author argues that the local authorities were not prepared for the event when it occurred, but post-disaster, were able to bond with many organizations and successfully handle the aftermath. This paper examines the methods and systems that have developed from the disaster in Towyn.

99. Rodrigue, C.M. (2004). Hazard vulnerability, media construction of disaster, and risk management. *International Working Conference of the World Association of Disaster and Emergency Medicine*. Brussels, Belgium.

This talk, according to the author, is a discussion of three areas of concern in her work: "differential vulnerability to disaster, media impacts on risk perception and policy, and communication between risk assessment and risk management." Each of these areas is briefly touched on in the talk.

100. Salter, J. *Risk management self assessment framework*. Blackwood, Australia: Emergency Preparedness Capacity Builders.

This paper discusses risk management and disaster planning, focusing on how they shape businesses and organizations. Further exploration reveals a framework for self assessment that can be applied to businesses and organizations wishing to assess and improve their risk management potential. A web address is given within the document

that leads the reader to a website with a free downloadable Excel spreadsheet to aid in risk management assessment.

101. Sharma, J.C. (1974). Measurement of social concepts: Indicators and indexes. *The Indian Journal of Social Work*. 34(4), 357-365.

The purpose of this article is to discuss indicators and indices as measures of social concepts. The author focuses on creating a conceptual foundation for indicators and indices and demonstrating their use as measures of social ideas.

102. Sharpe, A. (2001). *The development of indicators for human capital sustainability*. Center for the study of Living Standards.

This paper examines the development of indicators for human capital in two sections. The first section places the issues of health and education into a framework that tracks the sustainability of human capital. The second section develops a framework for tracking the economic sustainability of health and education. Each section provides frameworks and a selection of the best indicators for the topic.

103. Sheldon, E.B., & Parke, R. (1975). Social indicators. *Science*. 188(4189), 693-699.

This article provides a brief history of social indicators and how they developed as one of four research methods from early talks of social indicators. It discusses the use of social indicators as measurements of social change and how to make social indicators more valuable in their function.

104. Short, Jr., J.F., & Rosa, E.A. (1998). Organizations, disasters, risk analysis and risk: Historical and contemporary contexts. *Journal of Contingencies and Crisis Management*. 6(2), 93-96.

This article briefly discusses the historical rise of organizational risk analysis and other related literature with a particular focus on the early works of Barry Turner and Turner's collaboration with Nick Pidgeon.

105. Siembieda, W.J. (2001). Choosing a paradigm for disaster recovery in central america. *Center for Disaster Management and Humanitarian Assistance*, Retrieved May 25, 2006, from [Http://www.cdmha.org/Research/Chapter1.pdf](http://www.cdmha.org/Research/Chapter1.pdf).

The author conducted a study of four countries in Central America to determine the ability of people and communities to recover from disasters. In his report, Dr. Siembieda suggests that socioeconomic factors and societal relations have an impact on a community's ability to recover from a disaster. He creates a set of variables and factors to be applied to the four countries that he studied to determine how a community has chosen to accept one of two paradigms: the return to normalcy path or the transformative

path. This project serves, in part, to emphasize the necessity of incorporating disaster preparedness plans into developmental plans.

106. Simpson, D.M. (2004). Disaster Preparedness Measures: Test Case Development and Application.

The author developed a set of metrics that allows for measurement of emergency preparedness in several different communities. Various data sources were utilized for this study including: interviews, surveys of managers, and document data. The findings indicate that a preparedness model can aid in the comparison and evaluation of community preparedness but further testing is needed on a larger scale.

107. Smith, R., Simard, C., & Sharpe, A. (2001). A Proposed Approach to Environment and Sustainable Development Indicators Based on Capital. National Round Table on the Environment and the Economy.

This paper takes a capital approach to environmental and developmental indicators. The capital approach has been traditionally used under the economic banner but has now been adopted by those who are interested in a future of sustainability and environmental development. Capital is subject to deterioration over a period of time and needs to be utilized at a pace that will not jeopardize future generations. There are several different aspects of capital that include produced, human, and natural capital. The authors believe that monetary assessments are more beneficial than physical ones and therefore should be taken in this approach. A possible set of indicators would be based on produced capital, human capital, natural resource wealth, total national wealth, physical quantities of natural resource stocks, agricultural land use supply and demand, indicators of ecosystems service outcomes, and indicators of demand for ecosystems services.

108. Srinivasan, D. (2003, February). Battling Hazards with a Brand New Tool: When It Comes to Preparing for Hazards, Communities Need Straight Answers to Complex Questions. *Planning*, 69, 10+.

This article begins by discussing the post-9/11 state of hazard mitigation awareness. The article proceeds to discuss Hazards United States – Multi-hazards (HAZUS-MH), the Federal Emergency Management Agency run software used to estimate losses caused by hazards. This article discusses the original purpose of HAZUS as well as the upgrades that have been made to the system that make it HAZUS-MH. The author describes several circumstances where HAZUS has been used to mitigate in the United States.

109. Tapsell, S.M., Penning-Rowsell, E.C., Tunstall, S.M., & Wilson, T.L. (2002) Vulnerability to flooding: health and social dimensions (DOI 10.1098/rsta.2002.1013). *Philosophical Transactions of the Royal Society London A*. 360(1796), 1511-1525.

This article focuses on the effects of flooding, attempting to capture some of the non-monetary, social effects of floods. The authors introduce the Flood Hazard Research Centre's Social Flood Vulnerability Index (SFVI), an index used to predict the areas and populations most vulnerable to the impacts of flooding. Chosen variables and the index method are described within the paper.

110. Technical Committee on Disaster Management. (2004). *Standard on disaster/emergency management and business continuity programs* (NFPA 1600). Quincy, MA: National Fire Protection Agency.

This document, developed by the National Fire Protection Agency, contains the standard in emergency management practices. It was developed to help emergency managers, disaster managers, and business managers develop best practices for coping with disasters and emergencies. The document covers a variety of issues including preparation, mitigation, response, and recovery practices, as well as program establishment/evaluation techniques. It is intended to help both the public and private sectors develop, implement, and evaluate disaster preparedness programs. This document also contains a comprehensive list of public, private, and not-for-profit entities that share in disaster and emergency related issues.

111. Treasury Board of Canada Secretariat. (2002). *Canada's performance 2002* (Catalogue No. BT1-10/2002). Ottawa, Ontario: Treasury Board of Canada Secretariat.

This performance review provides an overview of the quality of life of Canadians based on particular societal indicators. These indicators are: economic opportunities and innovation, health, environment, and strength and safety of communities. Each indicator is intended to provide an overview of the indicator, an assessment of current government programs pertaining to that indicator, and information that will open debate for future assessment of the indicator. By compiling this data, the Treasury Board of Canada Secretariat expects to demonstrate where Canada stands in comparison to nations of similar situation and to provide a basis for discussion of future improvements.

112. Twigg, John (2002). Lessons from disaster preparedness. *Note for Presentation to Conference on Climate Change and Disaster Preparedness.*

This literature examines disaster preparedness, discussing the costs and benefits, as well as areas requiring attention. The reader is able to obtain a clear overview of the general issues in disaster preparedness, including information on the dynamics of the disaster preparedness community, methods and measurements, analysis, and decision-making. A review of this material would provide an excellent starting point for examining disaster preparedness issues as a whole.

113. United Nations Development Programme (UNDP). (2004). *Reducing disaster risk: A Challenge for development* (ISBN 92-1-126160-0). New York: John S. Swift Co.

The United Nations Development Program's Bureau for Crisis Prevention and Recovery suggests in this report that the process of development has a heavy impact, both positive and negative, on a country's disaster risk. The report demonstrates that previous developmental policies and disaster planning, when applied to similar natural hazards in countries at various levels of development, produce a variety of results when disasters occur. This report also presents the Disaster Risk Index (DRI), which intends to measure the risk for three significant natural hazards: earthquake, tropical cyclone, and flood. The DRI highlights development factors that contribute to risk and exhibits, in quantitative terms, the positive and negative effects of policy decisions.

114. United Nations International Strategy for Disaster Reduction (UNISDR). (2002). *Natural disasters and sustainable development: Understanding the links between development, environment, and natural disaster* (DESA/DSD/PC2/BP5). Background Document for the World Summit on Sustainable Development (WSSD). UNISDR.

This document poses questions on the relationship between sustainable development and natural hazards. It discusses what needs to be done and what should be done in the areas of disaster preparedness, mitigation, prevention, and development.

115. United Nations Population Fund (UNFPA). (2004). *State of the world population 2004*. New York: UNFPA.

This report by the United Nations Population Fund was designed to provide a comprehensive statement on the condition of the world. Of particular interest is the section on demographic, social, and economic indicators, which lists the statistics on several pre-selected indicators for every country in the world.

116. United States Department of Homeland Security. (2006). Discussion of the FY 2006 risk methodology and urban areas security initiative. Washington, D.C.: United States Department of Homeland Security.

This report provides an overview of the FY 2006 risk methodology and Urban Areas Security Initiative (UASI) implemented by the United States Department of Homeland Security. It contains an assessment of asset-based risk and geographically-based risk, important information on FY 2006 risk methodology and UASI, and visual representations of the two types of risk.

117. United States Department of Homeland Security. (2004). *National response plan*. Retrieved June 2, 2006, from United States Department of Homeland Security Website:
http://www.dhs.gov/interweb/assetlibrary/NRP_FullText.pdf.

The National Response Plan (NRP) was designed by the United States to eliminate issues that prevented smooth operations when federal, state, tribal, or local governments were required to cooperate on a disaster effort. The NRP development process focused heavily on improving communications between different types of emergency responders, public and private entities, and nongovernmental organizations. The national response plan contains four different components: the base plan, appendixes, emergency support function annexes, and support annexes.

118. United States Department of Homeland Security: Preparedness Directorate's Office of Grants and Training. (2005). *FY 2006 homeland security grant program: Program guidance and application kit*. Washington, D.C.: United States Department of Homeland Security.

This document, provided by the United States Department of Homeland Security, focuses primarily on the methods of implementing the long-term National Preparedness Goal. It is intended to demonstrate a commitment to preparing the nation for terrorist attacks and natural hazards. It includes a useful section on national disaster preparedness as well as several sections on different initiatives, programs, and systems being put into practice.

119. United States Federal Emergency Management Agency (FEMA). (2000). *Planning for a sustainable future: The link between hazard mitigation and livability*. Washington, D.C.: FEMA.

This booklet prepared by the Federal Emergency Management Agency addresses hazard mitigation and livability in the United States. It emphasizes the importance of disaster resistance in everyday community practices and provides methods of incorporating disaster resistance into pre and post-disaster scenarios. The booklet also provides examples of successful applications of sustainable development practices in United States communities.

120. United States Federal Emergency Management Agency (FEMA) and National Emergency Management Association (NEMA). 2000. *State Capability Assessment for Readiness*.

The intent of this document is to provide a set assessment tools for operational readiness in emergency management. The questions that are provided by FEMA and NEMA are designed as a self assessment and help identify strengths and weakness in the emergency management system. The underlying purpose is to help establish a set of priorities for emergency operations.

121. United States General Accounting Office. (2001). *Disaster assistance: Improvement needed in disaster declaration criteria and eligibility assurance procedures* (GAO-01-837). Washington, D.C.: GAO.

This report is primarily a review of the Federal Emergency Management Agency's practices and procedures for disaster declarations. In this piece, GAO determined that there were several issues with the existing practices and that they often provided inaccurate reflections of a states capacity to handle post-disaster problems. After evaluating FEMA, GAO asserts four recommendations to improve the process.

122. United States General Accounting Office. (2003). *Forum on key national indicators: Assessing the nation's position and progress* (GAO-03-672SP). Washington, D.C.: GAO.

This report is a collective effort by GAO and the National Academies that assesses the current national performance indicators and suggests how additions and subtractions to the list could benefit future indicator lists.

123. United States National Committee for the Decade for Natural Disaster Reduction, National Research Council. (1991). *A safer future: Reducing the impacts of natural disasters*. Washington, D.C.: National Academies Press.

This report examines the recommendations of the U.S. National Committee for the Decade for Natural Disaster Reduction. In this report, seven areas of natural disaster reduction are examined and recommendations are made for each: hazard and risk assessments; awareness and education; mitigation; preparedness for emergency response, recovery, and reconstruction; prediction and warning; strategies for learning from disasters; and international cooperation.

124. Walz, R. (2000). Development of Environmental Indicator System: Experiences from Germany. *Environmental Management*. 25, 613- 623.

This paper explores the environmental indicator system in Germany and its development. Fundamentals of the environmental indicator system are discussed along with the requirements that are to be met. These indicators serve as a policy aid in decision making as they provide the necessary information on the state of the environment. The pressure state response approach for an indicator system was selected and discussed based on recommendations from the Organisation for Economic Co-operation and Development (OECD). A process of selecting the most appropriate indicators is evaluated and finally conclusions are made about the indicators and how improvements need to be made to the environmental indicator system.

125. Watkins, K., et al. (2005) International cooperation at a crossroads: Aid, trade and security in an unequal world. *Human Development Report 2005*. New York: United Nations Development Programme (UNDP).

This report discusses a multitude of information about human development in the world, including general development, aid, trade, and violent conflict. The technical notes of the report are of particular importance as they describe the five key indices used and how

they are developed: the human development index (HDI), the human poverty index for developing countries (HPI-1), the human poverty index for selected OECD countries (HPI-2), the gender related development index (GDI), and the gender empowerment measure (GEM).

126. Wisner, B., Blaikie, P., Cannon, T., & Davis, I. (2003). *At Risk: Natural Hazards, People's Vulnerability, and Disasters*. New York: Routledge.

This book focuses on natural disasters and vulnerable populations by examining the relationships between economic and social issues and vulnerable populations. The authors suggest that risk and vulnerability are linked to people's "normal existence" and that the relationship between the risks, and the reasons for the risks, place the people with the least economic and social power in the most danger when disasters occur. The book also presents the "disaster pressure and release model" to emphasize that disasters are separate events from the circumstances that create vulnerability and the "access model" to record policy effects, distinguish vulnerable populations, and to predict likely disaster outcomes.

127. Yi-Ming, W., Ying, F., Cong, L., & Hsien-Tang, T. (2004). The assessment of vulnerability to natural disasters in China by using the DEA method. *Environmental Impact Assessment Review*, 24, Retrieved May 20, 2006, from [Http://www.elsevier.com/locate/eiar](http://www.elsevier.com/locate/eiar).

These authors propose a new method for assessing disaster vulnerability in China. The current method described by the authors involves the creation of weighted sub-indices that are summed to create a composite vulnerability score for the different regions of China. The authors suggest that this system is less credible than the data envelopment analysis (DEA) method because of the subjectivity of the weights used in the indices. The paper methodically describes the DEA-based model of analysis, using the regional vulnerabilities in China's mainland as a case study to promote the new model of analysis.

Additional Resources

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