RESILIENT DESIGN FOR HUMAN CAPITAL/HUMAN DEVELOPMENT-BASED BUILDINGS

Joseph Bilello[1]
[1]Ball State University, Muncie, Indiana

ABSTRACT: From case studies of architect and non-architect-designed buildings confronted by natural and manmade disasters of the recent past, where human capital restoration was a greater determinant in courses of design action rather than financial capital, this paper extracts exemplary cases of mitigation, adaption, and transformation design responses to disaster instances in first and third world sites at building and town scales. Testing the relevance of resilience attributes from biology and complexity theories (Zolli and Healy 2012), cases prepared with graduate students in courses on resilience and research methods, studied these tenets of resilience that readily mapped onto architecture (i.e., simple cores/complex edges, modularity, etc.). Further, the case method pedagogy challenged students to make architectural decisions before, during and after disasters. Selected disaster mitigation strategies for (a) post-earthquake school design in Port au Prince, Haiti, (b) future disaster adaptation designs in New Orleans 9th Ward housing post-Hurricane Katrina, and (c) post-tornado transformative building designs that changed the identity of small town Greensburg, Kansas, are abbreviated. In contrast to well-understood roles before and after disasters, architects roles during disasters are absent from the literature and mainstream practice of architecture. Efforts to better ascertain critical roles for architects during relatively predictable disaster events (i.e. hurricanes, flood, wildfire, storm surge, sea level rise, etc.) are explored and a precedent illuminated.

KEYWORDS: Resilience theory, human development, case method pedagogy for decision-making

Resilient design for human capital/human development-based buildings
This inquiry turns to answer this subject's questions that have emerged for the convergence of sources:

1. Wealth on planet earth defined by Buckminster Fuller (1968) in terms of human metaphysical energy, thus directly related to human development.
2. A former graduate student's compelling argument that my research focus and case development on resilient design for highly capitalized buildings should address human capital as well as financial capital preservation. Her case concerning Haitian school design and construction for third world human development was compelling (Goffiney 2012).
3. Concrete masonry unit innovation for post-earthquake Port au Prince field test results from an architect colleague working on the rebuilding of a Haitian orphanage.
4. Attempting to comprehend the horrific loss of human capital/development that refugee camps and other forms of dislocation resulting from man-made disasters, in many cases, have caused. Current estimates of 65 million refugees globally (UN Refugee Agency 2015), a "fourth world," subpopulation socially excluded from global society (Hall 2003);
5. Addressing a substantial previously unfulfilled pedagogical interest in case method teaching as a modality to accelerate design decision-making capability for students to work effectively before, during, and after disasters in practice.

In the paper, the terms *human capital development* and *human development* are used interchangeably despite different origins. The concept, human capital, dates back to economic theorist Adam Smith's work (1776). Smith conceived human capital:

> " . . . .*of the acquired and useful abilities of all the inhabitants or members of the society. The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labor, and which, though it costs a certain expense, repays that expense with a profit.*"

Relative to human capital formation, architects' designs range from concerns that dwellings elevate human potential, spirit or psyche (self-actualization is optimal), to designing institutional and civic space that envision enhancement of similar intent (morale/values elevation, productive capacity, retention, etc.). In both cases, resilient buildings/environments attendant to human capital development aspire to enhance the best of what it means to be human at this time and anticipate a better future that the built work intends to foster.

In the wake of increasingly obfuscating definitions of sustainability, those of resilience are expanding to similar detriment; fetishized, *au currant*, or just plain market savvy to enter the "resilience business." The definition adopted herein for resilience springs from Zolli and Healy's thesis (2012), distinctive in the literature, citing biological and complexity theory foundations for the term, and offering ten principle tenets. (See Appendix 1). Some tenets/attributes have readily mapped onto architectural design. To achieve reasonable simplicity and redundancy in works of complexity or large scale, nature takes on *modularity*. Architects frequently design modules in resilient works that benefit from repetitiveness. Similarly, other complex and large-scale works have designs with simple cores and complex edges to address performance demands of their respective functions and place within and at their perimeters. Other biologically-based tenets do not readily fit, but have become the source of substantive investigation for the potentials they infer. Bird and fish populations' capacities to flock and swarm seeking the collective safety found in numbers needed to preserve themselves, is notable (Balonso 2011).

Building designs that programmatically address aforementioned resilience tenets, as well as human capital development resources are not entirely new. Indeed, in seismic, windstorm, and flood prone areas of the developed world, safety attributes are frequently mandated and their regulation enforced. Now, comprehensive resilient design emphases are companion to strategic shifts in the design of human development-centered works and communities distressed by disasters globally. Indeed, 21st century sustainability and resilience-based meanings of human welfare in the health, safety, and welfare (HSW) licensed professions are becoming codified (Bilello and Rosenman 1997) and mandated. The State of California will require zero net energy for all residential buildings in 2020. With increasing frequency, architects built works illuminate human development concern in hospitals, churches, schools, affordable housing, and townscapes. This paper offers examples in the latter three types in three phases--before, during and after disaster. Further, briefs from the pedagogical strategy, case method, end each case. The discourse seeks to empower graduate architecture students to make effective design decisions when resilience-related response is essential. Finally, the author/instructor shares the widely shared concern that this Anthropocene Era will be characterized by a period of increased catastrophic events, climate change and seemingly incontrovertible sea level rise consequences to both the built environment and human development.

THE CASES

Case 1. Post-disaster Port au Prince, Haiti schools

Before this catastrophic seismic disaster (2010), poorly crafted, humbly furnished spaces aggregated children in schools that were, at best, simple shelters. As such, from human development perspective, they contributed to advancing life prospects in the most rudimentary of ways, rather ineffectively building human capital in this hemisphere's poorest country. Nonetheless, Haitians have believed that education is among the only promises for opportunities in the future for their people. (Goffiney 2012). Notably, almost half of the Haitian population is under the age of fifteen, with a strong demand for schools. At the time of the earthquake, nearly every block of Port-au-Prince had a school building.

During the disaster, schools became unwitting agents of harm. Buildings of non-existent or unenforced building codes collapsed on children as shear forces exceeded minimal range of building responsiveness to the safety needs of this most vulnerable population. (Booth and Wilson 2010). As a result, Haitians witnessed the near destruction of their entire school system. Eighty percent of Port-au-Prince's schools were leveled and sixty percent of the schools nationally became unusable. (Esnard and Sapat 2014). Schools had been constructed with limited funding and without the skills and expertise required to do the job properly. No building code had been enforced. (Goffiney 2012). Part of the multi-dimensional human tragedy (that included a cholera outbreak, violence, etc.) resulted from a lack of construction knowledge, a problem solved by improving the education system, which is ironically housed in buildings that failed.

After the disaster, when schools reopened in April 2010, school classes were frequently held under aid-provided tents from entities like UNICEF, provider of one hundred fifty tents for classrooms and a number of prefabricated offices for the Ministry of Education. Over time, several important post-disaster design and construction decisions were made by humanitarian architecture foundations to build contextually responsible schools to not only resist natural disasters, but promote sustainable living with features such as cisterns, photovoltaics, and community gardens. Some international agencies have remained working with the Haitian Ministry on a model for earthquake-proof schools using innovative building technologies, including environmentally-friendly compressed earth blocks. (Costello 2010)

A particularly noteworthy construction remedy has taken debris and re-appropriated it in building material for schools. (Gregory 2011). Stacked wire-frame cage modules, gabion baskets, became walls that should prove considerably more resistant to future earthquake and windstorm disaster forces than their unreinforced masonry forebears. Rubble-based, the walls also continually remind of the disaster, "lest we forget." In addition to concrete/rubble, salvaged rebar, scrap metal, wood scraps, earth, cars, and fabric have been similarly collected and reused in debris-based designs. Further, available natural materials--sugar cane, bamboo, cornstalks, and water--have been allocated to reconstruction ends. Even refuse from first responders' provisions: plastic bottles shipping pallets, shipping boxes, and tents have been adaptively reused.

These resilient design responses relate to the aforementioned Zolli and Healy cited attributes. The gabion baskets provide beneficial modularity with components that fit one another. They effectively cluster resources (the hybridity of debris and gabion), and turn the failure represented by debris into part of the solution to greater human development assurance.

Pedagogically, architecture students were challenged to address situation-based architect's decision-making questions/topics (before, during, and after disaster) including:

1. Before disaster: Architect's responsibility to work to affirm international building codes and their enforcement
2. During: Are architects as first responders? Second responders? Non-responders? First responders' contribution to life safety assistance was manifested in informal network formation, as Ushahidi Haiti (Tufts University students and friends globally). With cell phone connectivity globally, they real-time mapped emergency routes through the city in ways governmental entities could not, and ways architects did not. (Meier 2010)
3. After: How can architects better understand that cascading effects may hold solutions in addition to problematizing the disaster environment? Debris design, a hybrid solution of disaster and available technology, illuminates directions and ways of thinking in other disaster settings.

Case 2: New Orleans Lower 9th Ward housing post-Hurricane Katrina
Numerous resilience scholars have documented the Lower 9th Ward before, during, and after Hurricane Katrina (Hartman 2010; Kirby 2010; Klein 2008; LaRose 2014; Lohr 2016). In brief, before the Hurricane Katrina disaster, the largely residential district was home to a predominantly low income African American residential community, occupied by the poorest of the poor in New Orleans. (Giple 2013). What human development potential prospects existed were found in the homes, community, access to institutional infrastructure and technology beyond the neighborhood (exceeding that of its Haitian counterpart in what one scholar terms the American "fourth world," a subpopulation socially excluded from global society (Hall 2003, Dotson 2011)). During the hurricane's cascading effect, the flooding part of the disaster, water up to twelve feet deep filled the 9th Ward and stayed there for weeks. More lives were lost there than any other place on the Gulf Coast during the disaster. Initially forsaken, the place became abandoned. Over time, however, it was re-inhabited by a percentage of the community either committed to its place as home and those with nowhere else to go. After the disaster, the 9th Ward became the subject of deep architectural reflection and speculation on our professional subculture's humanity, its commitment to human development and its capacity to contribute to rebuilding in this context. Choices to rebuild challenged environmental rationality favoring the culture's other less rational attributes. They connect deeply to the human need to find home as a critical part of human development (Hartman 2015, LaRose 2016, Lohr 2016).

Responding to the need, *Make It Right Foundation* built more than one hundred houses for 9th Ward families otherwise unable to afford a home. Many have photovoltaic and other eco-friendly features. At least forty more are planned. Thom Mayne (Float House), Shigeru Ban, and Frank Gehry contributed innovative prototypes. Mayne and Ban designs proved unable to meet the project's $150,000 budget per prototype. The Gehry design team's duplex prototype came close ($350,000). Foundation officials consider moving beyond the prototype, but Lower 9th Ward would-be recipients have sought single-family homes more like those lost. Notably, the majority of the homes meeting budget, successfully built and that lend themselves to replication came from lesser-known regional and local architects. (Hartman 2015).

These resilient design responses also positively correlate to Zolli/Healy attributes. With assistance, the Lower 9th Ward is ensuring neighborhood continuity by dynamically reorganizing with housing prototypes both culturally and environmentally responsive. In the Lower 9th Ward, resilience is not robustness, redundancy, or attempting to recover to original state. Rather, translational leaders, some of whom are local architects, have collaborated in a noteworthy effort to promote cultural sustainability with resilience-centered prototypes.

Pedagogically, the case's situation-based decision-making questions/topics (before, during, and after disaster) for architecture students included:

1. Before disaster: how can architects best address divergent culture, sustainability, and resilience vectors in site selection and occupation and building design?
2. During: architects roles during disasters of long duration: informed decision-making on evacuation and

roles as first responders, and assessing building suitability for re-habitation.

3. After: re-engaging questions of cultural sustainability and resilience and expectations of socially responsive design by signature and lesser-known architecture firms.

Case 3. Transformative design strategies that changed the identity of Greensburg, Kansas
Greensburg, Kansas, population 1,574, 96% Caucasian, $28,348 median household income, 45-year old average was a small town remnant of the twentieth century American Midwest. Small, conservative, surrounded by farms, most buildings in town were built in the early to mid 1900's: a 95-year old county courthouse, a movie theatre built in 1915, and a schoolhouse built in 1903. Downtown was a one block row of buildings whose notable architectural feature was tin ceilings. A social vulnerability index with eleven composite factors that differentiates counties according to measures akin to levels of human development--personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race, ethnicity, occupation, and infrastructure dependence--gave Greensburg a *medium-high* ranking for vulnerability (ATSDR 2007). Measured for hazard risk, the State of Kansas ranking entity gave Greensburg 3.4 on a 4.0 point scale, a calculated priority risk index of *high planning significance*, meaning creating preparedness for tornadoes was essential.

On the evening of May 4, 2007, an F5 tornado destroyed 95% of the town: most dwellings and mobile homes, city hall, two schools, the business district, and its only tourist attraction, the world's largest hand dug well. Residents reportedly staggered out of shelters to find their town gone. Eleven people were killed by the Greensburg tornado and smaller tornadoes from the same storm system, most a result of debris (falling roofs and walls when seeking shelter in basements, flying debris, and trees). In addition, nearby oil storage tanks were damaged and caused large-scale environmental damage.

In the immediate aftermath, FEMA was delayed almost 48 hours delivering temporary housing shelters because there wasn't a place to put them. The National Guard was sent in initially but was under-manned due to troops being overseas. The Governor issued a statement saying, "When the troops get deployed the equipment goes with them. So here about 50% of our trucks are gone. We need trucks. We are missing Humvees. We're missing all kinds of essential equipment that would help us respond in this kind of emergency." Most city and county trucks were inoperable and weren't able to respond. Residents with operable vehicles and traversable roads left town for shelter and family elsewhere in the region. The National Guard issued a statement about being short on front-end loaders and equipment that could help move debris. Aid agencies rushed in as post-disaster responders: 39,172 meals were served by American Red Cross; 7604 volunteers were sent by Americorps alone; 57,786 work hours were logged by volunteers. The Kansas Department of Transportation removed 40,000 truckloads of debris in the first four days. The majority of main roads were cleared and useable in the first two days of cleanup. Eventually, $12.7 million was paid by FEMA to agencies and volunteers. No architect received mention.

Weeks after the disaster, the town's re-emergence from debris clearance was followed by considering the merits of abandonment versus rebuilding. Less than half of the residents returned. The eventual decision to rebuild came with the inducements of considerable state and federal aid. Heated discourse on how to rebuild ensued—reconstruct as the town had been? Or another alternative? Kansas City architects, BNIM, were called in to create a new comprehensive plan. In their design response, they noted,

> *"as one of few communities with the opportunity to do a complete overhaul of its infrastructure, buildings, and government, Greensburg is uniquely positioned to be a laboratory for research on sustainable design and community development. In addition, Greensburg is the first rural municipality to take on these aggressive goals, making it a one of a kind sustainable community. It is recommended that every entity involved in rebuilding take extra care to record successes and understand failures. In the coming years as Greensburg's rebuild becomes more and more substantial, there will be an opportunity to attract research entities in the way of resident programs, university partnerships, and even scientific studies. (BNIM Comprehensive Plan 2008)."*

Emergence of the new town was captured by a Planet Green network television series. With the architects input, the decision to rebuild moved from making Greensburg whole again to making it wholly different. Greensburg became a small town committed to rebuilding with LEED Platinum buildings: Arts Center, John Deere Dealership, Centera Bank, Kiowa County Courthouse, Kiowa County Memorial Hospital, Kiowa County Schools, Prairie Pointe Townhomes, and SunChips Business Incubator. Greensburg's identity was transformed. In so doing, widespread interest in seeing the re-created town was spurred. Newly conceived, Greensburg has now become a tourist destination and a sustainability model for the twenty-first century small American towns.

As in the previous two cases, Greensburg's resilient design responses relate to Zolli/Healy's tenets. The town's destruction, its *failure*, was an essential part of its resilience. The town did not attempt to recover to original state; it moved toward a new state that has thereby catalyzed human development. The town ensured its continuity by dynamically reorganizing into a new sustainability paradigm that would not have otherwise occurred. In the wake of the disaster, the clustering of human development needs brought the town's resources into close proximity with one another. Despite heated discourse, under supportive conditions internal and external to the community, residents exercised their capacity for trust and collaboration. In similar fashion, translational leaders became manifest inside and outside the community.

Again, pedagogically, Greensburg's story affords other professional practice decision-making questions/topics related to resilience:

1. Before disaster: what are the roles of architects in small towns distant from cities where architects typically practice? Similarly, what is the place/role of architecture in small towns? The design of buildings that protect the public's health, safety, and welfare (HSW)?
2. During: Are there roles for architects in rapid onset disasters? Can architects ameliorate cascading effects in the immediate aftermath of a disaster?
3. After: is architectural design potential for changing community identity predictable? Is the transformation of place into new identity the direct or indirect result of architecture?

The architect in resilient design for human capital/human development-based buildings
Architects' roles before and after disasters are enduring and well understood. Building codes and standards creators address the health, safety and welfare design needs of individuals and groups of all sizes and levels of vulnerability. Architects participate in the development of those codes. They adopt new building knowledge as it emerges, is popularized, and is legislated within the design and building industries. Works by architects meet or exceed HSW needs and the standards that enshrine them. In conforming jurisdictions, they are inspected and regulated for adherence. Those roles expand in scope as architects increasingly engage themselves in resilience work.
In contrast to architects' engagement before and after disasters, roles during disasters are largely absent. Efforts that occur are difficult to find in the profession's literature and equally hard to find in nearly all practices of architecture. Perhaps this is why, they become misrepresented. (Figure below. Can an architect do anything helpful with hands on hips as portrayed?).

The effort to better ascertain critical roles for architects may most readily begin with relatively predictable, longer duration disaster events like flooding (others include hurricanes, wildfire, storm surge, sea level rise, etc.). A case in a nearby Indiana community may illuminate directions.

In 2008, Columbus, Indiana experienced a flood that enveloped the regional hospital, Columbus Regional Health, a distinguished Robert Stern design adjacent to Haw Creek, the flood's source. As creek floodwaters rapidly rose above the hospital's ground floor level, all power, including backup generator power, was lost. The hospital became powerless jeopardizing the lives of patients on mechanical life support. The hospital facilities manager contacted the building's architect for ongoing other projects, Gary Vance, FAIA, BSA Lifestructures Principal in Charge at the time. In response to a call, Vance rapidly converted a significant segment of his Indianapolis team into an architectural SWAT team, shifted personnel from other projects to assist. First, they planned to stabilize conditions at the hospital, then create a temporary hospital facility that served as a transitional care unit, and design/organize a means to evacuate patients from the hospital to requisite life support beyond. Concerning his roles during the disaster, he asserted "assisting in saving lives during the Haw Creek flood has been the most significant professional experience in my life." The event revealed to the firm serious shortcomings in its adaptability to radically changing circumstances in practice but expanded the firm's scope of services thereafter. The search for other examples in other forms of disasters continues.

In summary, the cases show that failures in the built environment can be more substantial hazards to people than natural/man-made disasters themselves. Though lagging well behind engineering counterparts, these challenges/opportunities are becoming normalized in architectural practice in the United States. In terms of human development and human capital development, the cascading effects of disaster have PTSD type equivalence for victims, especially among the most vulnerable populations—children, the elderly, the impoverished, and the infirm. Despite protracted abandonment in communities following disasters, critical masses of people return out of necessity or desire with human development prospects hanging in the balance.

The challenges of providing forms of architecture that promote human development in a world of inequitable resource distribution, and varying degrees of compassion to address that increasingly problematic circumstance are profound. Resilience theories emerging from biology and complexity science affirm some existing design directions and open new possibilities.

Can architects help create places in which realizing the potential of all human development becomes central to humankind's aspirations and reflected in their works? Architect, inventor, and comprehensive anticipatory design scientist, Bucky Fuller, wondered aloud about humanity's prospect for human development in a world in which everyone could spend their time doing the things each loved doing most of all. The likelihood of invention frequency, now 1:250,000 people, he estimated (Fuller 1968), would increase many-fold. Redefining the meaning of wealth on the planet from its current accounting systems to the combined total of all the physical and metaphysical energy on the planet would be required, he further speculated. Design for resilience in ways that focus on the development of human capital must accelerate lest this era of increasing disaster brought about by climate change's devastating effects render us perilously bifurcated. Reasons for optimism, Fuller also points out, reside in our human ability to channel our thinking in ways that energize the potential for emerging new paradigms in times of profound crisis.

REFERENCES

Agency for Toxic Substances and Disease Registry. *The Social Vulnerability Index* (SVI). https://svi.cdc.gov

Balonso, J. *Seeing Complexity: Visualizing Complex Data* 2011. https://seeingcomplexity.wordpress.com/2011/02/11/flocking-behavior-swarm-models-and-art/

Becker, G. Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. New York: National Bureau of Economic Research, 1964.

Bilello, J and Rosenmann, M. Ed. Educating Architects for a Sustainable Environment. Muncie, Indiana: Ball State University College of Architecture, 1997.

CGI Haiti Action Network Wash/Shelter Group. *Activity Report.* CGI June 2011. http://haitiwater.org/sites/default/files/CGI_HAN_WASH_Shelter_June_2011.pdf

Costello, A.J. *R & D into the Strengthening of Concrete Masonry Construction to Aid in the Reconstruction of Port-au-Prince, Haiti.* A report to the National Concrete Masonry Association. 2010.

Esnard, A.M. and Sapat, A. Displaced by Disaster: Recovery and Resilience in a Globalizing World. New York: Routledge, 2014.

Fuller, R. Buckminster. Operating Manual for Spaceship Earth. Carbondale, IL: Southern Illinois University Press, 1970.

Fuller, R. Buckminster. Utopia or Oblivion: The Prospects for Humanity. New York: Bantam Books, 1969.

Giple, L. *Hurricane Katrina and the 9th Ward.* A case produced for Architecture Research Methods class, Ball State University College of Architecture, 2013.

Goffiney, Kelly. *2010 Earthquake Disaster in Haiti: A case study on the effect on schools.* A case produced for Architecture Research Methods class, Ball State University, 2012.

Gregory, D. *Refugee home design* 2011. https://houseplansllcblog.wordpress.com/tag/architecture-for-humanity/ .
Hall, Tony (2003). *The American Empire and the Fourth World: The bowl with one spoon.* McGill-Queen's native and northern series, 34. Montreal; Ithaca: McGill-Queen's University Press. p. 238.

Hartman, Shelby. *The Lower Ninth Ward Ten Years after Katrina*. August 31, 2015

Haas, P. Haiti's Disaster of Engineering. TED Talk July 2010 https://www.ted.com/talks/peter_haas_haiti_s_disaster_of_engineering .

Kirby, J. *Social Justice during Disaster Relief*. A Master of Architecture thesis, Ball State University, 2013.

Klein, N. The Shock Doctrine: The Rise of Disaster Capitalism. New York: Metropolitan Books, 2008.

Klein, N. This Changes Everything: Capitalism versus the Climate. New York: Simon & Schuster 2014.

LaRose, Greg. *Largest Lower Ward Initiative since Katrina moving forward*. Times Picayune, February 22, 2016. http://www.nola.com/business/index.ssf/2016/02/developers_seek_approval_for_n.html .

Lee. Andrea. *Greensburg, Kansas: Start from Scratch*, USA.

Lohr, David. *The Forgotten People of the Upper 9th Ward*. Huffington Post, August 29, 2016. http://www.huffingtonpost.com/entry/new-orleans-9th-ward-katrina_us_57c07c31e4b085c1ff2936d4

Meier, P. *Crisis Mapping Haiti: Some Final Reflections*. Apr 14, 2010. https://www.ushahidi.com/blog/2010/04/14/crisis-mapping-haiti-some-final-reflections/

Planet Green. Greensburg. Television series on *Planet Green network*, 2008.

Šlaus, Ivo and Jacobs, Gary. *Human Capital and Sustainability*. Sustainability Journal, Volume 3 Issue 1, 7 January 2011.

Smith, Adam: An Inquiry into the Nature And Causes of the Wealth of Nations. Book 2 – Of the Nature, Accumulation, and Employment of Stock. Reprint from the sixth edition. London: George Bell and Sons, 1887.

United Nations Office of Disaster Risk Reduction. *Women's Leadership in Risk-Resilient Development: Good Practices and Lessons Learned.* New York 2015.

United Nations Refugee Agency. 2015 Annual Report. http://www.unhcr.org/576408cd7. 2015

Zolli and Healy. Resilience: why things bounce back. New York: Simon & Schuster, 2013.

APPENDICES

Appendix 1. Attributes of Resiliency
From Resilience: why things bounce back, Zolli and Healy 2012.

Patterns (tenets) of resilience:

1. Feedback mechanisms to determine when an abrupt change is nearing
2. Ensure continuity by dynamically reorganizing
3. Decouple the system from underlying material requirements
4. Beneficial modularity: simple internal modular structure with components that plug into one another
5. Diverse at the edges but simple at their core
6. Flock or swarm when time is right and to break into islands when under duress
7. Clustering-bringing resources into close proximity with one another
8. Resilience is not robustness, not redundancy, nor attempting to recover to original state
9. Failure may be essential part of resilience
10. Resilient people have (a) capacity for trust and collaboration, (b) form informal networks, manifest translational leaders

Appendix 2. Characteristics Of A Safe And Resilient Community. ARUP report to the U.N.

A safe and resilient community:

1. .is knowledgeable and healthy. It has the ability to assess, manage and monitor its risks. It can learn new skills and build on past experiences
2. .is organized. It has the capacity to identify problems, establish priorities and act.
3. .is connected. It has relationships with external actors who provide a wider supportive environment, and supply goods and services when needed.
4. .has infrastructure and services. It has strong housing, transport, power, water and sanitation systems. It has the ability to maintain, repair and renovate them.
5. .has economic opportunities. It has a diverse range of employment opportunities, income and financial services. It is flexible, resourceful and has the capacity to accept uncertainty and respond (proactively) to change.
6. .can manage its natural assets. It recognizes their value and has the ability to protect, enhance and maintain them.