Disaster Forensics: Governance, Adaptivity and Social Innovation

Dorte Jessen

Abstract This chapter seeks to contribute to the discourse on disaster forensics, by arguing that the root cause and complex causality is ultimately governance, ideally cultivating the collective ability to navigate disasters rather than to command control. The focus will be on the social dimension and its impact on disasters. Governance theory, combined with complex adaptive systems theory (Duit and Galaz in Gov Int J Policy Adm Inst 21(3):311–335, 2008 [12]), will provide the analytical foundation for the examination of Hurricane Katrina and the Fukushima Daiichi nuclear disaster. The theoretical deconstruction will reveal that the traditional virtues embedded in the social amplification of risk (Kasperson and Kasperson in The social contours of risk, volume I: publics, risk communication and the social amplification of risk. Earthscan, London, 2005 [21]), remain at the heart of complex causality. With this insight, it is observed that social innovation, with its inherent positive connotation (Matei and Antonie in Soc Behav Sci 185:61–66, 2015 [28]), is expanding the horizon for how social divisions, vulnerabilities and resilience are measured. Optimistically, it is suggested that social innovation, driven by civil society, may prove a vital component in the creation of a new social narrative.

Keywords Governance · Social amplification of risk · Reflexivity · Social innovation

1 Introduction

Undeniably, science has equipped us with a growing understanding of the discernible patterns of natural destructive phenomena [42: 53], while complexity theory has taught us that understanding is not the same as being able to predict [25: 409]. Thus the obsession in the pursuit of disaster aetiology forensics is driven by

D. Jessen (✉)
Risk, Crisis and Disaster Management, University of Leicester, Leicester, UK
e-mail: dj103@leicester.ac.uk

A.J. Masys (ed.), *Disaster Forensics*, Advanced Sciences and Technologies for Security Applications, DOI 10.1007/978-3-319-41849-0_6

the innate need and human desire to apply order and structure, effectively increasing the collective *illusion* of control. Efforts which to some are rendered futile as accidents will happen [33]—it is only a matter of time. And once they do, it is only a question of how big a role human error played in its demise and the extent of its destruction [34]. The purpose of this chapter is to contribute to the discourse on disaster forensics, arguing that the root cause and complex causality is ultimately governance, ideally cultivating the collective ability to *navigate* disasters rather than to command control. The focus will, in particular, be on the social dimension and its impact on disasters.

The opportunities and latitude for collective organizational growth will be demonstrated through Governance Theory with a Complex Adaptive Systems lens [12]. The discourse will establish that at the heart of complex causality, traditional virtues such as the social aetiology of disasters [42] and the social amplification of risk [21] remain. This is coupled with High Reliability Theory [23]; the art of challenging weaknesses within the system to expose 'black swans' [27]. This will ideally foster behavioural change; enable early warnings, and minimise the impact by turning these majestic black creatures into grey swans (less black more white).

Governance as the root cause of complex accident aetiology, will be argued through Hurricane Katrina, the embodiment of complex causality. Katrina taught us that in the wake of catastrophe, the root cause can be altered in the name of re-examination [37]. This means, that disaster aetiology cannot be separated from the public interest and politics, and existing power structures. Looking at other cultures with different governance structures in place, but where the patterns of disaster aetiology in principle remain the same, will add texture to the examination. To this end, the Japanese Fukushima Daiichi nuclear power disaster, where avoidance, selective exposure and information rejection [38] and a deeply culturally anchored respect for authority and protocol outranked that of safety, will serve as an example.

Increasingly, governance involves non-governmental actors hailing from the private sector and civil society. Society, in its pursuit of social protection is converging to strengthen civil society, social capital and relational dynamics, through social innovation dynamics.

The argument will draw to a close by optimistically suggesting that social innovation fuelled by civil society, may prove a much needed agent of change in the creation of a new social narrative.

2 Complex Adaptive System Traits in Governance Theory

There is a discernible world pattern of disaster proneness and chain of events precipitating a disaster, ideally enabling us to treat the underlying root causes precipitating disasters, rather than the symptoms [42: 55]. Scholars have long come to realise, that although detectable, these patterns are not predictable, let alone linear [12: 311], and that these chains of events are compounded or diffused by the type and style of governance resident in a given context. This realization has spurred

connections to complexity theory, which offers a far broader scope for analysing non-linear cause and effect. In particular, Complex Adaptive Systems (CAS) Theory has proven beneficial for increasing the understanding of governance in relation to disaster management and complex causality, as it includes a much greater range of variables [12]. Its multiple strands of complexity paradigms, self-organised criticality, social equilibrium and stability serve to advance theoretical analysis of social dynamics and policy [35].

While governance theory explains how various governance systems and the capacity of their buffering and amplifying abilities are critical in determining the impact of disturbances (i.e. disasters), and how multi-level governance coexist and interact across societal levels [12: 312], complexity theory aims to deepen our understanding of unpredictable systems with multiple temporary equilibria, self-organisation through integration and disintegration [9]. The latter does so without insisting that all aggregate outcomes should be fully understood, with futile efforts of delineating variables and causal effects through various paths of opportunity and abstracting away their interdependencies and non-linear interactions. Instead, CAS operates at an inherently multi-level of abstraction, because order is dependent on lower-level behaviours as part of their constantly shifting integrative cross-level foundation, making CAS models and ordinary causal models complementary, not rivals.

As such, there is no single component that dictates the collective behaviour of a complex adaptive system. Instead it is possible to focus on an agent in its local environment, as part of a system that self-sustains by importing energy, enabling agents within the system to self-organise, co-evolve and adapt to the environment over time, and through these transformations constantly create temporary equilibria, conceived by shifts in the patterns of interconnectedness [3: 219–220]. This is, as it turns out, very useful in the enquiry into the hidden sources of order [35: 116] embedded in governance and complexity theory, which for the purposes of this discourse will focus on the institutional and collective social behaviour and its impact of disasters.

The quintessential role of government is to provide broad social protection to its citizens, an obligation which includes catastrophic events [10: 336]. Yet, the classic symbiosis of governance, social protection and constituency is mutually dependent on 'the conflict between the stability-inducing role of institutions and their capacity to experiment, innovate, and learn from changing circumstances' [12: 319]. This institutional flexibility and robustness can be represented by the constant tension between *exploration* and *exploitation*. Exploration denominates the 'search, variation, risk taking, experimentation, play, flexibility, discovery, innovation', while exploitation is defined by 'refinement, choice, production, efficiency, selection, implementation and execution' [26: 71]. The strength of a governance system's capacity for exploitation and financial viability is contingent on cooperation, and depends on social acceptance of institutional rules, including norms of force, hierarchy, trust, network structures, reciprocity and belief-systems [12: 319]. Especially this *voluntary* acceptance of social control [13: 790] is a critical dimension in building trust and stability in relation to social protection in vulnerable communities.

Exploration is determined by a community's capacity to learn, experiment, trial-and-error new policies and institutional configurations, evaluate and to gather and analyse information. These processes are all known to be costly, both in terms of physical, monetary, human and social capital, rendering the capacity for exploration contingent on available resources and 'is reflected by the quality of its educational system and informational infrastructures such as the existence of independent universities, research institutes as well as in arenas for public debate and science-policy dialogues and unbiased mass media' [12: 320]. Intuitively, in the pursuit of predictability and stability, people seek to establish institutions and norms of reciprocity. But stability is accompanied by rigidity, and while it is necessary for improving exploitive activities and to raise overall welfare, it is counter-productive in terms of maintaining a flexible and dynamic society. Therefore, building on March's delineation of exploration versus exploitation, Duit and Galaz argue that *the adaptive capacity of a governance system* is a function of the trade-off between exploration and exploitation, rooted in the fundamental tension between the *mutually opposing needs for institutional stability and change* [12: 320], emphasis added). Accepting this realisation, assisted by a diagram dominated by two parameters: exploration and exploitation, four governance types can be distilled: rigid, robust, fragile and flexible, each representing the adaptive capacity within each governance system [12: 321–322].

Governance in societies with a high level of exploitation and a low level of exploration are considered rigid as it maximises stability, but lacks flexibility. As long as no surprises occur, this state-dominated, centralised governance model is the most efficient form, as it capitalises on the stability and predictability necessary for keeping transaction costs low. Japan is considered an example of a state-centric governance system [12: 320].

Societies with high levels of both exploitation and exploration are considered robust as it is equally apt to provide firm state governance, long-term transformation processes, and navigate sudden changes. This is 'an ideal state in which the rigidity-inducing effects of institutions are kept from obstructing necessary processes of exploration', but does not exist in its purest form. 'The robust governance type is the only governance type that has a sufficiently high level of adaptive capacity to be able to respond to all sorts of complex processes' [12: 321]. The closest proxy would be High Reliability Organisations (HROs) [12: 321] characterised by 'early detection of change, flexibility in decision making in combination with dense patterns of cooperative action, and the ability to reorganize' [22].

One may wonder why this pure form does not exist, and what it would take for it to come to life. The answer may be found in the mutually opposing tension—perhaps even mutually exclusive tension—between exploration and exploitation. The value of imminent danger and potential annihilation (nuclear power-plants and space programs) should also not be underestimated as a catalyst for introducing direction at all levels of governance. Clarity of the *purpose of compliance* in a population, may be one of the reasons why the robust governance style not only does not exist in its purest form among sovereign nations or societies, but why the examples or proxies are borrowed from organisational structures, constructed by the

single purpose and motivation, with a well-defined goal such as safely running a nuclear plant, or launching a space mission—without the ambiguity of running a country.

In other words, the ability to reorganise at different levels due to the high element of network-based connections with apt decision-making capacity, risk of sub-optimisation or to compromise the overall goal is minimised as decisions taken at all levels of the organisational structure are guided by the pursuit of a clearly articulated goal. It is not a dictatorship—it is not a democracy either. It is a collective consciousness, guided by a clear goal and purpose of compliance. It may be naive to imagine that something as complicated as running a country could ever fall into this category, but it does not mean that one cannot speculate what it would take to at least find inspiration from the application of the purity of its principles.

Returning to the review of governance types; *fragile* denotes low levels of both exploitation and exploration. It is, by and large, traditionally observed in developing nations, as they face difficulties building institutional knowledge and capital due to high transaction costs. This compromises their capacity to reorganise and adapt to changes in the environment, with little resilience to buffer effects of shocks, inadvertently fuelling a vicious cycle, rendering them unable to 'achieve even moderate levels of economic development and human well-being' [12: 322].

Finally, the flexible governance system with high exploration and low exploitation, enjoys well-developed capacities for exploration (e.g., learning processes, feedback loops, monitoring schemes, resources, and capital) but is lacking in the capacity to transform these gains into economic growth and long-term opportunity. Flexible governance models are suggested to thrive in the welfare regimes in France, Germany, and the United Kingdom and have a certain level of capacity (incl. finances) and ability to adapt, yet hampered by their deep rooted individual and democratic heritage as the exploration factor lacks direction and is uncoordinated, and in the spirit of individualism, creating niche upon niche, thereby simultaneously presenting innovative dynamics and systematic organizational failure [12: 322].

Germany, however, might have distanced itself from this classification with a prominent production component in their sound national economy as well their adamant and broad support to the escalating refugee crisis in Europe during the course of 2015. It bears witness to the ability to adapt to a new situation, promptly. Whether their leadership by way of managing the refugee flows will have a long-term effect not only on Germany but also the rest of Europe, is yet to be seen. No doubt, the solution will be Trans-European, and perhaps this will be an opportunity (or risk, depending on the lens) to further merge the governance models in Europe, this time, with a clearly articulated common goal. Suffice to say, the unprecedented refugee streams into Europe in 2015 are likely to become a defining moment and a game-changer in European governance, the historic significance of which is yet to be fully realised.

The adaptive capacity within each of the four governance types, depends on the rate of change and the degree of predictability rendered in a conceptual space (refer to Fig. 1). Not surprisingly, the ideal (and possibly non-existing) robust governance

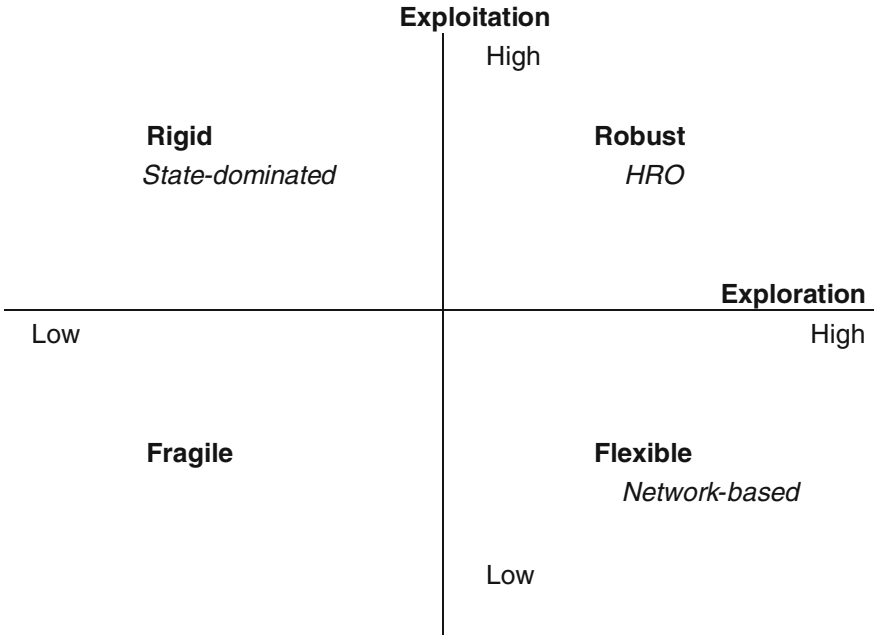

Fig. 1 Adaptive capacity of four governance types (*Source* adapted from Duit and Galaz [12] 'Governance and Complexity: Emerging Issues for Governance Theory', p 323. *Note* governance types added)

model can handle rapid/high rate of change with high unpredictability, steadily and without losing balance, as it is equally equipped to handle surprises, high impact and status quo. Meanwhile, the fragile governance system is equally unequipped to handle either, and will easily lose its equilibrium with even a low impact or small change [12: 323].

More interesting perhaps, are the conditions surrounding flexible—or Network-Based Governance (NBG)—as it, with its multiple governance levels, is able to harness changes and apply learning capacities and instant decision-making capacity, based on both formal and informal linkages with institutional diversity. While this type may be very efficient in responding to rapid changes (i.e. disasters), as long as the disaster is concentrated in a limited space where the informal and repeated social interactions can sustain themselves, it is less suited to convert this into long-term economic opportunity due to its low ranking on the exploitation dimension. It is worth noting that when dealing with a large-scale rapid onset disaster, the NBG model may lose its effectiveness as a disaster may demand quick, unilateral responses outside of the immediate vicinity of the NBG decision-making arena [12: 324].

This, however, is the State-Dominated Governance model's forte, given the legitimacy of the *democratic* state amongst its citizens and its ability to distribute powers both within different levels of government and civil society with accepted

authority, it can be argued that it may provide for the stability of governance infrastructure to soundly navigate disasters [18]. Although it may be somewhat hampered by its limited capacity to deal with information deficits, time of travel of information to decision makers and biased information management once it gets there. Given the path dependency with its strong institutions and norms, this governance model is not well equipped to deal with novel and fast changes [12: 324], but theoretically well equipped to deal with disaster, with the understanding that decisions need to be taken abruptly perhaps even abrasively within the legitimacy of the state, to limit the impacts of disaster. The US federal emergency management system can be considered an example of a rigid governance type [14: 235].

With this combination of complex adaptive systems traits in governance theory, a framework for analysing disaster forensics emerges. With an infinite variety of possibilities, it is virtually impossible to predict an outcome of an event, as they are inter-twined and linked with an endless number of feedback loops and paths of destruction. As are the social adaptations—equally unpredictable—which further enable these capricious patterns. Through the case examples of Hurricane Katrina in 2005 and Fukushima Daiichi Nuclear Power Disaster 2011, it is suggested that governance, regardless of culture, is at the core of disaster forensics, and with better understanding to enable a more suitable governance, disasters can be avoided, or at the very least, the social impact reduced.

3 Hurricane Katrina, 10 Years on

Hurricane Katrina made landfall on the Gulf Coast August 29, 2005 and is regarded 'the most destructive natural disaster in American history' [41: 1]. Havoc and destruction followed in her path, with entire coastal communities obliterated by the storm surge, killing more than 1300 people. New Orleans was one of the worst hit areas. Its 350 mile levee system was stressed past breaking point with overflowing and breaching the levees, flooding the city, much of which is below sea level [41: 34–35]. The vast majority of the fatalities (80 %) hailed from the New Orleans Metropolitan area, many of whom were elderly or infirm [41: 8]. At the height of the disaster, approximately 80 % of New Orleans flooded, transforming Hurricane Katrina into a 'catastrophe within a catastrophe'; devastating the lives of countless residents and presented state and local officials with challenges vastly exceeding their capabilities [41: 36].

A mass evacuation was called during August 30, mainly due to massive flooding. Despite concerns, the Superdome stadium was opened for the general population as a shelter of last resort, and by midnight, 12,000 people had arrived [41: 29]. Footage of an overcrowded and uninhabitable Superdome, and startling images of desperate residents marooned on rooftops were broadcast [37: 3] and etched into the public memory. Emergency preparedness and plans were all put to the ultimate test, and fell short.

The wider American public responded by directing disappointment and frustration at the local, state and federal government and their apparent inability to respond effectively to the crisis. In the wake of 9/11 five years earlier, and the associated structural changes with the Federal Emergency Management Agency's (FEMA) move into the Department of Homeland Security, which was widely perceived to hamper FEMAs capabilities in dealing with natural disasters [14: 227], 'millions of Americans were reminded of the need to protect themselves and their families' [41: 1].

Ten years on, Hurricane Katrina, remains part of the public domain and consciousness. She has been extensively researched, and has virtually become the embodiment of complex causality. In the study of causal evolution, Katrina taught us that in the wake of catastrophe, the root cause can be altered before one's eyes in the name of re-examination [37: 6]. The complex causality of Katrina was the centre of extensive post disaster controversy, much of which was motivated by establishing culpability and with that, liability [37: 10], leveraging existing power structures and capitalist interests, proving once again, that disaster aetiology cannot be separated from public interest and politics. While it is not unusual for the causal chain to be refined and adjusted as the dust settles after impact, and the disaster aetiology forensics process and legal apparatus is engaged, it is unusual to see a dramatic causal shift.

In the immediate aftermath of Katrina, it was widely accepted that a massive surge of water caused by a hurricane engulfed the city [37: 7], attributing it as a *natural disaster*. Engineering examinations would later identify defective, breached levees 'catastrophic structural failure', as the cause of flooding (as opposed to the storm), essentially a geo-technical failure. Now attributed a *man-made disaster*, it was far easier to assign blame, which was directed at the Army Corps of Engineers [37: 12]. Finally, the controversy moved on to attribute the flooding as an *environmental disaster*, by virtue of the *Mississippi River Gulf Outlet Shipping Channel*, which, after 40 years of increased salinity was slowly eroding the protective environment. The wetlands and barrier islands were critical in protecting the coastal areas from a storm surge. Yet, long-standing political factors inhibited wetland and barrier restoration due to conflicting political and economic interests in the oil and gas extraction in the area.

This dissonance between ideology and policy resulted in erosion and stark decrease of the Louisiana wetlands and marsh, making the region more vulnerable to hurricanes [43: 24–25]. Less swamp and fewer trees were noticeable to the naked eye, while a more virtual depiction of its importance was that the shipping channel alterations in topography had provided for a 'hurricane highway' said to funnel water directly into the heart of the city. As with the levees, the Army Corps was kept accountable for the extended lack of maintenance of the shipping channel, resulting in erosion [37: 19, 43: 30].

Information management and public perception played a central role in the after-math of Katrina, as did governance, especially in the interaction between the different levels of government. As previously established, the adaptive capacity of a governance system is amplified or attenuated by the interplay between various

levels of government. In theory, Katrina would have enjoyed the benefits of all of the above, except she didn't. Instead, the lack of structured governing arrangements exacerbated the lack of preparedness, impeding New Orleans' ability to respond, effectively exposing 'the failure of a nonregime' [6: 517]. But first, before examining these dichotomies, a review of Fukushima nuclear disaster, which like Katrina, had an incubation time of 40 years.

4 'Myth of Nuclear Safety' and Black Swans

A culture of complete nuclear safety had developed in the Japanese nuclear industry. Natural disasters were considered low risk, thus only limited resources were allocated to mitigating measures and disaster preparedness. And in accordance with classic group behaviour of minimising cognitive dissonance, information not conforming to pre-existing attitudes pro-nuclear power was avoided, ignored or distorted, ultimately contributing to a 'myth of nuclear safety' [38: 60].

This was a contributing factor to the lack of preparedness, when a powerful earthquake struck the east coast of Japan in March 2011. The earthquake generated a major tsunami, killing almost 20,000 people and causing multiple meltdowns at the Fukushima Daiichi nuclear power plant [2: 2], causing 'the worst nuclear disaster in history' [17]. Explosions at the nuclear power plant caused the release of radiation into the environment, affecting thousands of people living in the vicinity [2: 11], 150,000 of whom were evacuated. It was regarded by the Chairman of the subsequently established Nuclear Accident Independent Investigation Commission, as a 'profoundly manmade disaster—that could and should have been foreseen and prevented' [32: 9].

The Japanese nuclear industry was promoted with unwavering clarity throughout the past four decades, and was, for all intents and purposes, relatively accident-free. Substantial resources were invested in nuclear power compared to other sources of energy, more importantly, personal guarantees and social capital had been put forward in the promotion of nuclear energy. In Japan, personal endorsements are not offered willy-nilly, and certainly not at that level of government. The nuclear industry structure was institutionally flawed as the regulatory bodies did not have legislative power to implement safety measures, and the main regulatory body Nuclear and Industry Safety Agency (NISA), was part of the Ministry of Economy, Trade and Industry, which was responsible for promoting nuclear power [38: 60, 32: 9]. While these structural observations in themselves were concerning, the intimate, 'totally inappropriate' relationships between corporate and political sectors [32: 43], including authorities who were responsible for nuclear safety, further burdened the structural impartiality. In fact, it was so common for a retiring government official to accept highly paid jobs in the industry, that a term was coined to express this phenomenon of *amakudari*—or 'descent from heaven' [2: 27]. 'With such a powerful mandate, nuclear power became an unstoppable force, immune to scrutiny by civil society' [32: 9]. Needless to say, if it is

unthinkable for a mere mortal to lose face in Japan, then let alone an affluent member of the business and society with an air of deity.

Collectively, the nuclear industry could not afford for nuclear power to fail. Not financially, not personally. Failure in either avenue would be detrimental to the identity of the industry, and it would be seen as 'losing face' which is unthinkable in Japanese culture, especially in the elite. This devotion to obedience and reluctance to question authority [32: 9] resonated with the state-centric governance system, which fuelled predictability and stability, at the cost of flexibility, which became apparent in the subsequent disaster forensics and investigatory process.

A common misperception is that an accident-free track record is an indicator of safety. One problem with that is, that systems are inadvertently inhibited with latent failures or 'resident pathogens' [34: 74] thus it does not take into account the unrecorded adaptations, adjustments and tweaks constantly applied to keep an often imperfect system operating safely [34: 84], or inadequate tolerance built into the system of an external event. This is true, regardless of culture and governance structures, where the patterns of disaster in principle remain the same, and where predictable chains of error are left unattended, rendering the organisation unable to detect that an incremental mistake is compounding [29]. It can be the result of *taught oblivion* (much like group think, with a cultural dimension), or simply a flawed safety-culture.

Therefore, the operator of the Fukushima Daiichi Nuclear Power Plant, Tokyo Electric Power Company's (TEPCO) argument that 'severe accidents only occur every 100 years, and the lifespan of a reactor is shorter than that' [38: 60] as TEPCO's justification for refraining from implementing recommended safety procedures [32: 28], seems not only flawed, but alarmingly naive. And that is coming from a high risk industry, which is trusted nationally and internationally to honour their responsibility of constantly testing and adapting their high risk systems to changes in the environment, and most importantly: relentlessly and systemically challenging the system for weaknesses and latent errors to expose blind spots or 'black swans', effectively expanding the risk horizon and realm of possibility [27: 330], thereby stimulating the chances of *active foresight* [40: 65].

Perrow maintains that no matter how hard we try, accidents cannot be prevented. At best the frequency can be reduced [33]. High Reliability Theory complements in its continuous quest in search of systemic weaknesses, stemming latent errors before causing disruptions and seeking to de-couple elements and allow for more flexibility [23]. This view is supported by Reason, who discerns that it is not the pursuit of excellence which will bring the best outcomes, but instead an ability to detect and correct mistakes en route, within the given level of flexibility [34: 97], essentially navigate rather than control.

This is exactly what Complex Adaptive Systems theory promotes, although with many more variables. But a prerequisite for this to happen is that the governance allows for this flexibility. During Fukushima it did not. Let alone Katrina.

5 Navigating the Social Dimension of Disaster Forensics

Hurricane Katrina, without question, impacted the lower levels of society at a far greater rate than the more affluent members. In the case of Fukushima, vulnerability was impacted by filtered information flows, biased signals and a collective disregard or acceptance of risk. How is this reflected in governance? And how can governance address these issues? Typically too great an emphasis is placed on the scrutiny of the natural hazard itself, with only fleeting attention to the underlying sociological root causes that create vulnerability to natural disasters, and how social initiatives engage community and civil society [44: 18–20]. While it pre-dates both Katrina and Fukushima, it is a fair and very applicable observation, especially when contrasted with the controversies surrounding Fukushima, which was afforded a far more nuanced social lens in the theoretical deconstruction of its disaster aetiology.

In the late-modern, reflexive risk society, socio-technical and industrial disasters have become the norm [4]. While the environment is steadily turning more volatile and unpredictable, the public expectations for social protection has increased, and the tolerance for disasters and impact diminished, approaching zero. In other words, the two poles are headed in extreme opposite directions, leaving little room for reconciliation. Reflexivity has so far been the coping mechanism, 'keeping society honest' through an equilibrium held in check by multiple strands of constant opposing tension. While this has been the cautiously optimistic accepted locus, the question is now, whether a new state can be born from this condition that may inspire social innovation.

The increasing frequency of disasters is accompanied by an increase in the vulnerability of the population at risk, thus the social causes of disaster commands attention, especially underlying vulnerabilities and predispositions to disaster associated with rapid population growth and population density [42: 53–54]. Disaster vulnerability is a social construct. It is the economic and political power disparities between groups, disparities in the distribution of assets (i.e. knowledge and information) and disparities in social protection (i.e. disaster relief and recovery resources). Inequities in societal arrangements are likely to replicate themselves during and after disaster events and makes addressing those inequities a difficult political proposition and effective preparedness often is hampered by political and behavioural constraints [14: 237], a basic vulnerability premise easily applied to Katrina. According to Kasperson, the way risk is *collectively* experienced is referred to as the social amplification of risk. It denotes the social structures and group behaviour that shape the *perception* of risk, how they result in individual and collective responses and their effect on community, society and economy [21: 101]. This means that vulnerability is spawned by social, economic and political processes; all of which influence how hazards affect people in varying ways and with differing intensities [44: 7]. Governance in its purest form is able to address these issues, and inherent in all governance types, is an element of social amplification—or attenuation—of risk, depending on the gearing. Risk communication and information flows are integral parts of forming an individual or group's perception, as they can intensify or weaken

the information available, and filter what is attributed to a risk, essentially distorting the signal [21: 102–105]. Thus, the social amplification of risk along with social protection provides a framework for analysing the strength and type of governance, in relation to disaster aetiology.

The impact of Hurricane Katrina devastated the poor neighbourhoods of New Orleans—especially in the Lower Ninth Ward. Evidently, in terms of lives at peril, the residents unable or unwilling to leave were at greatest risk. While this seems rudimentary, a large element of risk perception, which is framed by the social amplification of risk lens, determined the actions of the population. Although free busses and basic accommodation were made available, residents stayed for a number of reasons, including being unable to leave due to unavailability of money, transportation and simply no place to go, as well as lack of clear guidance [36: 516]. There was a fear that by leaving, they would be left with nothing and due to poverty or old age would not be able to start afresh, either in another place, or in New Orleans. There was also a sentiment that by staying, they would be able to better protect their homes and belongings. These fears may have been powerful enough to drown out—or attenuate—the perception of the real risk. Naturally there was a portion of the population that simply stayed as they had an emotional attachment to their homes, and decided to stick to their homes, no matter what. Some people changed their mind last minute, for some, too late.

Many factors influence a population's propensity to accept risk. Where populations are poor, uneducated and uninformed, their daily struggle for subsistence would greatly influence their propensity to accept risk—either knowingly or unknowingly. Adams' risk thermostat outlines that everyone has a propensity to take risk, which varies from person to person and individual risk-taking decisions represent a balancing act against *perceived* danger, outcome expectancy along with the consequential rewards or accidents, and the severity of each. Add to this a cultural filter which denotes the characteristics or rationalities from cultural theory: fatalist, hierarchist, individualist and egalitarian [1: 42–45].

These elements all in turn represent the balancing act that influences each individual choice and response or in some cases lack of response as it may be. The perception of risk, taking into account an element of controllability and personal influence on the outcome, will inherently influence the decision making process and thereby the tolerance and in turn: the risk thermometer. A risk adverse culture increase risk seeking behaviour once commitment to a course of action has begun, especially in group decisions as those in favour of risky decisions tend to be more committed to create a consensus which is in favour of their position, which increases the social pressure of conforming to the dominant position [38: 60], and thus reinforcing a bias.

The motivation behind information avoidance, selective exposure to information, ignoring or rejecting certain kinds of information may be to minimise 'cognitive dissonance' [7], caused by information not aligning to the existing worldview. Information avoidance and attenuation of risk may even serve as coping mechanisms towards an incomprehensible level of risk and can foster serious adverse consequences from underestimation of risk in the shape of lack of safety

precautions or mitigating response [21: 102–103], as was the case during Hurricane Katrina. In other cases, such as Fukushima Daiichi, the disregard of risk may simply be born out of ignorance, enabled by a culture of reflexive obedience and insularity [32: 9], fostering a *taught oblivion.*

In line with Kasperson's observations of collective social behaviour in relation to risk communication 'Information behaviour plays an important role in information failures', particularly of interest are the barriers to either releasing, seeking or acknowledging information. Information behaviour will be affected by coping strategies in relation to stressful situations which will impact the perceived risk and usefulness of the information available [38: 57]. Affective Load Theory digs deeper into these risk communication behaviours and how they manifest collectively and culturally. It posits that by virtue of belonging to a cultural group, people are bound to develop 'learned affective norms' which influence how information is perceived, i.e. which cognitive and emotional (affective) strategies are employed [31: 191].

Information behaviour is habitually organised into patterns to cope with situational requirements. These are socially created and shared, and taking into account social and political values, paving the road for the establishment of 'learned affective and cognitive norms'. This helps create a reference point or inventory of jointly held attitudes, against which information is validated, used, avoided or ignored, which in turn reinforces the information behaviour [38: 58]. When these norms are optimistically geared, it is likely that a variety of different search strategies will be engaged to openly source information; however, when pessimistically geared, only limited information searching strategies will be employed and information behaviour will be rigid [30: 194].

6 Social Innovation as an Agent of Change?

The welfare state is undisputedly undergoing a severe crisis. While the underlying causes of lower productivity, erosion of 'normal' employment regimes and demographic changes including an ageing population have been widely accepted as underlying reasons, a less acknowledged factor is the erosion of the *moral* foundation. In step with the ongoing process of social individualization and financial independence, individualist ethics have followed in its wake [15: 2008], in turn manifesting itself in governance through political, intellectual and moral leadership [20: 455]. And it would have to, as it has become evident that the state-centric constellation with the custodianship for post-event relief insurance creates a fundamental dilemma with its disincentive to voluntary efforts for pre-disaster risk reduction [11: 3]—a paradigm that has been challenged past the point of return by civil engagement and social innovation dynamics.

Inherently, in any governance system, vulnerabilities and pre-dispositions to disaster are related to administrative and institutional arrangements [42: 54]. Add to that a discernible pattern of disaster proneness [42: 55], which is compounded by

the type and style of governance in a given context. In terms of social amplification of risk, it is clear that marginalised groups tend to concentrate in poor quality housing, separated not only spatially, but also socially. Given housing relies on free market economy processes, houses in low-lying flood-zones are more affordable, rendering the state unable to control an equitable socio-spatial distribution of households [15: 2005–2012]. Vulnerabilities are reinforced, as the population in these areas experience a higher affinity of families with limited coping strategies and absorption capacity for shocks.

Hurricane Katrina primarily suffered from the ripple-effects of these social inequities, secondarily by the risk communication in the economic and political agenda which demonstrated that the cause and effect of a disaster cannot be separated from perception—and by managing information and feedback, it can be willed into existence. Meanwhile, in the case of Fukushima, this was the exact opposite. Here, while vulnerable families were affected, the distortion of risk communication filtered through a deep-rooted cultural notion of infallibility was considered to have caused more damage than that of social inequities, city planning and zoning.

Both Katrina and Fukushima were governed at several levels (state, local and civil society) with a combination of robust state-legitimacy and a flexible network-based governance with local application of civil society and law. Theoretically, this combination of governance types would provide for buffering and amplifying characteristics, ideally assisting in navigating these disasters. Nonetheless, due to longstanding precipitating root causes, in the case of Katrina, environmental erosion across decades, and a nesting 'myth of nuclear safety' in the case of Fukushima, evidently, insufficient buffering capacity was available within the governance apparatus, stifling the responses. The general public was exposed, needless to say, the vulnerable part of the public, even more so.

It has been deduced that the society ideally equipped to withstand and navigate disasters would be administered by network-based-governance with high-reliability traits. Regardless of culture. Problem is, it does not exist. At least not at a sovereign state level. Then what is the solution? Is it possible, in a risk society where disasters are becoming more volatile and more frequent [4], rendering the ability to stay accident free is diminishing by the hour, and where the public expectation for social protection is challenging the status quo, that the answer is to be found in the application of complex adaptive systems? They do not rely on a central controller, but instead energy imported by independent agents, and self-organisation crystallising into patterns of regularity [3: 221]. Social (voluntary) entities thrive and self-organise as long as their members continue to contribute to work. In this milieu, informal—often persistent—structures emerge. The more turbulent the environment, the more energy is required to uphold a critical level of system or organisational sustenance [3: 222]. How can sufficient energy consistently be introduced into a massive civil protection system, and still remain nimble?

Perhaps the solution will emerge from society itself. Not as a revolution, but as an order spontaneously forming within larger scale systems, spurred by energy, born of social innovation. Bearing in mind that a defining feature of complexity is

that self-organisation is a natural consequence of interaction between at least two simple agents [3: 222], is it really that unthinkable that a public, reminded of the need to protect themselves and their families—without alluding to anarchy—in free and voluntary association has decided to engage? To spontaneously converge and contribute with their level of energy, investing in civil society, creating yet another equilibrium.

Social innovation has an explicit positive connotation and is fuelled by the desire to improve the quality of life of individuals and communities through new ideas developed to fulfil unmet social needs, either underserved or uncovered by services traditionally provided by the state [28: 32]. It builds on the principle of strengthening civil society with a moral foundation fuelled by the purity innovation, entrepreneurship and social capital. Without bordering on the naive, social innovation follows the principle of continuity, gradually optimizing the condition of society powered by optimism [24], in this context with the dimensions of individualism and civil society bridging the two. Building on governance theory, social innovation is, without a doubt, faring well in the exploration dimension [26: 71], and time will tell if it will find itself restricted from the lack of exploitation—or if a new equilibrium can be created, one that overcomes this dilemma.

Increasingly, governance involves non-governmental actors hailing from the private sector and civil society. Simultaneously, social innovation in governance relies on network-based relations and ties across fragmentations which can all be found in the labour market, the political, cultural and civil society, creating a hybrid institutional arena, by which actions and identities are formed and structures shaped [15: 2015]. Although civil society is far from a homogeneous entity, it cannot be considered independently from its historical and cultural context and the prevailing values, as the spirit and ethics of society is informed by a common reference to a collective experience [16].

Add to that, resilience: an indicator of the capacity to endure the impact of disaster, to cope and rapidly recover. Resilience has an *inherent* component, which is the classic delineation of the ability to with-stand disasters without major disruption; and an *adaptive* component, which refers to the ability to adapt, improvise, and access resources after disasters in order to cope and eliminate uncertainty.

It is relevant to recognise the drivers behind resilience, as it cannot be separated from wealth, social and cultural capital and political influence [39: 121–122]. Even then, it witnesses of a time where sociological and socioeconomic dimensions of community vulnerability and resilience has been given a far greater scope and promise of societal creativity in the inception of coping mechanisms. It would appear that the individualism has finally peaked, leaving space for a more collectivistic approach. For instance, vulnerability is increasingly becoming about ‘dealing with the awkward issue of poverty in society’ [44: 56].

Social divisions in society are changing their character, and vulnerability is no longer equated to a one-dimensional distributional notion of poverty and disposable resources [15: 2005–2010], although liquidity and social capital are fundamentally different, poverty in its traditional sense, has been known to dampen the ability to contribute and participate alongside more resilient members of society. Nonetheless,

a multi-facetted form is emerging, where social exclusion is considered in terms of *relational* dynamics such as 'inadequate social participation, limited social integration and lack of power' [15: 2010], ultimately resulting in *disaffiliation* [8: 2010], non-integration into social and institutional relations and the *absence of interdependence*, and with that, non-participation and non-affiliation with various dimensions of social life [15: 2005–2010].

It is interesting to note, how this constellation of social exclusion is easily reconcilable and traceable within complex adaptive systems theory, as the concerns raised in terms of *lack of participation* and *lack of interdependence*, seems the exact antithesis to a complex adaptive system, thriving on introduction of free agents and energy. The motivation for this reorientation of terminology, the optimist may wonder, is whether this is due to a desire to soften the blow or to take the stigma out of 'poverty', essentially removing the shame, with an understanding that poverty is not the same as unable to contribute. Certainly, a non-denotational treatment of poverty as an equaliser for social *inclusion* will provide for an important step, from a social innovation perspective.

It may even be, that in the wake of this intentional societal change, with its adaptive, dynamic and non-linear nature [5: 610] a measure of societal self-esteem [19: 51] is emerging. A value system with a consciousness that thrives on reflexivity, and perhaps even outgrows the transient anxiety of the risk society [4]. Either way, social innovation, with its distinct element of exploration, is likely to be part of the solution.

7 Conclusion

Clearly, understanding root cause and complex causality of disasters is not without difficulty. The complex adaptive systems perspective enhances the analytical leverage of governance theory by acknowledging a much greater variety of systems behaviour, with its application of multiple, simultaneously moving systems equilibria [12], energised by their thriving inter-dependencies.

On this basis, it has been demonstrated that a centralised governance system enjoying the legitimacy of the state, combined with a flexible network-based local administration, with informal network-based qualities, in principle, would provide for a robust emergency response. Through the examples of Hurricane Katrina and Fukushima Daiichi nuclear disaster, it has been deduced that in reality, this is not always the case. Instead, supported by complexity theory, a society ideally equipped to withstand and navigate disasters would be governed by network-based-governance with high-reliability traits [12]. Although this form does not exist at a sovereign state level, in its quest for reliable social protection, the risk society may, inadvertently, already be in wild pursuit of a solution through social innovation. It is only a natural progression, given the realisation that the state-centric system no longer is able to offer social protection on par with the expectations of a late-modern constituency. Instead, a reorientation towards a collective civil society,

social inclusion emerges [15], as for most humans, safety comes in numbers. Or at the very least; the illusion of safety.

The contemporary risk society [4] will need to learn to navigate a rampant risk-infused reality, with increasing aptitude. Perhaps this is the reflexivity the late Ulrich Beck was *really* referring to. It will be the gauge of the success of our collective global societal resilience. We will need to constantly bounce, search for weaknesses, always with a fresh perspective—and accept that accidents *will* happen [33]—the key is to minimize the *impact*. Turning black into grey. That comes down to (safety-) culture, politics and essentially: governance.

Social innovation, with its vigour and energy with an inherent positive connotation [28], extends the scope for new ideas in this societal state of being. It is key to creating a new condition in which social divisions, vulnerabilities and resilience are considered from a far more nuanced vantage point—one that builds on the principles of both reflexivity *and* self-organisation. This time, in the creation of the social narrative, by virtue of evolution by inclusion, it might even replace the methodical scepticism with optimism.

References

1. Adams J (1995) Risk. UCL Press, London
2. ANS—American Nuclear Society (2012) Fukushima Daiichi ANS Special Committee Report. American Nuclear Society, Illinois
3. Anderson P (1999) Complexity theory and organization science. Organ Sci 10(3):216–232
4. Beck U (1992) Risk society: towards a new modernity. Sage Publications, London
5. Boyatzis R (2006) An overview of intentional change from a complexity perspective. J Manag Dev 25(7):607–623
6. Burns P, Thomas M (2006) The failure of the nonregime: how Katrina exposed New Orleans as a regimeless city. Urban Aff Rev 41(4):517–527
7. Case D, Andrews J, Johnson D, Allard S (2005) Avoiding versus seeking: the relationship of information to avoidance, blunting, coping, dissonance and related concepts. J Med Libr Assoc 93(3):353–362
8. Castel R (1995) La me´tamorphose de la Question Sociale. Fayard, Paris
9. Cham K, Johnson J (2007) Complexity theory: a science of cultural systems? M/C J 10(3)
10. Comfort L (2005) Risk, security, and disaster management. Annu Rev Polit Sci 8:335–356
11. Daniels R, Kettl D, Kunreuther H (eds) (2006) On risk and disaster: lessons from Hurricane Katrina. University of Pennsylvania Press, Philadelphia
12. Duit A, Galaz V (2008) Governance and complexity: emerging issues for governance theory. Gov Int J Policy Adm Inst 21(3):311–335
13. Foucault M (1982) The subject and power. Criti Inq 8(4):777–795
14. Gerber B (2007) Disaster management in the United States: examining key political and policy challenges. Policy Stud J 35(2):227–238
15. Gerometta J, Haussermann H, Longo G (2005) Social innovation and civil society in urban governance: strategies for an inclusive city. Urban Stud 42(11):2007–2021
16. Gosewinkel D, Rucht D (2004) 'History meets sociology': 'Zivilgesellschaft als Prozess'. In: Gosewinkel D, Rucht D, Van Den Daele W, Kocka J (eds) *Zivilgesellschaft - National und Transnational*. Edition Sigma, Berlin, pp 29–60

17. Gutierrez D (2015) Fukushima disaster caused at least 1,232 fatalities last year as radiation death rate accelerates. Natural news. Available online at: http://www.naturalnews.com/049277_Fukushima_disaster_radiation_deaths_thyroid_cancer.html; accessed 7 December, 2015
18. Hirst P (2000) Democracy and governance. In: Pierre J (ed) Debating governance: authority, steering, and democracy. Oxford University Press, Oxford, pp 13–35
19. Jessen D (2015) A case study of governance in relation to private space exploration, exemplified by Mars one: private one-way colonisation of Mars. London Institute for Space Policy and Law. Available online at: http://www.space-institute.org/app/uploads/1448556892_Post_this_Dissertation_Dorte_Jessen__Mars_One_February_2015.pdf. Accessed 27 Nov 2015
20. Jessop B (2002) Liberalism, neoliberalism and urban governance: a state-theoretical perspective. Antipode 34(2):452–472
21. Kasperson J, Kasperson R (2005) The social contours of risk, volume I: publics, risk communication and the social amplification of risk. Earthscan, London
22. La Porte T (1996) High reliability organizations: unlikely, demanding, and at risk. J Contingencies Crisis Manag 4(2):60–71
23. La Porte T, Consolini P (1991) Working in practice but not in theory: theoretical challenges of 'High-Reliability Organizations'. J Public Adm Res Theor 1(1):19–48
24. Leibniz G (1991) [1686] Discourse on metaphysics and other essays: on the ultimate origination of things. Hackett Publishing Company Inc, Indiana
25. Manson S (2001) Simplifying complexity: a review of complexity theory. Geoforum 32 (3):405–414
26. March J (1991) Exploration and exploitation in organizational learning. Organ Sci 2(1):71–87
27. Masys AJ (2012) Black swans to grey swans: revealing the uncertainty. Disaster Prev Manag Int J 21(3):320–335
28. Matei A, Antonie C (2015) Complexity theory and the development of the social innovation. Soc Behav Sci 185:61–66
29. Mittelstaedt R (2005) Will your next mistake be fatal? Avoiding the chain of mistakes that can destroy your organization. Pearson Education Inc, Upper Saddle River
30. Nahl D (2004) Measuring the affective information environment of web searchers. In: Proceedings of the 67th ASS&T annual meeting, vol 41(1), pp 191–197
31. Nahl D (2009) Affective load. In: Fisher K, Erdelez S, Mechnie L (eds) Theories of information behaviour. ASIST, New Jersey, USA, pp 39–43
32. NAIIC—Nuclear Accident Independent Investigation Commission (2012) The official report of The Fukushima Nuclear Accident Independent Investigation Commission. Available online at: http://reliefweb.int/sites/reliefweb.int/files/resources/NAIIC_report_lo_res2.pdf. Accessed 15 Dec 2015
33. Perrow C (1984) Normal accidents: living with high-risk technologies. Princeton University Press, Chichester
34. Reason J (2013) A life in error: from little slips to big disasters. Ashgate Publishing Limited, Surrey
35. Room G (2011) Social mobility and complexity theory: towards a critique of the sociological mainstream. Policy Studies 32(2):109–126
36. Schneider S (2005) Administrative breakdowns in the Governmental response to Hurricane Katrina. Public Adm Rev 65(5):515–516
37. Shrum W (2014) What caused the flood? Controversy and closure in the Hurricane Katrina disaster. Soc Stud Sci 44(1):3–33
38. Thatcher A, Vasconcelosa A, Ellis D (2015) An investigation into the impact of information behaviour on information failure: the Fukushima Daiichi nuclear power disaster. Int J Inf Manage 35(1):57–63
39. Tierney K (2006) Social inequality, hazards, and disasters. In: Daniels RJ, Kettl DF, Kunreuther H (eds) On risk and disaster: lessons from Hurricane Katrina. University of Pennsylvania Press, Philadelphia, pp 109–128

40. Toft B, Reynolds S (1994) Learning from disasters: a management approach, 3rd edn. Perpetuity Press Ltd., New York
41. Townsend F (2006) The federal response to Hurricane Katrina: lessons learned. Available online at: http://library.stmarytx.edu/acadlib/edocs/katrinawh.pdf. Accessed 4 Dec 2015
42. Turner B (1979) The social aetiology of disasters. Disasters 3(1):53–59
43. Van Heerden I (2007) The failure of the New Orleans levee system following Hurricane Katrina and the pathway forward. Public Adm Rev 67:24–35
44. Wisner B, Blaikie P, Cannon T, Davis I (1994) At risk: natural hazards, people's vulnerabilities and disasters. Routledge, Oxon