A decision-making model of disaster resilience and recovery

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A DECISION MAKING MODEL OF DISASTER RESILIENCE AND RECOVERY

Stephen PLATT[1]

Abstract

The focus of this paper is on decision-making after a disaster. Based on case studies of recovery after 10 major disasters three fundamentally different processes, types of decision and decision-making groups are distinguished:

1. *Meta decisions* by politicians and policy makers, preferably made pre-disaster, but in many cases made in the first week or so after the disaster strikes.

2   *Operational decisions* made by disaster managers responsible for response, relief and early recovery, for the first 6-18 months after a disaster and who may also be concerned with preparedness, awareness raising and training issues before pre-disaster.

3. *Planning decisions* made by policy makers, urban planners, economists etc. responsible for physical, economic and social recovery and reconstruction from a month after the disaster for 1-5 years. (They may also be responsible for pre-disaster mitigation measures designed to reduce the impact of future disasters.)

The paper discusses the relevance of theories of rational and "irrational" decision-making for disaster management and presents a model of recovery based on four sets of factors: Information, Construction, Governance and Resources, The model is used to assess recovery after the 10 major disasters. It is suggested that it might also be used as a checklist in assessing the preparedness and "resilience" of countries at risk from natural hazards.

Introduction

Responding to disaster is a serious challenge because a crisis demands critical decisions that must be made in awkward circumstances. (Janis 1989) Disaster decision-making is typically posed as a series of dilemmas, for example balancing short term and long term needs (Ingram, 2006), speed or deliberation (Olshansky, 2006) and focusing on restoration or reform. (Davis, 2006)

Many commentators use the four-stage model of disaster management: mitigation, preparedness, response and recovery and the well-known diagram of the disaster cycle is ubiquitous in the literature. (Berke et al, 1993; Quarantelli, 1999; Joyce et al, 2009) Characterising the hazard cycle into these four temporal stages dates back at least until 1979 (Haas, 1979; National Governors' Association, 1979).

One of the most recent uses is by Sharad (2015). One of the issues with this model is that these stages merge into each other. And, as Cronstedt (2002) suggests, this "prevention, preparedness, response, recovery" approach may not be that useful to emergency managers. Tierney et al (2001) adopt a simpler more pragmatic model of "disaster preparedness and response", distinguishing between decisions and actions pre and post disaster. Wallace and Balough (1985) provide a conceptual framework for decision-making in disaster management that has three levels of control – operational, management, strategic planning. These two approaches are adopted in this paper.
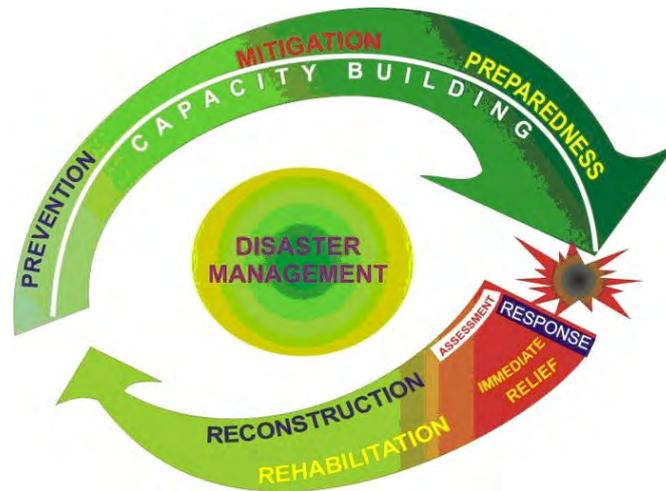
Figure 1. Disaster management cycle.

Rational and "irrational" decision-making

Decision-making can be seen as a problem-solving activity terminated by a solution deemed to be satisfactory. (Schacter et al, 2011) It is, therefore, a process of choice that can be rational or irrational and can be based on explicit or tacit assumptions. Rational choice theory embodies the notion that people try to maximize benefits while minimizing costs. But most decisions are made unconsciously. Nightingale (2008) suggests that, "we simply decide without thinking much about the decision process". How this impacts crisis decision-making will be discussed later.

Rational theories of cognition tell us how we ought ideally to reason, make judgments, and take decisions. These theories, particularly formal logic, probability theory and decision theory, give us rules to follow that supposedly make our thought rational. On the other hand, descriptive theories try to describe how people actually think and make decisions. Evidence that people are out of line with a normative rule might suggest that their thinking is irrational or biased. However, there are disputes about whether normative theories are really relevant to people's rationality and real-world decision-making. (Over, 2007)

Kinicki (2008) suggests that rational decision-making implies a structured and sequenced approach to decision-making that follows a rational, four step sequence:
1. Identify the problem
2. Generate alternatives
3. Select a solution
4. Implement and evaluate the outcome

In contrast the "irrational" model suggests that decision-making is characterised by limited information and information processing capacity; by judgemental heuristics and shortcuts used to simplify decision-making and by "satisficing" – choosing solutions that meet minimum requirements and are "good enough". This model of decision-making takes into account the fact that decision-makers are bound by certain constraints when making decisions. These constraints include time, complexity, uncertainty, limited resources, politics and corruption.

All rational choice models deal with preferences (motivations, affects, desires, values, tastes) and beliefs (cognitions, ideas, knowledge, information) as the systematic driving forces behind action (Sun-Ki Chai, 1997). The conventional model posits that actions are an optimization of expected utility under the constraint of beliefs. It presupposes that there is one best outcome and that it is possible to consider every option and know the future consequences of each. The main advantage of the rational choice approach is its ability to aid in the prediction of action, either at the individual or the collective level. But there are severe limitations to this model for disaster decision-making. The search for an optimal

solution may cause unacceptable delay; there may be insufficient information; problems can change quickly.

Baron (2004) says the study of decision-making is concerned with the comparison of judgments against standards. The standards derive from probability theory, utility theory and statistics. Systematic deviations from the model are called biases. If biases are found, Baron suggests that we try to understand and explain them by developing descriptive models or theories. Whether the biases are "irrational" is of no consequence. If we can help people make better judgments, that is a "good thing". The idea is that good, or goodness, is "stuff" that can be measured and compared.

Meta decisions

High level strategic or 'meta' decisions preferably need to be made before rather than after disaster strikes. They are generally the responsibility of the Office of President, Prime Minister or the Cabinet in a country affected by a disaster. Often meta decisions are not made in advance of a disaster and may not be articulated clearly. They are typically made in response to media pressure and reports of failure to take effective action. (Davis, 2006)

These meta questions include:
1   *Authority and governance:* Who is in charge – the existing authorities or a special dedicated body?
2   *Speed or deliberation:* Is the emphasis on rapid reconstruction or on deliberation, participation and building back better?
3   *Restoration or reform:* Should the primary aim be to reinstate and replicate what has been lost, in terms of land use or building design, or is it an opportunity to modernise and introduce change?
4   *Self help or government intervention:* To what extent should the Government be involved in recovery? Should survivors and new residents rebuild themselves or should the Government build new homes?
5   *Relief or recovery:* What proportion of available resources should be spent on relief and temporary measures and what proportion on improved safety and long-term recovery?

Rosenthal (1997) presents a typology of government decision making with five dimensions:

- *Scale of disaster*: local to nationwide or cross-border
- *Administrative level* of response: from organisational to international
- *Government style*: open or closed
- *Response strategy*: pre-emptive or reactive
- *Timing*: prompt or delayed

Interworks (1998) present a "model" that covers both the institutional structure as well as the national preparedness plan and supporting legislation. Based on a 1993 study of disaster management models from seven disaster prone countries (Bangladesh, Colombia, Jamaica, Tanzania, Trinidad and Tobago, Turkey and Zimbabwe) national models are classified into three groups:
1.   The national disaster management office (NDMO) is located in the Prime Minister's Office (as in Tanzania, and Colombia).
2.   The NDMO is located in a line ministry (as in Bangladesh, Jamaica, Trinidad and Tobago and Zimbabwe).
3.   There is no single NDMO but certain ministries have their own disaster units or departments (similar to Turkey's pre 2009 structure).

Operational decisions

Disaster managers have to make a myriad of reactive decisions as they respond to crisis events. In a well-prepared country many of these operational decisions will have been rehearsed in advance and there will be well-established protocols for most eventualities. Time is compressed after a disaster and there is an urgency to bring relief and to 'get back to

normal' – to clear up the debris, repair the damage and rebuild livelihoods. This means that decision-making happens much faster and under more pressure than normal.

In general emergency managers will be in post when the disaster happens and they will use experience and instinct to guide their decisions. The questions they need to answer are of the 'how many, how big and who, where, what and when' type, for example:

- How many people are injured, dead?
- How many people are displaced and how many need temporary shelter?
- Which access roads are blocked and need clearing?

Crisis managers must solve complex dilemmas without information under conditions of severe stress. (Boin, 2004) Even though crises generate an explosion of data, there is a lack of useful, accurate information to help make decisions and vital pieces of data may be missing. Crisis managers have to balance the "need to know" with the "need to stay in control". Crisis managers also have to operate in fluctuating organizational settings marked by inter-agency tension and "bureau politics". (Rosenthal, 1991) Traditional crisis management is preoccupied with the "here and now" and the consequences of decisions tend to fade into the background in the immediacy of the moment. But recovery from disaster is a long-term process rather than a single event. (Irving, 1989) Considering all the dilemmas, "disaster management may well be an impossible job". (Boin and 't Hart 2003)

The Nobel prize-winning economist Daniel Kahneman (2012) suggested that we have two ways of thinking. Fast thinking involves intuition and instinctive behaviour while slow thinking demands deliberation and rational analysis. Over five years of research he found that people make most decisions heuristically, using simple rules of thumb or through resemblance to similar previous experience. Experts use the experience of many repeated similar events to make judgments seemingly magically. This intuitive thinking works but can be biased and, on occasion, can lead to severe error. If a question is too difficult to answer intuitively we answer a simpler question. Failing that we think slowly –we try and collect evidence and analyse the problem. This insight is relevant to disaster management decision-making. In scenario planning exercises in Kyrgyzstan and Turkey experienced disaster managers in both countries found it difficult to use the information provided. In Kahneman's terms they were "making decisions seemingly automatically using well established heuristics and a wealth of experience … rarely waiting for information to be provided by the information group who in the first half of the day were much too slow". (Platt el al, 2014a)

Planning decisions

Governments need to appoint a team of people – economists, architects and urban planners – to plan recovery. The four key areas they need information about are:

Resourcing: What is the insurance coverage? What government compensation, loans and investment schemes are available?

Reconstruction: Which buildings can be repaired and which need rebuilding? Should building codes be changed or enforcement improved?

Planning: Are there existing approved urban and regional plans? What existing built up land needs to be taken out of use?

Mitigation: What new 'hard' infrastructure measures need to be implemented? Can public perception of risk and community preparedness be improved?

This sounds a more orderly process than it is in fact. People talk of "building back better", of "increasing resilience" and of disasters being an "opportunity for change and improvement". But Davis (2014) suggests that the practice of recovery can be very different – "piecemeal, dilatory, bureaucratic, venal even". Urban planners, he says, "never miss an opportunity to miss an opportunity. But occasionally, just occasionally, they surprise and reimagine the city in ways that might have been impossible had disaster not struck".

Strategic spatial plans have always been prepared and implemented under conditions of uncertainty. Planners have traditionally dealt with this uncertainty by either ignoring, or 'fudging' the complexity. Various authors regard strategic spatial planning as an exploration of possible futures. (Balducci, 2008; Hillier, 2005) Patsy Healey maintains that spatial planning involves "encouraging the emergence of particular development trajectories". (Healey, 2008) This emphasis on emergent trajectory suggests a move away from specified goals to a more flexible approach that seeks to foster beneficial change. de Roo (2010) claims that, "instability is necessary for development and far more common than stable situations". Balducci et al (2011) propose reframing the discourse of strategic spatial planning in a way that does not use instrumental rationality in order to reduce complexity but try to explore working with multiple, interacting actors. Others go further and suggest that only by involving citizens in a debate about alternative futures can strategic planning match peoples needs and expectations "through the creation of arenas for transparent, inclusive, democratic debate of foresighted potentialities". (Hillier, 2007)

Post-disaster planning has to cope with chaos and time pressure. Most strategic decisions do not present themselves in convenient ways and problems and opportunities have to be identified from streams of ambiguous, often conflicting subjective opinion. (Mintzberg et al, 1976). Little is known about the decision-making routines of "diagnosis, design, and bargaining" that disaster managers adopt. Initial diagnosis is crucial, since it determines in large part subsequent courses of action, yet researchers, Mintzberg suggests, have paid little attention to diagnosis or to the process of strategy formulation. Disasters may escalate in intensity, scope or scale and by further disasters compounding the initial events. Quarantelli (1969) says recovery implies an attempt to bring the post disaster situation to some level of acceptability that may or may not be the same as the pre-impact level. Recovery may mean a form of stability, rather than a return to any recognizable pre-event order. (Hills, 1998)

In the early 1950s, planning became increasingly rational. The archetype was that decision-makers consider all possible alternatives, would identify and assess the consequences of each course of action, and then select the most preferable. One aspect of this rational model of planning was the integration of evaluation in the plan-making process. By the 1980s this model had been challenged. Faludi (1987) sees planning as a frame of reference for decisions and the plan as a helpful device for decision-making; he also argues for the incorporation of uncertainty in the planning process, making it more flexible.

But this notion of rational planning and evidence-based decision-making is a strong element in disaster management theory and amongst scientists and engineers working to provide better information to disaster managers, insurers, governments and NGOs. Christensen's (1985) matrix of means, ends and uncertainty shown in Figure 2 produces four 'prototype' conditions with associated planning 'responses' and 'expectations of government', depending on whether goals and strategies are known or unknown.

GOAL

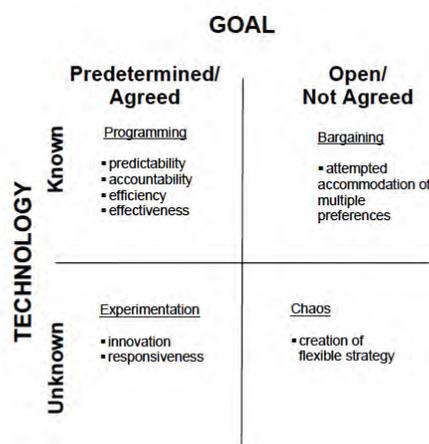|	Predetermined/ Agreed	Open/ Not Agreed
Known	Programming • predictability • accountability • efficiency • effectiveness	Bargaining • attempted accommodation of multiple preferences
Unknown	Experimentation • innovation • responsiveness	Chaos • creation of flexible strategy

TECHNOLOGY

Figure 2. Comparison of recovery management approaches. Source: Christensen (1985)

Talen (1997) published a paper called Success, failure and conformance: an alternative approach to planning evaluation. She argued that understanding why planning succeeds should be one of the main topics in planning research. Oliveira and Pinho (2010) believe that planning outcomes should be evaluated and they propose a "Plan–Process–Results" (PPR) methodology for evaluating planning decisions. Comerio (2013) used her own judgement to compare recovery management based on the balance between government roles and citizen participation (Figure 3). For example, Chile and New Zealand have combined both "top-down" and "bottom-up" approaches, providing government leadership and funding along with community empowerment in decision-making. One might disagree with where exactly she has located the various countries on her matrix. In Turkey, for example, the central government's role in recovery is much 'stronger' than in Chile. (Platt and So, 2014b) Nevertheless, the idea of characterising post-event decision making in terms of the national government's role and the level of community participation is useful.
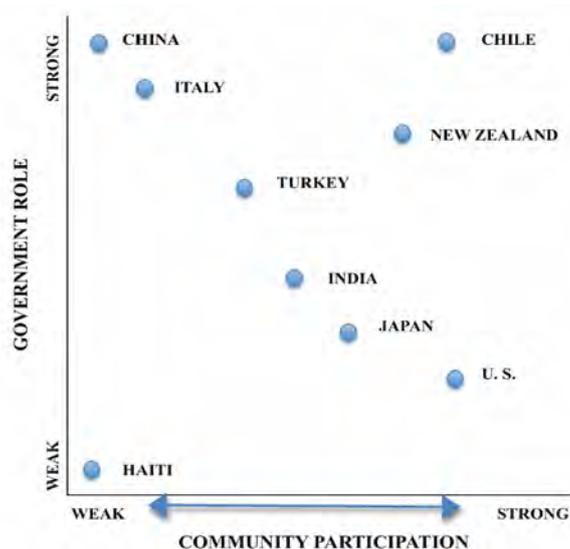

Figure 3. Comparison of recovery management approaches. Source: Comerio (2013)

Case studies of recent major earthquakes and tsunami

The author of this paper has conducted case studies of recovery after 10 major earthquakes and tsunami. Table 1 relates the size of disaster with type of control using Comerio's typology. Size disaster is measured in terms of number of deaths plus missing persons and the economic loss as a proportion of national GDP. The events have been ordered from the largest to the smallest. A composite indicator of size of event was created using the following formula.

$$size = deaths * loss/gdp$$

Governance or control is described in terms of central government versus local decision-making and the level of stakeholder/community participation in decision-making.

"Type" of governance has been simplified into three types.

Type 1 involves top-down central government policy-making and operational control with no stakeholder or community involvement in decision making.

Type 2 central government led but with some community consultation.

Type 3 involves a clear delegation of responsibility for planning, decision-making and implementation to the appropriate local authority with a high degree of citizen participation in strategic decisions.

It is remarkable that the three approaches are fairly evenly represented in the ten disasters and the style of governance is completely unrelated to the size or scale of the disaster.

Table 1. Case studies of 10 earthquake/tsunami disasters

Disaster	Deaths Missing	Loss US$bn	GDP US$bn	Size of disaster	Control / Community Participation	Type
China, Wenchuan 2008	87,587	130	9,240	1,232	Existing authority. Central government led, military involved. Little community participation	1
Japan, Tohoku 2011	20,350	210	4,919	869	Existing authority. Municipalities main decision-maker; central government provide guidelines. Public consultation and community agreement needed	3
Pakistan, Kashmir 2005	87,000	2.3	232	863	New authority. Central government led, military involved. Little community participation	1
Iran, Bam 2003	30,000	1.5	368	122	Existing authority. Central government led. Some resident involvement.	2
Chile, Maule 2010	547	30	277	59	Existing authority. Government set strategy and delegated responsibility to region. Residents and business people involved the planning process	3
New Zealand, Christchurch 2011	181	15	186	15	New authority. Initially local then central. Share an Idea' initiative to involve people	2
Thailand, Indian Ocean 2004	8,212	0.4	387	8	Existing authority. Central government led. Some community consultation	2
Italy, L'Aquila 2009	308	11.6	2,149	2	Existing authority. Top-down decisions. No account of local community	1
Turkey, Van 2011	601	1	819	1	Existing authority. Central government led. No public consultation	1
USA Northridge 1994	72	41.8	16,768	0	Existing authority. Clear delegation of responsibilities between federal and state agencies. Community involvement high	3

Model of disaster resilience and recovery

Disaster management is a challenging domain to model because of the complexity of dynamic characteristics. Komendantova (2014) presents a review of risk models and decision-support tools, many of which purport to incorporate feedback from stakeholders or involve them in the decision-making by setting priorities or weighting outcomes. But this author's experience of 10 disasters suggest that they are little used by disaster-managers.

Othman et al (2013) present a disaster management "model" adapted for Christchurch, New Zealand. What is immediately apparent is the complexity of the institutions involved in decision-making and interactions between them. The author of this paper interviewed the key players in the Canterbury Earthquake Authority (CERA), Christchurch City Council, Waimakakiri District Council, Tonkin & Taylor (the engineering consultants responsible for managing much of the reconstruction process) the University of Canterbury together with local politicians and business people (Platt, 2012). His impression is that this diagram, complex as it is, doesn't really capture where power lay or how key decisions were made.

Table 2 presents a model of disaster recovery devised by the author of this paper to assess recovery after the 10 major disasters in Table 1. This model might also be useful as a checklist in assessing the preparedness and "resilience" of countries at risk from natural hazards. The model is simple but takes a holistic socio-technical-economic system approach. The model is based on four sets of factors: Information, Construction, Governance and Resources.

By way of illustration, the model has been applied to two of the ten case studies: Chile and Turkey. Recovery and reconstruction after the 2011 Van earthquake in Eastern Turkey was exceptionally fast. AFAD, the Prime Ministerial directorate in charge of all aspects of disaster preparedness, response and recovery, took central control of all decision making. The government housing agency, TOKI, constructed 15,000 new apartments within eighteen months of the disaster and the central government pumped money into infrastructure projects. But there was no community involvement in decision-making, nor was there any

urban planning of the urban area. In contrast, in Chile there was much more deliberation and attempts to "build back better". The government quickly developed a national plan that assigned a budget for reconstruction and delegated responsibility to the regional government of Maule Province. National ministries took a lead role in master planning Concepción but a high powered team of architects and planners were seconded from the University of Bio-Bio to produce master plans for all 18 coastal settlements affected by the 2010 earthquake and tsunami. Local residents and business people were actively involved in decision-making.

It must be stressed that, although it is based on fieldwork, interviews with key players and stakeholders and extensive desk study, the scoring in Table 2 is subjective and based on the author's opinion. Nevertheless, the comparative scores are instructive. Despite admirable speed Turkey scored less than Chile on all four dimensions of recovery and was given a total score of 54 out of 100 compared with a score of 77 for Chile.

GOVERNANCE	CHILE	TURKEY	RESOURCES	CHILE	TURKEY
clear assignment of responsibility	5	5	insurance penetration	2	1
meta decisions made	4	5	national/international aid	4	4
legislation	4	5	household incomes	3	2
strategic community involvement	4	0	family networks	3	4
planning policies	4	0	business continuity/job security	3	2
	21	15		15	13
INFORMATION			CONSTRUCTION		
hazard risk maps	3	4	safe locations	4	4
scientific understanding	5	5	building codes (enforced)	4	1
damage GIS	4	2	build quality	4	3
engineering expertise	5	3	community preparedness	4	3
land use/transport/economic plans	4	0	public perception of risk	4	1
	21	14		20	12

Table 2. Model for assessing disaster recovery

Conclusion

This paper has argued that distinct types of decision are made post disaster and that these can usefully be typified as meta, operational and planning decisions. It also argues that three different types of people are involved: "policy makers", "disaster managers" and "planners". The paper uses theoretical models of rational and "irrational" decision-making to explain why these groups, although not entirely separate, make decisions differently, under different time pressures, with different ends and with different types of information.

In particular, the decisions made by disaster managers during the first six to twelve months of immediate response and early recovery are quite different from those made by planners charged with managing long-term recovery. People charged with disaster management have to make choices fast using experience and instinct, following established protocols. They find it difficult to think about using the kind of information research scientists are able to provide. In contrast the people charged with long-term planning are able to plan deliberately and are

desperate for detailed and reliable information to help make good decisions. This means two entirely different kinds of information are required – fast and slow information (Platt, 2014a).

The paper presented data from ten major earthquake/tsunami disasters and, using an analysis suggested by Comerio (2013), produced a classification of governance into three types according to the degree of central government control and level of community participation. It found that there was no relationship between the size of disaster or severity of the impact and the type of governance.

Finally the paper used insights from these 10 case studies to suggest a model of the disaster recovery process that was used to assess the quality of recovery and reconstruction post-disaster. The model, by way of example, was applied to the 2010 Maule earthquake and tsunami in Chile and the 2011 Van earthquake in Turkey. Despite being two to three times quicker, the recovery in Turkey scored significantly lower using this subjective tool than did Chile. This model might also be used to assess resilience and preparedness of countries at risk of natural hazard pre-disaster.

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