

## **Chapter 2 - Acting in Time Against Disaster: A Comprehensive Risk Management Framework**

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**ABSTRACT:** This chapter presents a framework for comprehensive analysis of how society can reduce the aggregate loss in social welfare resulting from disasters, identifying five leverage points in which investments in capacity can make a difference. It notes that substantial emphasis is generally placed on two of these leverage points: emergency response at the time of a disaster and preparation for response. In addition, in the wake of a disaster society often commits massive resources to recovery for those individuals and communities directly affected. Less attention is typically paid to prevention and mitigation efforts, which work on reducing the likelihood that a disaster will occur or on reducing the consequences of an event if it does take place. And almost entirely neglected are steps that could be taken in advance that would make recovery quicker, less expensive, or more complete. Society would benefit from developing a more balanced portfolio of investments across these leverage points. Ultimately, this is a problem of “acting in time” – of whether society can foresee hazards, figure out actions to address them, and mobilize itself to take those actions on a timely basis.

How should societies organize themselves to prepare for large-scale hazardous events – serious earthquakes, major floods, severe hurricanes, massive industrial accidents, significant terrorist events – that occur with little predictability of time and place? Obviously, such events constitute *emergencies* – urgent situations where the stakes are high, outcomes depend on the actions taken (but in a highly uncertain or significantly unknown way), and significant losses are, in the absence of effective action, highly probable. Some of the major consequences of the hazards we face can be effectively ameliorated if we act in advance; most can be responded to as they unfold; and nearly all will require significant efforts after the fact to help us recover. How, then, can we best organize our capacities – our thinking, institutions, processes, and resources – to cope with major emergencies? How can we most productively “act in time” against disasters?

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What actions can we take in advance – what effective, high value investments that address the prospects and potential consequences of future emergencies can we identify and activate ahead of time – rather than simply waiting for negative events to happen and then figuring out what to do after the fact?

As they break upon us, emergencies are frightening and highly salient – images of damage and injured or imperiled people demand our consideration. Confronted by unfolding disaster, our natural instinct is to *respond* – to rescue and support the afflicted. We volunteer to help; we open our homes to the displaced; we send donations to the agencies that answered the call. Perhaps in part because of their visual and political immediacy, the most common focus of work on minimizing the overall damage and meeting the cost of disasters is by responding quickly and effectively once they occur. When a given class of disasters confronts us repeatedly – wildland fires, for example, or spring floods, or hurricanes – we generally develop enough foresight to prepare in advance – that is, we build response capabilities so as to be able to mobilize an effective response when an event occurs.<sup>1</sup>

The terms “crisis management” and “emergency management” are used extensively in discussions about how major social hazards are addressed.<sup>2</sup> These terms nearly always imply a focus on a relatively brief time window of preparation for and execution of a response to disasters. They concentrate on whether the response apparatus and procedures in place before the event are adequate to the task and on the efficiency and effectiveness of actions in the immediate aftermath of the event. Response is primarily concerned with the intense “rescue” period during which critical assets– lives, especially, and property – are directly at risk. But preparation for response – that is, making preparations so as to be able to execute response/rescue actions – is not the only way that societies can or should manage the hazards of uncertain events. More comprehensive management of large-scale risks – or, to put it another way, more complete and systematic development and exploitation of cost-effective opportunities to reduce the negative consequences from major risks – requires us to expand the common but narrow focus away from mere response.

We need to extend the time frame of our examination of disasters in both directions. We need to look farther into the future, after the end of the immediate response and into the longer process of recovery. And we need to look farther into the past – into things that can be done to avert events (by preventing them altogether), to shape them so that their consequences are not so severe if they do occur (through efforts at mitigation), or to permit more rapid recovery from disaster consequences that still occur in spite of these efforts.

In what follows here, we build on the discussion presented by Kunreuther and Useem in the preceding chapter. They observe that social losses flow from the vulnerabilities of an inventory of valuable assets (which can be either tangible or intangible) in the face of uncertain hazards. In this chapter, we present a simple framework for systematically developing the full range of options for intervention to reduce the expected net losses from such hazards. This can include

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<sup>2</sup> By “social hazard” we mean any uncertain prospective event with negative consequences that societies face – like droughts, hurricanes, floods, earthquakes, industrial accidents, and terrorist attacks. As the examples illustrate, social hazards can be either naturally-occurring or man-made – and, in the latter case, can be either accidental or intentional.

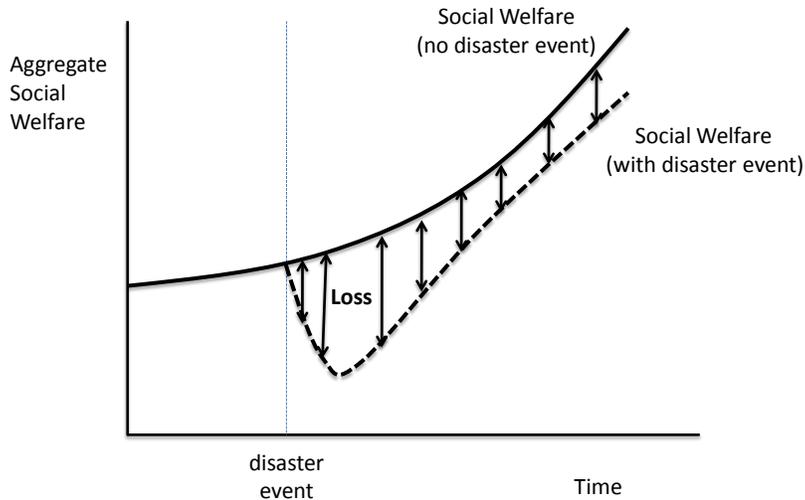
efforts to reshape the hazards themselves, as well as efforts to shift the vulnerabilities of the identified valuable inventory of social and individual assets; and the actions can take place either before or after the hazardous event transpires. We will refer to the approach we outline here as a “comprehensive risk management framework.” In our view, this approach derives in a straightforward and logical way from a simple social optimization problem: as a society, we want to make cost-effective investments to minimize the expected net present value of damage from future hazards.<sup>3</sup> Societies face a series of probabilistic hazards. If we do nothing and they come to fruition unchecked, they will cause a loss of social welfare – a decline in the quality of life for some or all in the community – over some period (and perhaps indefinitely).<sup>4</sup> For example, a major earthquake like that recently experienced in central Italy causes losses in social welfare from loss of life and from injuries, from destruction of valuable property and assets, from lost earnings and wealth (and, therefore, a decline in consumption opportunities for a long period following the event itself), and from a lost sense of security and safety among those who remain. Losses in social welfare often continue well after the event. We can think of the total loss flowing from a disaster event as the cumulative loss of social welfare, the amount by which social welfare over time falls below what it would otherwise have been in the absence of the hazard. Figure 2.1 depicts a notional graph of the path of social welfare in the absence and in the presence of a disaster. In the example shown, in the immediate aftermath of the event social welfare declines rapidly and precipitously, and gradually recovers over time; the area between the social welfare path that would have obtained in the absence of the event (shown by the solid black line) and the curve in the presence of the event (shown as the lower dashed black line) indicates the cumulative loss in welfare associated with the event.

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<sup>3</sup> “Present value” means the value of future events, adjusted for the fact that they are in the future. Since we have the capacity to invest in the present and receive positive returns in the future, in general when the same event occurs at a later time it looms as less important in our thinking; it is, in the language of economics, “discounted.” Taking account of present value means examining future consequences “discounted” to their equivalent current value (so as to make all of the costs and benefits, which may appear in different time periods, directly comparable to one another). “Expected” present value makes a further adjustment for those consequences that are probabilistic – it discounts them on the basis of the probability that they will happen. “Net” means that we take account of the costs of avoidance as well as the (probabilistic) value of damage from risky events. Thus, “expected net present value” refers to the time- and probability-adjusted future damage from a hazard, together with any investments made to reduce the anticipated damage.

<sup>4</sup> “Social welfare” is a term used by economists to refer to a very general understanding of the economic and social conditions and quality of life or well-being in a community. Generally, social welfare is correlated with income, but income is not by itself a complete measure of quality of life. Social welfare would include income and consumption, health status, and sense of security in the community.

Figure 2.1: Time Path of Social Welfare With and Without a Disaster Event



For example, imagine that the event depicted in Figure 2.1 is an earthquake in a major city. In the immediate aftermath of the event, social well-being declines rapidly as members of the community are killed or injured, property is destroyed, and economic and social activity is disrupted. With effective response and rescue, further damage from the event is minimized; and with efforts at recovery, the quality of life begins to improve. Over time, the general quality of life and economic activity returns to and then exceeds that before the event – but, in the trajectory shown in Figure 2.1, it never reaches as high a level as it would have had if the event had not taken place. For example, some businesses may fail or permanently move away and not be replaced, or the reduced sense of security may lead to a permanently-lowered willingness to invest in economically productive physical assets in the affected area. In this example, the community never fully recovers from the event.

Other trajectories of social welfare in the aftermath of an event are, of course, possible. In the example shown, at every point in time after the event the level of social welfare falls below the level that it would have had if the event had not taken place. In other circumstances, the time path of welfare after the event may regain the level it would otherwise have had, or it may even exceed that level. This would be possible, for example, if a set of suboptimal capital investments – like housing, roads, or utilities – that had been holding social welfare below its potential level were swept away in the disaster. It might not have made economic sense to destroy them before the event; but once they are destroyed *by* the event, they can be rebuilt in a more efficient social investment pattern, raising social welfare above and beyond its ex ante value. For example, the damage during the Loma Prieta earthquake to an elevated freeway along San Francisco’s waterfront was sufficiently extensive to make the cost of repairs prohibitive, and the elevated structure was taken down; in the opinion of many, this created a renaissance in the waterfront district. It is at least possible that, at least in this limited instance, the earthquake resulted in a valuable opportunity to reconstruct an area where the productivity of social assets was far below

its potential level – and the damage from the earthquake allowed the community to move on to a more valuable use of some of its remaining assets.

Indeed, not only are different post-event trajectories *possible*, but the *purpose* of our interventions in facing hazards is precisely to shift that trajectory cost-effectively in a favorable direction – to reduce the amount by which social welfare after the event falls below what it would otherwise have been. Transparently, the object of our effort should be to minimize the present value of the cumulative difference between the trajectories, taking into account the resources expended in shifting the trajectory. For example, relatively inexpensive investments in strengthening the levees in New Orleans would have resulted in vastly less destruction from Hurricane Katrina. Here, an effective intervention in advance (in the form of advance mitigation expenditures) would have resulted in a significantly less steep decline in social welfare, and a much more rapid return to a trajectory very close to or equal to what would have taken place had Katrina never come ashore. Our challenge in the face of future hazards is to find opportunities – in mitigation, in response, and in recovery – to spend resources in ways that preserve social welfare by keeping the trajectory of social welfare in the aftermath of an event, if it does occur, as close as possible to – or above! – what it would have been without the event.

### **Points of Intervention: When and where can we invest most effectively?**

Logically, a prospective disaster event defines three different time periods in which we can intervene against its associated future probabilistic losses: we can take actions (1) before the event occurs, (2) during or in the immediate aftermath of the event, or (3) once the event itself is over and the community is working to recover from it. And we can make these interventions in three different forms:

- (a) **Prevention and Mitigation** We can intervene (through prevention or mitigation measures) to shape the event itself– we can try to keep it from happening at all or can try to shift its consequences if it does occur;
- (b) **Crisis Management and Response** We can intervene (through crisis management of the event) to execute an effective, further-damage-limiting response for those events that do take place; and
- (c) **Recovery** We can intervene (through recovery efforts) to push the social welfare trajectory back toward where it would otherwise have been.

**Intervening by changing the events themselves** The first opportunity to intervene to reduce the net present value of social losses from risk events is before the event occurs, by altering circumstances either to prevent the event entirely or to reduce the damage if it does occur. Sometimes hazardous events may be prevented altogether, as, for example, when successful cloud seeding brings an end to what might otherwise have been a devastating drought. In other circumstances, even though the event itself may not be preventable (or may not have been effectively prevented), we may be able to take actions that will reduce the damage the event will

do if and when it does take place.<sup>5</sup> For example, we do not currently (and may never) have the technology to prevent earthquakes, but we do have the technology to make buildings resistant to the damage that earthquakes do; and with the right investments in building materials and design, we can dramatically reduce the extent of damage that a given earthquake will cause. As described above, Hurricane Katrina provides an object lesson in the value of advance prevention and mitigation – a comparatively small investment in strengthening the levee system would very likely have prevented the massive flooding and attendant multi-year disruption to the lives of hundreds of thousands of New Orleans residents.<sup>6</sup> Indeed, Hurricane Katrina probably constitutes the largest – and one of the most preventable – losses of social welfare ever to befall the United States. Katrina thus dramatically illustrates the fact that the opportunity to prevent events or mitigate their consequences provides a distinct point of intervention to reduce harms, a set of potentially cost-effective investments that might reduce the expected net present value of social loss from hazards.<sup>7</sup> Prevention and mitigation thus point to our first materially distinct opportunity to reduce social harm, through action in advance of an event: *eliminate or reduce the probability of the event, or reduce its negative impacts if it does occur.*<sup>ii</sup>

**Intervening through “crisis management”** Much of the public discussion of addressing prospective social hazards begins with “emergency” or “crisis” management. In terms of the trajectory in Figure 2.1, the intent here is to limit the amount of damage by intercepting the negative consequences as they unfold after the event and moving people and property out of harm’s way. This reduces the amount by which the post-event trajectory of social welfare falls below its ex ante path and reduces the time during which it remains below the level it would

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<sup>5</sup> To the extent to which there is consideration in most existing literature given to actions that can be taken in advance that will accelerate recovery after the fact, they are generally in this category – the suggestion is that if the event can be made less severe, the recovery period will then be faster. Thus, nearly all existing discussion of what we would call advance recovery strategies are in the domain we would call advance *mitigation*, and not truly in the domain we refer to as advance *recovery*.

<sup>6</sup> Whether one regards the levee system as a form of prevention or a form of mitigation depends on how one defines the “event.” If the event is defined as the arrival of a hurricane (which cannot be prevented), then the levees constitute mitigation. If the event is defined as floodwaters throughout 80 percent of the City of New Orleans, then a robust and intact levee system constitutes prevention. Since this difference is semantic, and depends on an arbitrary choice in the way the event is described, we generally treat prevention and mitigation as synonymous, and refer to them together.

<sup>7</sup> The terms “prevention” and “mitigation” are, confusingly, used differently by research communities focusing on different hazards. In general (applying the standard that ordinary English usage should be preferred), by our definition prevention refers to keeping an event from happening, while mitigation refers to acting so as to modify the consequences of an event if it does occur. Unfortunately, this convention is not universal. For example, climate change commentators refer to CO<sub>2</sub> reduction – which can reasonably be expected to prevent climate change – as “mitigation.” Under our usage, “mitigation” in climate change would involve adaptive responses that reduce social damage that would be caused by shifts in climate – but this is referred to in that arena not as mitigation, but as “adaptation.” By our definition, aerial cloud seeding would constitute prevention of a drought; building a levee would constitute mitigation of the consequences of flooding. But (see footnote 6) the distinction between prevention and mitigation depends on the how the “event” is defined. If the event is excessive rainfall, then a flood levee is a form of mitigation. If the event is defined as the flood within the city limits, then the levee is a form of prevention. Since this is largely a matter of terminology, we generally find it unhelpful and unnecessary to distinguish prevention from mitigation – in the end, both change the flow of consequences, which is all that matters, and we will generally treat them as two parts of the same thing. In examining particular hazards, however, we should be careful to seek a wide range of different possible interventions, ranging from making the event disappear (prevention) to managing its impacts (mitigation). Where the terminological difference helps in the creation of a more robust search, it should be retained.

otherwise have had. Actions during and immediately following the event are generally referred to as “response” or “rescue,” and, as noted above, they tend to be the predominate focus of what is commonly referred to as crisis management. Examinations of emergency management generally focus on what can be done “in the moment,” when the event is underway and the consequences of the event are still actively unfolding at a rapid pace. Studies and training in crisis management emphasize decision-making and execution in stressful situations of uncertainty, with high stakes in the balance, and seek to improve performance during the event by developing the skills of crisis leaders and identifying (and, hopefully, rectifying) common errors or biases in decision-making that often lead to difficulties.<sup>iii</sup>

Of course, response and rescue will generally be much more effective if it has been planned, organized, and readied in advance, so crisis management also focuses attention on the period before the event begins. Its attention in this time period tends to be narrowly focused on supporting more effective action in response – arranging people, training, skills, equipment, procedures, systems, and organizations that will enable (and, hopefully, insure) a rapid, reliable, and effective set of rescue actions.

Crisis management, thus, suggests two forms of intervention to reduce probabilistic harms, in two different “time zones” – first, before the event, take actions to *prepare the response capability*; and, second, as the event unfolds, *respond effectively and reliably*.

**Intervening through recovery** Finally, as the immediate response actions are accomplished, and as the active and rapid flow of consequences subsides, we move to the “recovery” period. Here, in terms of the trajectories in Figure 2.1, the intent is to shift the trajectory of social welfare *after* the event so that it more quickly returns to or near the level that it would have had if the event had not transpired. Actions taken well after the event have traditionally not been viewed as very directly related to crisis management. Indeed, they are often approached as though the event itself, the source of the consequences being managed during the recovery, were no longer relevant; all that matters is what the actual consequences are or were, and the best way to manage them. In communities devastated by a hurricane or flood, we institute programs of housing and community development, often with little attention to the source of the initial damage – presumably on the theory that if houses need to be rehabilitated, it makes little difference whether it is because they sustained flood damage or were blighted by neglect or were burned out in a wildland fire. The program will simply deal with whatever damage exists, and try to rectify it. Traditionally, then, the work of recovery is understood to begin (well) after the event is over and the response has ended or is imminently ending, and it is time to begin rebuilding the community and its various assets that were damaged by the event. “Recovery” – and actions to support recovery, like planning and community mobilization – are understood to take place after the fact. Traditional recovery discussions thus focus on one set of actions (rehabilitation and reconstruction) and on one time period (after the event).<sup>iv</sup>

From a logical perspective, however, there is no reason that at least *some* recovery activities cannot be undertaken *before* an event takes place. Just as response that will take place during the event can be prepared for in advance of the event (and the response can be profoundly better – faster, more reliable, more effective – as a result), there may be actions that can be taken in advance of the event that will “prepare” for a more rapid recovery. Importantly, such “advance

recovery” actions are distinct from the mitigation or prevention measures described above. Mitigation and prevention are designed to reduce or eliminate the consequences of the event – that is, to reduce the amount of recovery that is necessary. By contrast, advance recovery efforts are designed to make whatever recovery *does* need to take place more efficient, rapid, and effective.

What kinds of advance recovery actions might be helpful? To be sure, it would be foolish to make detailed plans for a recovery before a major event took place – every event is different, and most major events have a high variability in intensity, so that some areas are heavily damaged and other areas nearby are largely unscathed. Unduly detailed planning before we have knowledge of the specific damage that needs to be rectified could easily be a waste of resources.

Nonetheless, there *are* actions that we can take in advance that will shift the recovery trajectory. Generic preparation for major disasters might be very effective at accelerating the pace of recovery in the aftermath of an event. For example, some more general forms of planning may be valuable as a framework for more detailed efforts after an event. Attention in advance to rules and regulations that might need to be suspended in order to allow rapid rebuilding (e.g., public procurement regulations or building codes), or the development in advance of a planning and permitting mechanism that is designed to be nimble in the aftermath of a significant event could significantly speed reconstruction. The development of financial arrangements that would facilitate access to resources after an event could enable recovery efforts that would otherwise be impossible (especially early in the recovery period), and thus may constitute an effective way to accelerate recovery. Studies of the pace of recovery after major disasters also reveal the importance of the quality of very local (that is, neighborhood-based) leadership as a significant determinant of how rapidly and effectively recovery takes place – so efforts that build local leadership groups and provide them with experience in organizing their neighborhoods may significantly increase the rate of recovery.<sup>v</sup> For example, San Francisco currently has underway an ambitious program to identify and construct advance recovery infrastructure that will successfully accelerate recovery in the aftermath of a major seismic event, and is developing planning, budgeting, regulatory, and financial tools that will yield significant dividends if a major earthquake occurs in the Bay Area.

Thus, a more robust examination of what happens during recovery suggests that seeking to reduce the net social cost of future hazards through more rapid and reliable recovery calls for consideration of actions of two kinds, in two time periods. The first category consists of actions taken after the fact to ***undertake reconstruction*** and thereby shift the social welfare trajectory up toward where it would have been in the absence of the event – as rapidly as possible given the event and the recovery preparations that preceded it. The second category includes actions taken in advance of the event – “advance recovery” actions – that are designed to ***accelerate the planning and execution of recovery activities*** should a major event occur.

Taken together, then, we have identified five different forms of action in three different time periods that, if well and efficiently undertaken, can reduce the expected net present value cost of the hazards we face. Table 2.1 lists these five alternative approaches, and Figure 2.2 shows them graphically. These alternatives for intervention collectively constitute a “comprehensive risk

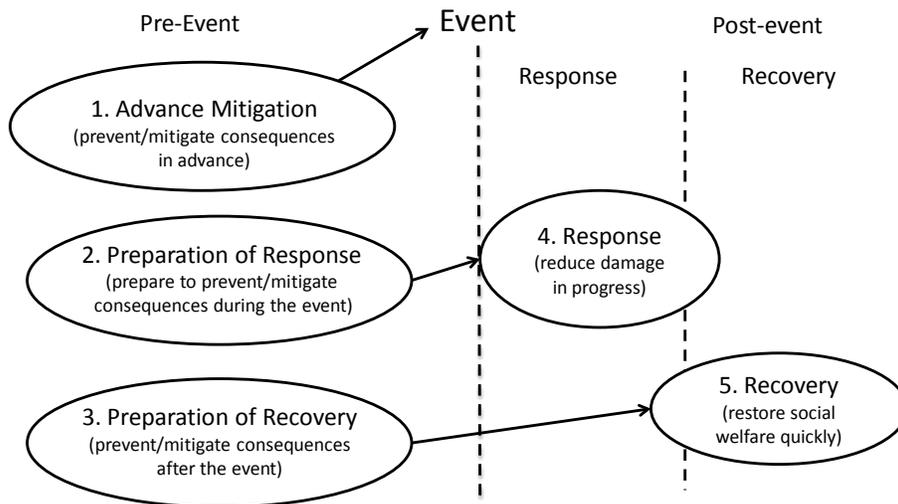
management framework.” Within this framework, we can identify and compare different opportunities for reducing damage from hazards. We can also search more comprehensively, seeking interventions of all possible forms instead of limiting our attention to only a subset of the five logically distinct forms of action. Ideally, we want to find the most cost-effective interventions – the actions, in any of the five categories, that most significantly reduce the expected value of future losses per unit of resources expended. In short, we want to use the comprehensive risk management framework to help us form a balanced, efficient, cost-effective portfolio of actions across the full range of options.

Table 2.1

Form, Time Period, and Intended Benefits of Alternative Actions to Reduce Net Present Value of Social Damage from Hazardous Events

Investment / Intervention / Action	Time Period	Intended Benefit
1. Prevent and/or mitigate	Before the event	Reduce harm created
2. Prepare a robust response	Before the event	Reduce damage in progress
3. Build recovery infrastructure	Before the event	Accelerate recovery
4. Respond	During and immediately after the event	Reduce damage in progress
5. Recover	After the event	Restore social welfare as rapidly as possible

Figure 2.2 Time Periods of Investments to Reduce Social Cost of Disasters



In the context of this picture of the comprehensive risk management framework, we can readily see the sense in which the traditional focus on crisis management is too narrow. Crisis

management, as generally defined, focuses on the response itself (area 4 in Figure 2.2). In order to make that response effective, it also has to focus on the preparation for the response (area 2 in Figure 2.2). It does not generally concern itself, however, with the genesis of the events – or with attempts to shape those events in advance; and it also generally avoids examining either the recovery or any efforts that could be made in advance to make the recovery more efficient, reliable, and effective. Thus, in order to get an appropriately balanced portfolio of investments, we need to expand the traditional focus on crisis management in both directions – farther back in time, to explore opportunities for prevention, mitigation, and advance recovery, and farther forward in time, to contemplate and execute the most successful possible recovery that can follow the crisis response/rescue phase of the event. A key opportunity framed by the comprehensive risk management framework is precisely that it requires us to expand our focus in both of these directions to seek cost-effective means to reduce the net expected present value of social losses from hazards – and it is to the development of such a balanced portfolio of investments that we now turn.

### **The level and balance of the current portfolio of risk management efforts**

Viewed through the lens of this more comprehensive framework, it is natural to inquire about the level and composition of the current portfolio of investments in hazard loss reduction. Do we – in societies around the world – invest at roughly the right level in these strategies? And do we have reasonably coherent and efficient patterns of investments across the five possible domains?

Unfortunately, there are good reasons to believe that in most, if not all, societies, we do not. Getting an efficient level and pattern of investments across such a wide range of possibilities is intrinsically difficult, and existing institutional structures and frameworks for developing hazard reduction strategies do little to encourage integration across the spectrum we have identified. Indeed, one potential value of articulating the simple framework outlined here is simply that it may encourage more comprehensive search and analysis across the wider array of possible options.

**The overall *level* of advance investments in hazard loss reduction** Investing now to reduce future harms is intrinsically a difficult decision to get right. The costs of such investments are, for the most part, both immediate and certain, while any benefits are probabilistic, uncertain, and delayed. Human beings and human organizations have always struggled with the challenge of balancing current, immediate expenditures of clearly-valuable resources on things they need now – against the uncertain, future, delayed, probabilistic gains they might get from diverting those resources into investments with uncertain, delayed future returns that can only be hoped for. In the preceding chapter in this book, Kunreuther and Useem outline some of the reasons for this struggle – for example, the fact that people do not naturally think in probabilistic terms, and the widespread tendency toward myopia in making individual (and, often, group) decisions. It may be especially difficult for people to balance current expenditures against future reductions in loss when the events for which these investments would need to be made are horrible to contemplate, and most of us would thus prefer not to think about them. But political strategies have been devised to ensure funding for other investment areas that have these characteristics – national defense, for example – and we may well be making progress in dealing with some other areas

like this, including preventive health and climate change. Kunreuther and Useem outline a series of principles of social risk management that are designed to help construct social decision mechanisms that can help counterbalance biases toward myopia in the face of probabilistic events. And a central theme of a number of the chapters in this book that look at specific hazards is that there are politically feasible ways in which a better balance might be struck between current resource demands and future hazard reductions. The fact that this remains a significant focus of research and political effort, however, suggests that in general the overall level of investments to reduce losses from future hazards probably falls short of the socially optimal level. For example, while it may not be possible with current knowledge and technology to assess the optimal level of investment that we should be making to avoid climate change (or the consequential damages of climate change), most knowledgeable observers believe that we are currently well below the optimal level of mitigation and adaptation efforts (to use the phraseology common in climate change discussions). One virtue of outlining the comprehensive risk management framework should be that it helps us to search more effectively for a broader range of possibilities, and allows us more systematically to compare investments of different types by treating them all as variations on the same general theme of reducing the expected net present value of future social losses, and thus putting them on a more commensurable basis.

**The balance among different forms of loss-reducing investments** It also seems likely that some areas of investment in loss reduction attract relatively more resources than others – that is, that the portfolio of investments, in addition to being on average smaller than it should be, is also imperfectly balanced. What keeps us from having a balanced pattern of investments? One important factor is that some forms of investment are dramatically more salient than others – both visually and emotionally – and thus are more likely to attract resources. For example, the rescue or response period in major disasters is highly visual and emotionally galvanizing, and therefore tends to generate a sense that we must do everything possible – so “all available” resources are often mobilized once a major event has begun. Similarly, once an event has taken place, there is little choice but to expend resources, subject to the limits of availability, to recover from the consequences; when a community lies in ruins, we generally rush to provide resources for the rebuilding. After an event, the losses are no longer uncertain, probabilistic, or in the future – they are here, now, visible all around us, and they cry out for help and resources. No matter how much less it might have cost if we had made investments in advance to avoid the tragedy, once it has befallen us we have little choice but to front the resources to make the community at least partially whole again, whatever that may now cost.<sup>8</sup> Thus, the response itself and the recovery (investment areas 4 and 5 in Figure 2.2) tend differentially to be able to attract and command (and consume) resources, and are thus probably at least relatively over-represented in the array of disaster-related investments.

There is reason to believe that preparation for response (investment area 2 in Figure 2.2) also differentially attracts resources, particularly after a major event has passed (in preparation for the

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<sup>8</sup> Of course, the extent of resources made available for recovery varies greatly. For example, four years after the terrible events of Hurricane Katrina, some areas of New Orleans still lie in ruins. Nonetheless, as a society, we have now spent many billions of dollars recovering only partially from an event that could have been prevented by the judicious expenditure of at most only a small number of billions of dollars. Thus, while Katrina gives us an example where even the relatively advantaged form of spending – recovery, after the fact – has probably been underinvested in, it still also illustrates that the *relative* balance of spending seems to favor recovery over prevention.

next event). This is because, during the highly salient rescue period of the last event, it never seems that we have enough preparation, resources, and readiness to deploy quickly enough; there never seem to be enough fire trucks, and they never arrive as soon as we would like. In critical discussions after the fact, highly animated victims of the last event (naturally enough) often demand explanations for why the response was not faster, bigger, better. A common response is to increase the preparation budget so as to have a larger fleet of fire trucks available when the next event takes place.<sup>9</sup> During periods with few events, however, declining salience and memory sharpness leads to lessened political demand for disaster protections. Often political interest in sustaining these investments wanes, leading to cuts – and thus sets up the next cycle of disaster followed by reinvestment. Whether investment area 2 is over- or under-invested in may thus depend in part on where we are in the cycle of disasters. Nonetheless, the salience of response and the prospect of future needs probably generally inclines investment area 2 toward differential ability to attract resources – particularly in the immediate aftermath of a major event.

By contrast, two other investment areas seem to get comparatively little attention. Prevention and mitigation efforts (investment area 1 in Figure 2.2), and advance recovery activities (investment area 3), are both disadvantaged (in the same way as are all hazard-reduction investments) by the fact that their costs are immediate and certain, while their benefits are probabilistic, uncertain, and delayed – that is, they are subject to the same myopia that generally plagues individual risk perception and assessment. But they are *further* disadvantaged by the fact that their potential benefits are less visible (at least, until the event takes place). Prevention and mitigation famously create invisible benefits – we rarely are in a position to observe what was prevented. The need to prevent or to be ready to recover is intrinsically an abstraction, an idea. By contrast, the need to be ready to respond is vivid, and the need to recover once an event has occurred is visible all around us. This is the flip side of the fact that response and recovery after the fact get so much more attention than prevention, mitigation, and advance recovery before the fact. The event and the recovery from the event that was uncertain and off in the future (and therefore attracted relatively little prevention, mitigation, and advance recovery planning attention in advance) has become immediate, inescapable, certain, and *now*. It is therefore able to get many times the resources that might have been necessary to prevent it, reduce its consequences, or prepare a more rapid recovery from its after-effects.<sup>vi</sup>

**Institutional challenges** An additional problem further enhances the difficulty of forming a fully efficient social portfolio of investments across the range of opportunities to intervene to reduce social losses: the institutional structure of governments in most countries gives responsibility for various components of these investments to different agencies and, frequently, to different levels of government, which makes it difficult to compare them (or even to assemble a comprehensive picture of them).

Consider, for example, floods as a social hazard in the United States. Responsibility for flood control – what we have referred to here as prevention and mitigation of the consequences of floods – lies with the Army Corps of Engineers (in the U.S. Department of Defense) and with some state and local agencies. This, by itself, is a complicated start, forced by the multi-level

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<sup>9</sup> This phenomenon is sufficiently common that it has a name in disaster management circles – it is commonly referred to as the “big red truck syndrome.” In deliberately gender-laden terms, some refer to it as “boys and their toys.”

U.S. governmental structure, driven by the fact that floods are often large-area events that will involve many different jurisdictions, and reflecting the fact that the best place to control a flood may be many hundreds of miles (and multiple jurisdictional boundaries) upstream from where the flood may take place.<sup>10</sup> Preparation for response – and response itself – is the domain of planning and organizing and first-responder agencies – at the federal level, the Federal Emergency Management Agency [FEMA] (which will mobilize many other organizations, including contractors and state and local government agencies outside the affected region) and the Coast Guard; at the state level, the National Guard and other state agencies; at the local level, police and fire departments. There is little attention to advance recovery – no agency appears to have an extensive mandate for this area of investment. And recovery will be in the province of FEMA, the Department of Housing and Urban Development, and a variety of state and local agencies.<sup>vii</sup>

From an institutional perspective, different possible interventions suggested by the comprehensive risk management framework lie in multiple agencies in multiple jurisdictions at multiple levels of government. Developing a comprehensive picture of the different responsibilities of and investments being made by these different players would be a daunting undertaking – and this is only one of many major hazards for which the society should want to have a comprehensive, balanced portfolio of investments before, during, and after an event. The complex structure of institutions involved in these matters is thus an additional barrier to examining the existing investments, forming a more comprehensive picture, and developing a more efficient portfolio of social hazard reduction strategies and investments.

The net result of these systematic forces acting upon our (largely disconnected and independent) decision-making processes for investments in social risk loss reduction appears to be (1) that we wind up spending too much on response to and recovery from events that we should have instead figured out how to prevent or mitigate, and (2) that our recoveries are generally slower than they should be, exacerbating social losses, because we have not built the necessary or useful infrastructure for rapid recovery in advance.

The fact that these forces probably result in an inefficient distribution of investments across hazard loss reduction investment areas is precisely why we need a comprehensive risk management framework in the first place. In its absence, we have to try to identify and carry out investments of different kinds in an independent and disconnected form, with little comparative attention to where the greatest opportunities and most efficient investments lie. By contrast, if we use a comprehensive risk management approach, we should be able to build a more balanced portfolio with higher average returns on our investments.

Consider, for example, the problem of the management of wildland fires in the Southwestern United States. Over the last century, recurrent fires in fire-adapted ecosystems have become more intense and more damaging as a constellation of forces has systematically increased the hazard and built up the inventory of valuable assets in high-hazard zones. Traditionally, risks to

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<sup>10</sup> Professor Gilbert White and his fellow hazards geographers generated the field of pre-disaster hazard mitigation and its notion of sustainable development. Their work contributed to the establishment of the US National Flood Insurance Program, America's first systemic approach to disaster risk reduction.

life and property from wildland fire were managed through a standard crisis management response approach, with growing investments in fire suppression technology and efforts. Recurring dramatic (and highly photogenic) events – including 200-foot high flame walls driven by high winds at great speed toward vulnerable communities, and the charred remains of homes and their treasured contents, and, far too often, the bodies of fire victims – galvanized massive efforts to increase resources for traditional responses designed to suppress fires once they had started. Ironically, these (often partially successful) efforts to suppress fires led to a systematic buildup of volatile fuels in wildland areas, which actually increased the hazard by making fires both more likely and more intense. Meanwhile, politically-popular (but myopic) land use policies (encouraged by false confidence in our presumed ability to continue to suppress fires) permitted fire-prone areas to be colonized by suburban real estate development and extensive building of second homes deeply embedded in fire-adapted ecosystems. The results have been utterly catastrophic: costs of fire suppression and of property losses have spiraled upward, and both civilian and firefighter deaths and injuries have increased. Far from investments that have reduced the present value of loss from future hazards, policies and investments in this domain have systematically *lowered* the expected path of future social welfare.

How might the application of the comprehensive risk management framework developed here help us organize our investments more judiciously in the face of this challenge? It would focus attention on the full range of possible investments, including prevention and mitigation, response, and recovery. Doing so should help us notice that we have made enormous investments in response and in preparation for response, and have been forced to make enormous expenditures for recoveries – but have made only small investments in (a) prevention (through land use policies that would discourage embedding vulnerable high-value properties in fire-prone areas); (b) mitigation (through treatment of areas to reduce the buildup of natural fuels in areas with concentrations of valuable property); and in (c) preparation for rapid and less expensive recovery. A more balanced analysis, structured by the comprehensive risk management framework, will allow us to formulate a more judiciously balanced array of investments – and, thus, to reduce expected future social losses substantially.

It is reasonable to ask what institution(s) might conduct this cross-agency, cross-jurisdictional, cross-level-of-government analysis and how the decision making process might be structured. In many ways, this problem recalls the efforts since the early 1960s to develop comprehensive, analytic budgeting systems – e.g., the Kennedy-Johnson Administrations’ promotion of the Planning-Programming-Budgeting System (PPBS), first in the Pentagon and then federal government-wide.<sup>11</sup> PPBS was much less successful than desired, in part because even when analysis of major “programs” in the Defense Department alone were conducted, it was exceedingly difficult to make and enforce executive decisions based on this analysis. The “best” course indicated analytically was often lost in the intensely political budgetary bargaining within the Pentagon, between the Department of Defense and the White House, and between the executive branch and Congress in a fragmented authorization and appropriations process. Similar, perhaps even more complex, forces operate in the current Homeland Security arena in the United States.

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<sup>11</sup> Other approaches that share some similarities to PPBS in this respect include Zero-Base Budgeting (ZBB) and, in a system with broader purposes than budgeting alone, the Balanced Scorecard approach initially developed for business organizations and later extended to not-for-profit and public sector applications.

Nonetheless, the likelihood that a more comprehensive analytic process might not be perfectly effectuated in decision making should not preclude making the effort to think more systematically and comprehensively about the full portfolio of investments that societies make to reduce the net losses from disasters of all types. One approach that might prove beneficial would be to develop “balanced scorecards” for a “virtual” homeland security sector either in an individual jurisdiction or for a system that cuts across agencies, jurisdictions, and levels of government.<sup>12</sup> Good analysis, effectively articulated and publicized, can shape public discussion and constrain policy politics even if it does not wholly “win out” in the final political decision-making process. The difficulties of institutional setting will remain, but the public debate – and the direction of the outcomes – can nonetheless be altered over time.

### **The more general problem of Acting in Time**

Identifying a more robust set of possible cost-effective social hazard loss reduction opportunities – which the comprehensive risk management framework should help us to undertake – is, in the end, only one part of the problem of actually addressing the hazards and reducing the prospective losses. Before they can find strategies for expected loss reduction, societies need to identify areas of hazard that are worth investigating – and in addition to finding strategies for addressing the hazards they focus on, societies need to carry those strategies into action.<sup>13</sup> Thus, the risk management framework needs to be seen as part of the larger challenge of organizing and mobilizing public action. The losses from hazards – and the benefits from hazard loss reductions – are intrinsically in the future, so we can view this wider challenge as a problem of “Acting in Time” – that is, of taking action against future harms (or in favor of future opportunities) while there is still time to do so.<sup>14</sup>

What does it take to act in time against a future hazard? First, the hazard itself must be identified with sufficient clarity to permit us to develop possible actions that could reduce its expected future damage. If it cannot be – or is not – foreseen, we cannot take specific action against it. Second, if it is observed, then we next have to be able to identify actions that could cost-effectively reduce its future impacts. (This, of course, is the challenge to which the comprehensive risk management framework described above is directed – it is designed to help in the effective search and comparative evaluation of alternative strategies for reducing future

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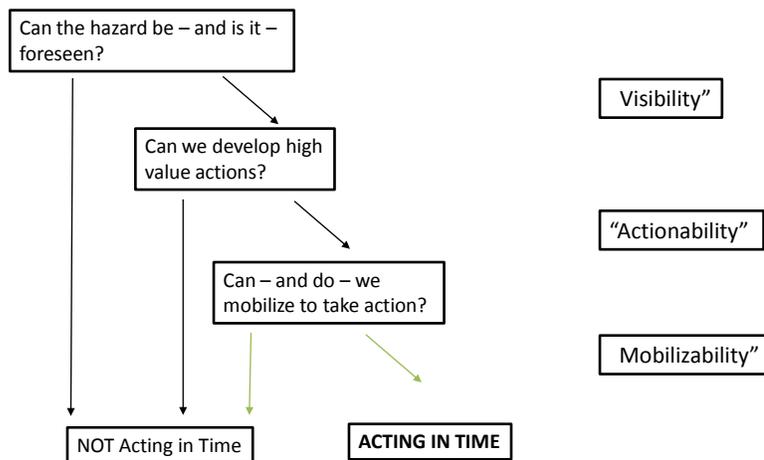
<sup>12</sup> There is an extensive literature on the development and use of “balanced scorecards” and other mechanisms for focusing attention on outcomes in a performance management system. See, for example, Robert Kaplan and David Norton, *The Strategy-Focused Organization*, Cambridge, MA: Harvard Business School Press, 2001.

<sup>13</sup> The American experience with disaster risk reduction has been uneven, at best. But promising practices were developed with the enactment of the Disaster Mitigation Act 2000 and the Federal Emergency Management Agency’s Project Impact effort that seeded safety projects in 250 disaster-prone cities.

<sup>14</sup> The language of “Acting in Time” is drawn from a multidisciplinary research project by that name, developed by David Ellwood, dean of Harvard’s Kennedy School of Government. Generally, this project focuses on the challenges of mobilizing public action in the face of more or less obvious harms with more or less obvious solutions – but where getting people to act is nonetheless difficult. A considerable portion of our work on crisis leadership in the last several years has been conducted under this general rubric; in our work, the harms are not always so obvious, nor their solution so straightforward, so we use a broader interpretation of the Acting in Time framework, as presented here. For an overview of the Harvard Kennedy School’s Acting in time initiative, see: <http://www.hks.harvard.edu/about/admin/offices/dean/ait>.

damage from probabilistic events.) Third, once we have identified or developed potentially valuable actions that can be taken to reduce expected future harms, we have to figure out how to mobilize the resources and actions implied. Figure 2.3 illustrates these phases of being able to act in time. We refer to the first phase as “visibility” – can the hazard be perceived clearly enough to be acted upon? The second can be described as “actionability” – can we identify cost-effective actions that would reduce its expected harms? The third can be referred to as “mobilizability” – is this hazard, and the associated set of actions for addressing it, something around which we can mobilize people and institutions to take action (and expend resources)? Only if we are able to work our way successfully through each of these steps will we be acting in time; otherwise, we may have general preparations for dealing with the consequences of this particular risk, but we will not have acted in time in the face of this risk as effectively as we might have.

Figure 2.3 The Simple Analytics of Acting in Time



As an example of the “acting in time” challenge, we can return to the wildland fire management problem discussed above. In this case, the hazard is certainly visible. Through application of the comprehensive risk management framework, we can develop a more judicious and balanced set of investments across the full scope of opportunities to address the hazard. These range from prevention and mitigation (through better land use and wildland fuel reduction) to right-sizing the response capabilities that will be required in the lower-hazard environment thus created to developing rapid recovery mechanisms for circumstances where damage still occurs. Thus, the comprehensive risk management approach helps us to explore and develop opportunities for investment, and thus helps generate “actionability.” The remaining problem for acting in time against this hazard, then, is mobilizing communities to actually undertake the resulting, more balanced set of investments. This is a problem of political visioning and will to act, and it has proven immensely difficult to solve. There are, however, communities where significant rebalancing of efforts has been undertaken. In Ventura County, California, for example,

extensive efforts at brush clearing on public lands and the development and enforcement of ordinances requiring brush cutting around homes to create “defensible space” have dramatically reduced the number of homes lost to wildland fire (in comparison with other nearby areas). “Positive deviants” like Ventura County may be able to help us spot conditions in which individuals and communities are more likely to address these challenges successfully.<sup>viii</sup> The challenge of mobilizing is partly a problem of risk perception and assessment (as described in the preceding chapter), and partly a challenge of finding mechanisms to collectively overcome the systematic forces of myopia, and partly a challenge of generating the will to carry through on a decision to act. Throughout the remaining chapters of this book, the issue of how the acting in time problem of creating visibility, actionability, and mobilizability can be successfully addressed for different social hazards will be a recurrent theme.

## Conclusion

The comprehensive risk management framework focuses attention on five different kinds of actions that can be taken at different times (three before the event; one during and in the immediate aftermath of the event, and one that continues long after the event) to reduce the expected present value of the losses associated with a future hazard. Examining risks to social welfare in this framework will permit the development of a portfolio of interventions that is balanced across the different points of entry, encouraging us to seek cost effective investments in all five of these areas and allowing us to compare investments in different areas to see which will provide the greatest anticipated net reduction in losses associated with the hazard – that is, the greatest return on our investments in expected hazard loss reduction.

The useful risk management work outlined by the comprehensive risk management framework, however, cannot be undertaken without prior work to identify hazards that can be acted upon – and it will not be useful unless the high-value investments it identifies are actually undertaken. Identifying the opportunities to intervene, designing interventions, and actually making these investments in time to matter thus requires that we “Act in Time” – and this implies that the comprehensive risk management framework needs to be embedded in the larger framework of “Acting in Time:” (a) identifying or perceiving hazards clearly enough to permit investments to be made to reduce their expected future costs; (b) using the comprehensive risk management framework to design alternative interventions and determine which of them provide the greatest reduction in expected future losses per unit of resources expended; and (c) mobilizing the political and social will to expend with certainty current and future resources against the probabilistic prospect of reduced social losses in the event that a possible hazard turns into an actual event. Only if we can manage each of these challenges will societies be able to construct a fully systematic, efficient, and effective approach to social risk management.

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<sup>i</sup> Herman B. Leonard and Arnold M. Howitt, *Against Desperate Peril: High Performance in Emergency Preparation and Response*, in Deborah E. Gibbons (ed.), *Communicable Crises: Prevention, Response, and Recovery in the Global Arena* (pp. 1-25), Information Age Publishing, 2007.

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<sup>ii</sup> Dennis Mileti (ed.), *Disasters by Design*, Joseph Henry Press, 1999. Mileti discusses the issue of sustainable development that encompasses disaster risk reduction.

<sup>iii</sup> Max H. Bazerman and Don A. Moore, *Judgment in Managerial Decision Making*, 7<sup>th</sup> Edition, John Wiley and Sons, 2009; and Herman B. Leonard and Arnold M. Howitt, Improving Performance: Dealing with Novelty and Cognitive Bias, in Arnold M. Howitt and Herman B. Leonard (eds.), *Managing Crises: Responses to Large-Scale Emergencies* (pp. 407-412), CQ Press, 2009.

<sup>iv</sup> Brenda D. Phillips and David M. Neal, Recovery, in William L. Waugh and Kathleen Tierney (eds.), *Emergency Management: Principles and Practice for Local Government*, 2<sup>nd</sup> Edition (pp. 207-234), ICMA Press, 2007; see, also, Kenneth C. Topping, "Toward a National Disaster Recovery Act of 2009," *Natural Hazards Observer*, 33 (3), 2009, 1-9, for a recent discussion on the need for a national approach on disaster recovery.

<sup>v</sup> Craig E. Colten, Robert W. Kates, and Shirley B. Laska, "Three Years after Katrina: Lessons for Community Resilience," *Environment*, 50 (5), 2008, 36-47; see, also, Esther Scott, "*Broadmoor Lives: A New Orleans Neighborhood's Battle to Recover from Hurricane Katrina (A, B, Epilogue)*", John F. Kennedy School of Government, Harvard University, 2008, for a detailed examination of how local residents organized themselves to spearhead recovery efforts in the New Orleans neighborhood of Broadmoor following Hurricane Katrina.

<sup>vi</sup> Multihazard Mitigation Council, *Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities*, National Institute of Building Sciences, 2005. This study quantified the benefits of pre-disaster mitigation by examining the efficacy of federal risk reduction grant programs.

<sup>vii</sup> Claire B. Rubin (ed.), *Emergency Management: The American Experience, 1900-2005*, Public Entity Risk Institute, 2007; and William L. Waugh and Kathleen Tierney (eds.), *Emergency Management: Principles and Practice for Local Government*, 2<sup>nd</sup> Edition, ICMA Press, 2007. Taken together, Rubin's and Waugh and Tierney's works provide a comprehensive overview of how emergency management is organized, administered, and structured across multiple levels of government and agencies in the United States.

<sup>viii</sup> "Positive deviance" is a term and approach to social learning developed by Jerry and Monique Sternin. See, for example J. Sternin and R. Choo, "The Power of Positive Deviance," *Harvard Business Review*, January-February 2000: 14-15.