

Risk Management REVIEW



RISK MANAGEMENT
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National Symposium on Risk and Disasters

On December 1st, 2005 a National Symposium on Risk and Disasters sponsored by the University of Pennsylvania in association with the Communications Institute and Congressional Quarterly will be held in Washington, DC. The Symposium will bring together leading scholars in the fields of risk, health, sociology, engineering, and environment, as well as representatives from involved NGO's, trade associations, and government agencies to elaborate the lessons for the future from the Hurricane Katrina experience. These lessons can apply to other natural and man-made mega disasters that are a consequence of American society's growth patterns and expose large concentrations of people and property to potentially devastating forces.

"This symposium is a natural way for the University of Pennsylvania to bring the expertise of our faculty members to bear on issues of national importance," according to Ron Daniels, Provost of the University of Pennsylvania. "It is our obligation to ensure that we are

making timely and relevant contributions to policy debates at all levels – and we are delighted to have convened leading Penn faculty, along with colleagues from other universities, to inform and shape the creation of responsible and humane policies when dealing with such crises."

subject of considerable research by many of the participants on the panel and attendees.

Equal Treatment – In developing a strategy for minimizing risk and responding to disasters, all Americans should be treated equally regardless of sex, race, ethnicity, and class.

**"This symposium is a natural way for the University of Pennsylvania to bring the expertise of our faculty members to bear on issues of national importance."
- Ron Daniels, Provost**

The discussions and debates at the Symposium are designed to guide policy deliberations by the United States Congress and leaders from the public and private sectors as well as the academic community on disaster management strategies. A summary of the Symposium's contributions will be published shortly after its completion by the University of Pennsylvania Press.

A set of principles, listed below, will serve as the basis of the discussions by the experts participating in the Symposium. Each of these principles has been the

Risk Analysis – Public and private organizations alike should consider the likelihood of disasters—including alternative strategies to minimize risks and reduce costs—in developing emergency preparedness and recovery plans, as well as plans for economic growth and development.

Cost-Benefit Analysis – Public and private organizations should consider the relevant costs and associated benefits of alternative policies. The assessment of benefits should include social and

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The Case for Comprehensive Disaster Insurance

By Howard Kunreuther

Hurricane Katrina has raised a number of questions regarding the role that insurance can and should play in providing protection against natural disasters. Preliminary estimates suggest that it will be the most costly disaster in the history of the insurance industry with total claims ranging between \$40 and \$60 billion. Some insurers have indicated that they cannot continue to provide coverage against wind damage from hurricanes in regions of the country subject to these severe events.



Despite the commitment of over \$60 billion of federal disaster assistance, many of the victims from Katrina have been complaining about receiving substantially less than they anticipated to repair or rebuild their damaged or destroyed property. In fact, many of the individuals did not have flood insurance, which covers water damage from hurricanes, even though they were eligible to purchase such a policy through the National Flood Insurance Program (NFIP). A standard homeowners policy, normally required as a condition for a mortgage on a house, provides protection against damage from fire, hail, winter storms, tornadoes, and wind from hurricanes but not water damage.

The time appears ripe for formulating a comprehensive disaster insurance program in combination with other policy tools for reducing losses from natural disasters. In order for such a program to be effective there needs to be action at the local, state, and federal levels that take advantage of the strengths of the insurance industry while recognizing its limitations in providing coverage against large scale losses from catastrophic events such as Katrina.

Advantages of Insurance

Insurance has an advantage over other policy tools in that it encourages risk mitigation prior to a disaster and provides financial assistance should there be losses. It can do this by lowering premiums for those who invest in loss reduction measures and making claims payments should these same individuals suffer damage from a disaster.

If insurance is to play a central role in a hazard management program then those in disaster-prone areas need to bear a substantial cost of making their communities safer and should be responsible for most of the losses after a disaster occurs. The larger the subsidy provided by the general taxpayer, the less important the role that private insurance can play in covering damage from disasters. In the long run, if there is genuine public concern with the increasing costs of natural disasters, as Katrina has highlighted to the nation and the world, an insurance system with rates based on risk has an important role to play in a hazard management program.

Why Comprehensive Disaster Insurance

Over the years there have been discussions by insurers and policy makers as to the feasibility of combining hazards into a comprehensive insurance program. Expanding a standard homeowners policy to include earthquake and flood has considerable appeal if the program is designed so that rates reflect the risks faced by those residing in hazard-prone areas and insurers are able to obtain financial protection against catastrophic losses, they may experience from one or a series of disasters in any given year. Such a program has several advantages over the current structure.

By setting rates based on risk one signals to those considering moving into hazard-prone areas what the expected losses are from natural disasters if one chooses to live there. If the resident decides to adopt mitigation measures against one or more hazards, then the insurer can reduce the premium to reflect the lower loss that would occur from

Co-Director's Corner

future disasters. An all-hazards insurance program also reduces the variance associated with claims in any given year due to the larger premium base to cover losses from any single disaster and the diversification of risks across a wider area.

An all-hazards program may also be attractive to both insurers and policyholders in hurricane-prone areas because it avoids the costly process of having an adjuster determine whether the damage was caused by wind or water. It also averts disputes between the insured and insurer. In the case of hurricanes, these are likely to arise if the adjuster rules that the losses were uninsured because they were caused by water and the policyholder believes it was due to wind.

Another reason for having an insurance policy that covers all hazards is that there will be no ambiguity by the homeowner as to whether or not she has coverage. Some residents are likely to be under the misimpression that their homeowners policy covers earthquake damage. Many residing in the Gulf Coast believed they were covered for water damage from hurricanes when purchasing their homeowners policy.

There are challenges that need to be addressed in developing a comprehensive insurance program. Despite the emergence of catastrophe models there is still considerable uncertainty surrounding the estimates of the likelihood of disasters of different magnitudes occurring in any given area and the resulting damage. Insurers may want to limit their coverage against certain risks in order to reduce the chances of a large decrease in surplus through a catastrophic loss such as some insurers experienced after Hurricane Andrew in 1992, the Northridge earthquake in 2004 and now Hurricane Katrina. This is one of the reasons why insurers are reluctant to provide coverage today against earthquakes in California and wind damage from hurricanes in the Gulf Coast states.

If one believes that those residing in hazard-prone areas should be responsible for bearing their own burden if they suffer losses from a natural disaster, then insur-

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Co-Director's Corner

By Robert Meyer

Consider the following problem: you are the CEO of a large chemical industry firm located on the Atlantic Coast, and you have recently been swamped with memos warning you of the myriad catastrophic threats faced by your facilities. In addition to the omnipresent threat of terrorist attacks and hurricanes, one memo warns that the region is "long overdue" for a major earthquake. While you believe that the technology exists to protect your facilities against these threats, the cost of implementing each would be in the tens of millions. How would you decide whether to make such investments and, if so, how to prioritize them?

The textbook answer, of course, would be to compute the long-term expected profits of the firm, given that each one of these investments is made (as well as computing expected profits assuming no action is taken) and then prioritize actions based on cost/benefit ratios. Sound simple? On paper it is, but it is also an approach that is not likely to be very useful in this case—and, in fact, has the potential of being dangerously misleading in its advice. The reason is straightforward: implementation of textbook cost-benefit methods requires us to make a range of quantitative assumptions about a range of entities for which precise estimates do not exist. These include the probability of specific hazards, the conditional consequences of hazards, and the true effectiveness of mitigation investments. Below I will explore specific examples of this quantification problem and describe how proceeding with "best guesses" can sometimes be worse than not proceeding at all—and what the alternatives might be.

The Hazards of Hazard Probabilities

The core of any risk analysis is the assignment of numerical probabilities to hazards and their severity; for example, the probability that one of the chemical facilities will be subject to a terrorist attack sometime over the next

twenty years. How should an analyst construct this number? The reality is that he or she cannot. Despite what you might hear (and see) from experts, a mathematically meaningful probability of terrorist attacks does not exist. To see why, recall that when mathematicians speak of "probabilities" they use the term in a more precise way than we typically use it in common speech, where it is a subjective sense of how certain something is—such as whether one is likely to have a good time at a forthcoming visit to the in-laws. To mathematicians a probability is the relative frequency with which a particular outcome will be observed in an experiment in which outcomes are being randomly sampled from a specific universal set of outcomes, termed the sample space. The problem with assigning a numeric probability to terrorist attacks is that, while we know the outcome of interest, we don't know anything about the sample space that attacks are being drawn from or the process by which draws are being taken. To illustrate, one might define the sample space as the universal set of behaviors that might be exhibited by all those people who are prone to terrorism at various points in time. But this gets us nowhere; since that set is unobservable, all probabilities one might construct are equally plausible mathematically.

So what should one do? One tempting solution might be to substitute the required *mathematical* probabilities with *subjective* ones derived by asking experts to judge how likely they believe a terrorist attack might be. The problem here is that these judgments are not mathematical probabilities as required by theory; they are simply subjective ratings of perceived certainty that happen to be provided on a 0-to-1 scale—ratings that may well be distorted. There is extensive evidence, for example, that people (even experts) tend to overestimate the true likelihood of rare events, think events that are more easily remembered are more likely, and rarely grasp the idea that probabilities should sum to one. While there is nothing to prevent one from analyzing

The Hazards of Hazard Analysis



such expert guesses *as if* they were real probabilities, the results will almost certainly be of dubious value.

Another option is to concede uncertainty about true probabilities by conducting the analysis over a range of possible values—such as a "best case/worst case" range. But this does nothing to resolve the core problem; because one does not know what the true probability distribution is, it is impossible to know what the "best" and "worst" cases might be. Moreover, highlighting an arbitrary range raises the hazard of luring policy makers to viewing the mid point as being a "best guess" analysis—an inference almost certain to be wrong.

I should stress that this problem in specifying probabilities is by no means limited to settings where there are few useful historical precedents, such as terrorism. Consider, for example, the risk of severe hurricane landfalls in the United States. While we have data on tropical cyclone impacts that date back to the mid-1800s, for most of this record there is little reliable information on the intensity of storms at landfall; it is unknown, for example, whether the rash of Category 5 storms that were observed (over water) in 2005 was a truly unique event or was typical of the frequencies that were observed in the 1930s and 40s, before there were satellites and air reconnaissance flights. In addition, hurricane frequencies (and possibly intensities) appear subject to cyclical variations for which we lack the long-term data to model. As a consequence, actuarial estimates of hurricane risks computed from data over the past century are, at best, a crude estimate of long-term hazard exposure.

The (Mis)calculation of Consequences

Another barrier to applying traditional cost-benefit analyses to rare events is that we also lack an ability to precisely predict both the effectiveness of mitigation strategies and the likely damage impacts. Hurricanes Katrina and Wilma this year offered a dramatic illustration of this. By the best

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knowledge we had at our disposal in early August of 2005, the widespread destruction caused by Hurricane Katrina should not have occurred. When Katrina crossed the Mississippi coast its intensity was considerably less than that of Camille in 1969—some analyses now suggest that wind speeds were may have been no more than that typically associated with a Category 2 hurricane—yet it produced a storm surge that exceeded that produced by Camille, and over a much larger area. Likewise, the levees in New Orleans failed when subjected to a storm event no worse than what they were engineered to prevent. Likewise, the widespread loss of windows in high-rise buildings in Miami/Ft. Lauderdale during the comparatively mild (Category 1) attack by Wilma in October shocked many structural engineers, as many of these losses were observed in buildings constructed to conform to the rigorous building codes set after Andrew in 1992. A key lesson in both cases is that we know far less than we thought we knew about hurricane impacts and mitigation—a lesson that certainly generalizes to other domains.

An even greater potential source of error lies in the difficulty anticipating—and quantifying—social impacts of a disaster conditional upon its occurrence. There is often a tendency when conducting cost-benefit analyses to focus on metrics that are most easily quantified—such as the dollar value of lost property and the economic impact of lost jobs. But the real impact of hazards often goes well beyond that, and involve elements that are much less knowable, such as psychic impacts. Few would contest the suggestion that the impact on American society caused by the 9/11 attacks went far beyond the equivalent monetary value of the lives and materials lost, and the same was certainly true for the massive human displacement caused by Hurricane Katrina. Even if we could attach financial equivalents to such impacts, we are back to dilemma of probability assessment described above: while it might be possible to imagine a range of possible consequences, any attempt to provide mathematically-meaningful probabilities to these scenarios would be, at best, fruitless and, at worst, dangerous (if their

resulting prescriptions are followed).

So What are We to Do?

Although bleak in its assessment, the above analysis is not meant to discourage attempts to use the logic of cost-benefit analysis to make mitigation investment decisions. Rational decisions *can* be made using limited knowledge, but it comes with a few simple rules:

1. *The precision of recommendations should not exceed the precision of inputs.* In the absence of useful historical data to gauge the probability of risks, the best option we have may often be to get the subjective estimates provided by experts. But remember: these are *not* probabilities. Hence, they cannot theoretically be used to compute cost/benefit ratios. What they *are* useful for are analyses that only require estimates of *relative* risk—such as in ordering hazard priorities.

2. *Look for parameter-free solutions.* When one is uncertain about the validity of parameters that enter into an analysis, one should look for solutions that are robust to the assumptions one makes about likelihoods. For example, one of the oldest heuristics for risky decision making is to take actions that avoid the maximum regret (the mini-max rule)—a heuristic that does not require one to make an assumption about how likely that regret might be.

3. *Work to ward off cognitive biases.* In the end one may need to construct cost-benefit ratios (or the like)—even if of dubious value—on the logic that some action is better than none at all. But it is essential to proceed with full awareness that human judgments are frail and are prone to specific biases that we should attempt to correct. One should question, for example, subjective estimates of risk taken shortly after disaster episodes; while it might *seem* like we are at greater risk of tsunamis and hurricanes than in the past, this is largely illusional. If the risk is greater, it is only because more people now live where they are subject to the constant hazard. On the flipside, excessive focus on salient events poses the risk that we will under-attend to less familiar hazards. As always, the greatest risk lies in the hazards that we don't currently see more than those that we do.

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ance rates should reflect the risk. For example, property owners residing along the Gulf Coast should pay considerably more for insurance against wind and water damage from hurricanes than in other parts of the country. Given the existing system of rate setting and the need for special treatment for low income residents in high hazard areas, considerable care will have to be taken in developing a premium structure that will be approved by state regulators, the general public, and hence policy makers.

Today there are limited private reinsurance and catastrophe bonds to cover the losses from catastrophic hurricanes such as Katrina and severe earthquakes such as Northridge. If insurers are willing to market a comprehensive disaster insurance policy they will require some type of federal involvement either through federal reinsurance or some other type of backstop. For example, Christopher Lewis and Kevin Murdoch have developed a proposal that the federal government offer *catastrophe reinsurance contracts*, which would be auctioned annually. This federal reinsurance effort would be part of a broader program involving mitigation and other loss reduction efforts.

Katrina has brought the issue of insurance against natural disasters to center stage. The challenge is to take advantage of this window of concern to develop new programs now that reduce the losses from future disasters while at the same time providing financial protection should a catastrophe occur. A comprehensive disaster insurance program, coupled with other measures such as well-enforced building codes, has the potential to do just that.

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psychological effects as well as the direct and indirect economic impacts.

Samaritan's Dilemma – Federal disaster assistance creates a Samaritan's dilemma. If individuals and organizations assume that the federal government will provide significant assistance after hardship—that the government will be insurer of last resort—there will be fewer incentives for those in hazard-prone areas to reduce their risks before the next disaster and to purchase adequate insurance coverage.

Uninsured Losses – A policy by both government and the private sector that implicitly anticipates high rates of uninsured losses should not be tolerated unless one explicitly acknowledges that the public sector will respond with financial assistance after the disaster.

Assisting Low Income Residents – Subsidies should be provided to low income residents in hazard-prone areas so they can afford to protect their property and to purchase insurance in advance of a disaster. Such a program would reduce the need for disaster assistance following the next catastrophic event.

Mitigation Measures – A disaster management program should encourage those at risk to adopt mitigation measures. However, disasters inevitably involve complex and interdependent risks, and policy makers need to carefully examine public programs to

avoid unintended consequences.

Loss Distribution – The disaster management strategy must consider who is most likely to suffer losses and how the costs are distributed among victims (residents and private organizations), businesses in the private sector that cover some risk (including financial institutions, insurers, and reinsurers), all levels of government (local, state and federal), and the taxpayers.

Relocation of Residents – In determining strategies for relocating residents to other areas following a disaster, policy makers need to consider the economic, psychological, and social effects on victims. The same careful consideration should drive strategies for rebuilding the region (especially the Gulf Coast and New Orleans in the aftermath of Hurricane Katrina).

Governance – Policy makers should devise effective public policies that avoid creating large bureaucracies, establishing complex programs, or incurring excessive costs. The governance system should be transparent, effective, and responsive.

By addressing these underlying principles during the day's sessions, a broad set of recommendations will be developed that can serve as the foundation of the policy debates that will occur next year and beyond. We expect the University of Pennsylvania to continue to be an important contributor to these deliberations.

Lessons from Katrina: Déjà vu all over again

One of the most famous visual images to emerge from Hurricane Camille's strike on the Mississippi Gulf Coast in 1969 was the ruins of the Richelieu Apartment Complex in Pass Christian, MS where, according to legend, 23 people met their fate when they chose to stay for a hurricane party rather than evacuate. While the legend has only a partial basis in fact—there was, apparently, no party and a number of residents survived—for years the vacant lot where the complex once stood remained a tangible reminder of the destructive power of hurricanes. The site remained untouched until 1995, when a decision was made to construct a shopping center at the location. But as if to remind developers who is really in charge, in 2005 Hurricane Katrina replicated Camille's feat: the new complex was again leveled to its foundations.

We spoke to Chad Hirn of the Cress Realty Group (who owns and manages the property), and he was quite optimistic about future prospects for the site. He was not at all worried that the site might be jinxed: "It had been 36 years since the last storm, so once every forty years is not that bad a frequency; storms are just a way of life down here". When asked what the company's future plans were for the location, he indicated that they will likely wait until the coast economy rebounds, then re-build—probably a condominium complex. "Sitting right there on the coast, it is still a great location".



Richelieu Apartment Complex after Hurricane Camille
(note pool at center)



Pass Christian Shopping Center after Hurricane Katrina

Rewiring for Success

By Don Kettl

New Orleans is no stranger to bitter battles with the federal government. The last invasion of federal troops, during the Civil War, produced riots and fires from citizens who felt betrayed.

They christened the occupying federal general, Benjamin Butler, as “The Beast.” A woman who dared laugh during the funeral of a Union officer was sentenced to two years in prison, and for years afterwards even genteel New Orleans ladies used chamber pots lined with pictures of Beast Butler.

So it might not be so strange after all, in the aftermath of Hurricane Katrina, that the sheriff of Jefferson Parish near New Orleans would post armed guards to protect the parish’s emergency communication links from FEMA officials, who had already cut it once.

But the disastrous federal response to Katrina shows that top officials have failed to learn 9/11’s most important lessons. FEMA was hard-wired for failure.

The 9/11 Commission tersely identified the government’s biggest failure before the terrorist attacks as a “failure of imagination.” In Katrina’s wake, top homeland security officials said that they could not have predicted the damage that the storm could bring, even though FEMA in 2001 identified a major flood in New Orleans as one of the top three catastrophes facing the nation. After the water broke through the dikes, top officials said they did not realize the extent of the crisis, even though television viewers around the country had a ringside seat.

Following its move into the new department, FEMA became less capable—less prepared to imagine, to prepare for, and to respond to major disasters. Why? The Bush administration used the best of 1940s technology—the creation of the Department of Defense—as the model for the

biggest problem facing 21st century government.

It was little wonder that the hurricane swamped disaster response by FEMA and DHS. Top officials were barreling down a crowded highway by looking in a rear-view mirror. They seemed to assume that they had the response to natural disasters under control and could push them aside to worry about terrorism.

They saw their job in terms of fixing clear rules and boundaries. They faced a problem that paid no attention to regulations or authority diagrams. The press secretary for Louisiana Governor Kathleen Babineaux Blanco complained, “We wanted soldiers, helicopters, food, and water.” From the feds? “They wanted to negotiate an organizational chart.”

The primary job of DHS and FEMA is a tough one: to plan for the unexpected. The overwhelming nature of Katrina’s damage would have overcome any plan. But as Homeland Security officials gradually realized that their apparatus wasn’t up to the job to be done, people died.

What would it look like to rewire the system for success? Here’s a three-point plan for starters.

First, FEMA should be taken out of the Department of Homeland Security and be made an independent agency again. Katrina proved yet again what disaster management experts have always known: it doesn’t matter whether people are trapped on a rooftop or inside a building because of flood waters, a gasoline explosion, a tornado—or a terrorist bomb. We need an effective emergency response system that is flexible enough to deal with any problem it’s dealt.

Second, FEMA needs to rebuild its tattered partnership with state and local governments. In the 1990s, that was one of the agency’s most important missions. All homeland security issues, whether from terrorism or natural disasters, start as local issues. The unseemly squabbling among the governments involved has to stop.

Third, FEMA needs to rebuild its capacity as orchestra leader. Battles over authority and organization charts can blockade the flow of help in an emergency. Experience shows that FEMA works best when it focuses on performance—making the huge collection of different disaster relief elements work smoothly together—not on trying to insert itself as the top of a pyramid.

Every disaster is different, just as is every symphony. But, like every symphony, disaster response relies on a relatively manageable collection of instruments, from emergency medical services and water to food and shelter. FEMA’s job is putting together the instruments that match what’s needed at the moment—to orchestrate a symphony instead of battling over the baton, to focus on results instead of organization charts.

We need to retool the nation’s emergency response system immediately. The Katrina job will be facing us for months, and it will change constantly along the way. We can’t afford a FEMA handicapped by a failure of imagination or an obsession with command.

Surely terrorists have watched the Gulf Coast embarrassment with glee. There is no time to lose. We can’t afford for FEMA to become the new Beast of New Orleans.

Don Kettl is Director of the Fels Institute of Government at the University of Pennsylvania



More information is available in the September 2005 paper, “The Worst is Yet to Come: Lessons from September 11 and Hurricane Katrina” available online at <http://www.disaster-central.com/Worst%20is%20Yet%20to%20come-Kettl.pdf>.

Energy Infrastructure: Coping with Disasters

By Erwann Michel-Kerjan

Oil and natural gas are the lifeblood of the U.S. economy. Together they account for more than 60 percent of the energy consumed in the United States. How can we best protect such critical services in the wake of disasters, whether natural or terrorist?

The 2005 hurricane season has certainly brought this question to the forefront. About 735 oil and natural gas rigs and platforms were evacuated due to Hurricane Katrina, shutting down an estimated 95% of crude production and 88% of natural gas output in the Gulf of Mexico.

According to the U.S. Department of Energy, two months after Katrina made landfall as a Category 4 hurricane, oil production was still down by 1 million barrels per day; compared to 200,000 barrels two months after Hurricane Ivan (2004). It will be months before we recover full capacity. And it is fair to say that the impacts on the energy infrastructure would have been much more devastating had a major hurricane directly hit a city like Houston, Texas.

Crisis Management: The Strategic Petroleum Reserve

With such destruction, one might expect a direct and long term impact on energy prices. While this is certainly true for natural gas – two months after Katrina, the price of natural gas remained about 35% higher than it was on August 26, 2005 – oil prices have quickly returned to their pre-Katrina levels (after reaching the \$70/barrel threshold). There are several reasons for this (including the quick reaction of European and Middle-East countries to stabilize the market). In the U.S., one instrument has played a major role: the Strategic Petroleum Reserve (SPR). Established in the aftermath of the 1973-74 oil embargo, the SPR provides the President with a response option if a disruption in commercial oil supplies threatens the economy. On August 31, 2005, the President authorized the SPR to lend 12.6 million barrels to affected refineries such as ExxonMobil, Placid Refining, Valero, BP, Marathon Oil, and Total, and to sell 30 million other barrels to

maintain adequate supply levels (the previous largest sale was 21 million barrels during Operation Desert Storm, 1990-91). Oil prices came back to their pre-Katrina levels just two days after the President announced this draw-down, thus limiting global economic impacts.

Who's in Charge?

This series of hurricanes forces us to address policy and strategy issues directly related to the Wharton Risk Center's work and expertise in managing and financing extreme events. Insured losses for Katrina are in the range of \$40-60 billion (see Howard's column), i.e. the most costly event ever in the history of insurance worldwide. More broadly, these major hurricanes (Katrina, Rita, and Wilma, among others) have raised a set of fundamental questions about protection of the nation's so-called critical infrastructure.

The Strategic Petroleum Reserve constitutes a concrete example of fruitful collaboration between the government and the private sector. However, the distribution of the roles and responsibilities in protecting critical services, thus assuring the economic and social continuity of the country, is often a complex issue.

On the one hand, as some 85% of critical infrastructure is operated by the private sector in the U.S., it is very likely that a huge portion of technical expertise, know-how and information on users/consumers is in the private sector as well. This would call for a private market answer to the question of an adequate protection. On the other hand, market forces alone are not always sufficient to induce needed investment in adequate protection. Indeed, the ongoing search for competitive advantage leads firms to seek efficiency gains that result in a loss of resiliency in the face of extreme events whose likelihood and consequences are difficult to predict and for which return on investment for security measures is difficult to measure in the short run.

Additionally, the federal government is supposed to be responsible for protecting the country and organizing a national strategy (considering social costs and

benefits, rather than only the private ones a firm would focus on). But government does not always have the resources, authority or best available expertise to achieve this goal alone. The draft National Infrastructure Protection Plan (NIPP) that was released publicly by DHS this November provides a good illustration. While this plan addresses in detail the "who does what" roles of relevant federal agencies, it does not address the most critical questions: What are the key vulnerabilities of critical infrastructure service providers, their willingness to face the risks of disaster or invest to reduce them? What are public policy tools to give such firms the incentive to become more reliable and resilient while preserving a fair and efficient competitive market for their services? How should public and private stakeholders be made accountable for our national security, and to what extent?

We've addressed some of these issues and suggest concrete ways to tackle them in *Seeds of Disaster, Roots of Response. Who Will Protect the Nation's Critical Services?*, an innovative book that results from a joint initiative between the Wharton Risk Center, Harvard University, and George Mason University (Forthcoming from Cambridge University Press in 2006).

Will 2006 Be Worse?

Economic activities worldwide are increasingly interdependent. If disasters in the United States become more frequent and more devastating than those in 2005 (or 2001 in the case of terrorism and national security), ripple effects will be felt far beyond U.S. borders. Should this happen, we would all be forced to seriously rethink how better to protect and operate our energy infrastructure, here and abroad.

I look forward to working with industry and government partners on these strategic questions. (For more information, contact erwannmk@wharton.upenn.edu.)



Can One Predict the Relative Likelihood of a Low Probability-High Consequence Chemical Accident among Firms Operating Similar Processes?

By Irv Rosenthal

The Risk Center's work on Low Probability-High Consequence chemical process accidents has largely been done under cooperative agreements with the Office of Emergency Management (OEM) of the U. S. Environmental Protection Agency (EPA). The Center has analyzed the occurrence of EPA Risk Management Program (RMP) reportable process accidents and company demographics using data that the approximately 15,000 facilities covered under EPA's RMP regulations were required to file with EPA for the period from the inception of the RMP Rule to the June 20th, 1999 reporting date.

While the Center is currently focused on completing the descriptive work on the 2004 body of 5 year RMP data as called for under its cooperative agreement with OEM, it is clear that the ultimate objective of this descriptive work is to help EPA and regulated companies do a more effective job in preventing process accidents and, failing that, in mitigating the consequences of those that do occur. Over the past year, the Center has done some exploratory research on this prevention objective and has developed hypotheses on tools and approaches for reducing the incidence and consequence of process accidents.

The purpose of this brief note is to update Risk Center members on one specific aspect of this exploratory research, namely, identifying effective facility process safety management systems. We seek your input and guidance on this ongoing exploratory work.

The Risk Center's review of the literature confirmed that most practitioners believe that the underlying "root" cause of a very large majority of all accidents, both the relatively frequent occupational injuries and illnesses (OII) reportable to OSHA, as well as LP-HC process accidents reportable under the Seveso Directives and EPA's RMP regulation, can be

traced to deficiencies in safety management systems. Further, there is general agreement that an appropriate facility safety culture is a necessary but not sufficient prerequisite for effective management systems in regard to preventing both OII and LP-HC process accidents.

However, while there is strong experimental evidence in the literature supporting this culture – safety management system – accident prevention thesis in regard to OII events, this is not the case in regard to LP-HC process accidents. A recent Risk Center working paper on "Predicting and Confirming the Effectiveness of Systems For Managing Low-Probability Chemical Process Risks" describes several instances in which culture changes led to improvements in firms' OII safety management systems, and these management system changes were further reflected in statistically significant lowering of the firms' OII rates.

However, no single facility can easily demonstrate that a similar relationship between cultural and safety management effectiveness exists in regard to process safety because the incidence of RMP process LP-HC accidents of the type reportable to EPA is relatively low, of the order of ≈ 1 reportable incident per process in 25 to 40 years.

In fact, some process safety experts do not believe that OII and RMP accident rates are related. A recent Risk Center working paper demonstrates that this expert opinion may be correct: there appears to be no statistically significant correlation between firms OII and RMP accident rates. One must conclude, therefore, that one cannot rely on OII accident rates to predict RMP rates. Given the relative rarity of LP-HC events, even in a population as large as that covered by RMP, absence of a statistically significant relationship between OII and RMP accident rates should not be taken as definitive proof that no such relationship exists.

Given the inherent difficulties of determining causal factors for LP-HC

events, the approach taken at the Risk Center has been based on using an epidemiological approach in order to identify the characteristics of effective facility LP-HC process safety management plans. More specifically, the Risk Center is considering prospective and retrospective nested case-control studies aimed at corroborating the statistical association of accident frequency and severity outcomes with the results of candidate employee survey tool predictors.

Such studies would involve dividing the population of RMP covered firms into sub-populations with and without a particular type of RMP reportable accident event in a specified time period. Sub-populations would be further divided to arrive at groups of matched facilities with and without specified accidents that are matched as closely as feasible in regard to all of the demographic aspects firms are required to furnish EPA. If RMP data alone is not sufficient for achieving the desired degree of facility matching, additional information could be generated via firm identifiers such as Dun and Bradstreet numbers which are in the RMP*INFO database.

Appropriate administration of the candidate survey instruments is a task that will be difficult to accomplish. One approach for accomplishing this could be through a cooperative effort by EPA, OSHA, unions, and chemical and insurance trade associations that incorporates measures to ensure that while the results on any individual facility were made available to that facility, the results and identity of all other evaluated facilities and responding employees would be kept completely confidential in regard to public disclosure or use in legal proceedings.

Exploratory conversations with stakeholders in industry, unions, and trade associations on achieving the required participation in such an investigation have been encouraging. Reactions and recommendations from Risk Center members would be welcome in this regard. Please contact rosentha@wharton.upenn.edu for the background references.

Food Safety, Insurance and Third Parties Roundtable

By Peter Schmeidler

While the initial focus of the contact between the USDA Economic Research Service (ERS) and the Wharton Risk Management and Decision Processes Center was the use of third parties to enhance regulatory oversight and the public welfare, subsequent discussions between ERS and the Risk Center have suggested that an understanding of insurance industry's current and potential role could lead to a safer food supply. Some questions are posed below that will serve as the basis for an off-the-record Roundtable on December 8th at ERS in Washington, DC.

1. What is the current role of insurance in the area of food related risks? What is the division of risk transfer between insurers and government and are there generally understood policies for this? Can this be better understood from how food safety insurance contracts are written? What parts of the food supply chain are covered? Are environmental factors covered?

2. Why doesn't insurance play a bigger role in food safety? According to Tanya Roberts of ERS, there is an insurance industry model for food safety audits in some Scandinavian countries that may be relevant to the United States.

3. Are there areas of public-private cooperation by engaging the insurance industry that can enhance the safety of the food supply chain?

The role of third party verifiers will also be discussed at the Roundtable. There will be several presentations by the larger certifiers for the food industry. How these certifiers interact with the regulators and the insurers will be examined. Certain voluntary certifications for different food stuffs have been established by the USDA that allow the producer to display a logo on a product to demonstrate that it has

undergone third party oversight. With regard to these certifications, do data exist that can be used to do a quasi-epidemiological study of their benefits? One could potentially use the methodology of a study of ratings of restaurants in the Los Angeles area if a geographical concentration of the distribution of certified product could be identified that will allow a review of health records in the region of interest.

Some areas of the food industry and their relation to its insurers will be presented. Whether this partnership can be enhanced to benefit food safety will be a discussion topic. Additionally, the liability aspects of having third parties as part of the oversight of food safety will be explored.

Roundtable attendance is by invitation only, but if you interested in participating and if you receive the Risk Management Review in time, please let us know by sending an email to pschmeid@wharton.upenn.edu. There may be an opening for you.

“Global Risks”: A New Initiative

The Risk Center's Howard Kunreuther and Erwann Michel-Kerjan, along with Witold Henisz and Steven Kobrin from Wharton, recently joined as experts in a new initiative on “global risks” developed by the World Economic Forum (WEF) in Davos, Switzerland.

The principal objective of the Global Risk Program is to identify and assess key current and emerging “systemic” risks to global businesses, to study the links between these risks, and to assess their likely effect on different markets and industries.

The program was launched in 2004 and is now undertaken by the WEF in collaboration with Merrill Lynch, Swiss Re and Mercer Oliver Wyman (MarshMcLennan). Several other faculty members from the Wharton School are involved as well.

First results will be presented to participants at the annual meeting in Davos, January 2006. The project is envisioned to be a multi-year effort.

Founded in 1971, the World Economic Forum is “an independent international organization committed to improving the state of the world by engaging leaders in partnerships to shape global, regional and industry agendas.”

More info at: <http://www.weforum.org>

Risk Center in the News:

- **Irv Rosenthal** has been named to the BP Independent Safety Review Panel, chaired by former Secretary of State James Baker, that is investigating the Texas City Refinery Incident earlier this year. More information is available online at <http://www.bpresponse.org/go/site/946/>.
- Center Co-Director **Howard Kunreuther** was elected a Fellow of the American Association for the Advancement of Science.
- Center faculty have been interviewed recently by NPR's **Talk of the Nation** and **Capital Report**, the **Christian Science Monitor**, **The Wall Street Journal**, and **The Economist**, as well as several local newspapers and radio programs. **Op-Ed pieces** have been appeared in the **Los Angeles Times** and **The International Herald-Tribune**.

The Future of Terrorism Risk Financing in the U.S.

Who should pay for the economic consequences of a terrorist attack in the United States?

Terrorism risk poses fundamental challenges to our national security that must be seen in a dynamic perspective, as the threat is continuously evolving. One of these challenges is associated with terrorism insurance coverage. Careful research and policy development are needed in the current debate on the future of terrorism insurance to assure economic and social continuity in the case of new terrorist attacks in the U.S.

Since September 11th, 2001, members of the Wharton Risk Management and Decision Processes Center team have been studying the issue of national security and terrorism insurance as part of a longer range Wharton Risk Center project on *Managing and Financing Extreme Events*. In August 2005 the Risk Center published its *TRIA and Beyond* report analyzing the Terrorism Risk Insurance Act of 2002 (TRIA) and, more broadly the future of terrorism risk financing. The report was written by a nine-person team, led by Howard Kunreuther and Erwann Michel-Kerjan, in close collaboration with number of organizations in of public and private sectors. The other authors include Neil Doherty, Esther Goldsmith, Scott Harrington, Paul Kleindorfer, Mark Pauly, Irv Rosenthal, and Peter Schmeidler.

The goal of the *TRIA and Beyond* report is to provide policymakers, key industry representatives, and other interested parties with an analysis of the roles that the public and private sectors can play with respect to terrorism risk coverage in the United States in the post-9/11 world.

The report concludes that there is a role and responsibility for government in collaboration with the private sector to provide protection against the terrorism risk. We favor a temporary extension of TRIA subject to increasing the threshold level for a terrorist act to be certified and including both

domestic and foreign terrorism under the program.

The report concludes that the private-public partnership established by TRIA should be modified so it is more equitable and efficient than the current program. We recommend that consideration be given to other arrangements and policies to deal with catastrophic losses in the long-run. The development of a strategy for managing catastrophic losses needs to be based upon careful analyses of these and perhaps other programs in collaboration with key interested parties.

The United States faces an ongoing threat of terrorism. With the passage of TRIA, Congress and the White House recognized a role and responsibility for both the federal government and the private sector in providing adequate protection against terrorism. Although TRIA has provided an important and necessary temporary solution to the problem of how terrorism insurance can be provided to commercial firms, we do not believe it constitutes an equitable and efficient long-term program.

The challenges associated with terrorism risk financing are clearly fundamental, but they will not be solved overnight. This Wharton Risk Center study on *TRIA and Beyond* provides conceptual and empirical evidence that argues for a modified terrorism insurance program. Such a program would enhance the role that the private sector can play in reducing risk and providing funds for recovery after a terrorist attack while utilizing the public sector to provide financial protection against catastrophic losses.

As an important step in developing such a program, we have urged that Congress or the White House establish a large National Commission on terrorism risk coverage before permanent legislation is enacted. The American public deserves such an initiative given the importance of this issue for national security.

On October 7, 2005, the Risk Center co-organized a National Symposium on the Future of Terrorism Insurance in Washington, DC, with the Rand Corpo-

ration and the University of Southern California. Hundreds of leaders from the public and private sectors attended this conference on Capitol Hill. A set of principles were developed jointly to guide policy discussions on the future of terrorism insurance by the US Congress and leaders from all sectors (http://www.tcil.org/confseries.asp?conf_series_id=8).

In mid-November both the House and the Senate passed bills to extend TRIA. As this newsletter goes to press, it is not clear how the program will be modified, and whether the law that will ultimately be passed will recognize the importance of addressing the question as to what would be the most effective ways for the Nation to prepare for and recover from a terrorist attack. Such an effort calls for the establishment of a more robust commission than either the Senate and House bills currently authorizes. It would enable stakeholders and experts to carefully examine alternative long-term solutions without political pressure. All of us here at Wharton are ready to work closely with whatever commission is formed by bringing our expertise to the table.

An electronic version of *TRIA and Beyond* (224 pages) can be found at:

<http://opim.wharton.upenn.edu/risk/newresearch.html>.

2005-06 Ackoff Award Recipients

This year, the Risk Center introduced the *Russell Ackoff Doctoral Student Awards for Research on Human Decision Processes* to help foster student research in decision processes at Penn. The inaugural recipients of the award are:

Athena Aktpis, Gnana Bharathy, Michael Braun, Peter Desioli, Jennifer Dunn, Noah Eisenkraft, Jeff Larson, Alexander Leeds, Ryan Muldoon, Lakshi Ramarajan, Joseph Redden, Nicole Ruedy, Jacqueline Volkman, and Haitao Yin.

The Corporate Associates program is a vital part of the Risk Center's operation. Corporate Associates sit on the Center's Advisory Committee, participate in roundtable discussions and offer information and insight into the value, direction and timing of research projects.

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Submissions are welcome.

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If you would like to be added to our mailing list, please telephone, mail, email or fax your contact information to the Risk Center (telephone, 215-898-5688; fax, 215-573-2130; email, risk@wharton.upenn.edu).

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Since its creation 17 years ago, the mission of the Wharton Risk Management and Decision Processes Center has been to carry out a program of basic and applied research to promote effective corporate and public policies for low-probability events with potentially catastrophic consequences. The Risk Center has focused on natural and technological hazards through the integration of risk assessment and risk perception with risk management strategies. After 9/11, research activities extended to national security issues (e.g., terrorism risk insurance, protection of critical infrastructure).

Building on the disciplines of economics, finance, insurance, marketing, psychology and decision sciences, the Center's research program has been oriented around descriptive and prescriptive analyses. Descriptive research focuses on how individuals and organizations interact and make decisions regarding the management of risk under existing institutional arrangements. Prescriptive analyses propose ways that individuals and organizations, both private and governmental, can make better decisions regarding risk. The Center supports and undertakes field and experimental studies of risk and uncertainty to better understand the linkage between descriptive and prescriptive approaches under various regulatory and market conditions.

Bringing expertise and a neutral nexus, Risk Center research investigates the effectiveness of strategies such as incentive systems, risk communication, insurance and regulation, in the context of extreme events. The Center is also concerned with training decision-makers and promoting a dialogue among industry, government, interest groups and academics through its research and policy publications and through sponsored seminars, roundtables and forums. A regular Newsletter and Project Snapshots provide an update of Center activities and publications.

Risk Center on the World Wide Web

Visit the Wharton Risk Management and Decision Processes Center's homepage on the World Wide Web at:

<http://opim.wharton.upenn.edu/risk/>