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Risk Management REVIEW



RISK MANAGEMENT AND DECISION PROCESSES CENTER
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For a Sensible Reform of the National Flood Insurance Program

On October 1, 2010, the President signed a one-year extension of the **U.S. National Flood Insurance Program (NFIP)**, which is one of the largest government disaster insurance programs in the world. The program has been in place since 1968 and now covers \$1.23 trillion in assets, mostly in coastal states.

But the program faced unprecedented losses in the aftermath of the 2004-2005 hurricanes seasons. Reforming the operation of the NFIP (views ranging from small changes to discontinuing it altogether), is now being discussed by business and government decision makers.

Surprisingly, little empirical analysis has been undertaken in recent years about this large federal program. Against this backdrop, the Wharton Risk Center decided two years ago to launch a multi-year research initiative that would consist of a series of economic analyses of the NFIP and active participation in the national debate on possible improvements of the program: How does it work in practice? What are its real benefits and shortfalls? What improvements can be made? How do we get there? Our goal: help top decision makers ultimately make decisions based on sound empirical evidence.

Several studies have already been completed by our team. (See our [website](#) for working papers and articles including “[Redesigning Flood Insurance](#)” *Science* (333): 408-409 by Erwann Michel-Kerjan and Howard Kunreuther.) Thanks to strong support we have received from our research partners, several other studies are underway.

We are also exchanging ideas and proposals for reform with key stakeholders, including several committees in the U.S. Senate, the White House, FEMA, local government agencies, the insurance and reinsurance industry, and other experts.

Risk Center managing director, Erwann Michel-Kerjan participated in the public **NFIP Listening Session**, held in December 2010 in Washington, DC. And in April 2011, Howard Kunreuther and Erwann Michel-Kerjan participated in the analysis phase of FEMA’s NFIP reform process, providing input and expert judgment in a panel discussion among academic experts to evaluate policy alternatives which take into account the basic principles that the cost of flood insurance is borne by individuals; individuals incur costs of increased risk gradually; financial assistance is provided to those who cannot afford flood insurance.

The panel was led by **Michael Grimm, NFIP Reform Program Manager, Office of the Deputy Federal Insurance and Mitigation Administrator of FEMA/DHS**. The NFIP Reform Working Group is comprised of a cross-section of mitigation and insurance staff which has been working on the challenge of NFIP reform since March 2010. Following the completion of the policy evaluation phase, the Working Group will provide policy recommendations in support of NFIP reform.

The **National Science Foundation (NSF)** recently awarded a three-year grant to Erwann Michel-Kerjan (Wharton Risk Center) and Carolyn Kousky (Resources for the Future) to undertake an “*Analysis of Flood Insurance Purchases, Claims Filed and Reform Options for the National Flood Insurance Program*.”

Benefitting from unique access to the entire portfolio of the National Flood Insurance Program (NFIP), the research team’s goal is to improve flood risk management in the United States. The research is composed of work in three complementary areas: understanding flood insurance decision making by individuals; measuring the effectiveness of flood risk mitigation measures; and evaluating reform options. Findings will have broad

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significance to other catastrophic risks and the role that the public sector can play through the adoption of more effective risk management strategies.

We are also promoting knowledge exchange on flood insurance, for instance, by bringing this topic to the **American Risk and Insurance Association (ARIA)**, with a policy session on “*Reform of the NFIP*” developed and moderated by Erwann Michel-Kerjan at ARIA’s annual meeting in August 2011 in San Diego, California.

In the **U.S. Congress**, **Rawle O. King, Analyst in Financial Economics and Risk Assessment** has proposed a **Capstone project** entitled: “*Encouraging Flood Insurance Purchase and Individual Investment in Mitigation by Modifying the Structure of the National Flood Insurance Program*” which will be led by the Risk Center team. The information in the Capstone report will be used in a CRS report for members of Congress and their staff seeking additional information on NFIP policy.

Findings from the Risk Center’s studies are also being disseminated widely as Issue Briefs. The non-technical briefs present empirical findings together with the research team’s best thinking on how the concepts can be applied to the management of catastrophic risks. Two such issue briefs this year include: “*How long do homeowners keep their flood insurance: An analysis of insurance tenure under the National Flood Insurance Program*” and “*Who’s paying and who’s benefiting most from flood insurance under the NFIP? A financial analysis of the National Flood Insurance Program.*”

Properly improving flood insurance in the United States will not be accomplished overnight. Doing so in a sustainable manner will require a much better understanding of the issue than we have today. It will also take a dose of leadership in Washington to find the right balance between increased economic efficiency of the program and equity (thus, political feasibility), in order to create a series of recommendations which have a good chance to be implemented. Data-driven applied research can help here. We will continue to take a leadership role in that important space.

The NFIP is up for renewal, again, on September 30, 2011.

AWARDS FOR BOOKS!

At War with the Weather was selected by the [American Risk and Insurance Association \(ARIA\)](#) to receive their **Kulp-Wright Book Award**. The award is presented annually by ARIA to the most influential text published on the economics of risk management and insurance. The book contains findings of the Risk Center’s multi-year project on “Managing and Financing Extreme Events,” and offers a coherent strategy to ensure sustainable recovery from future large-scale disasters.



AT WAR WITH THE WEATHER: Managing Large-Scale Risks in a New Era of Catastrophes

by Howard Kunreuther and Erwann Michel-Kerjan, with Neil A. Doherty, Martin F. Grace, Robert W. Klein and Mark V. Pauly

www.AtWarWithTheWeather.com

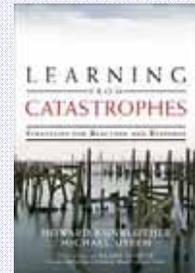
paperback, September 2011.

Learning from Catastrophes was named one of the “Top 10 Books of 2010 for Risk Managers” by [Risk Management Monitor](#), and to the list of “Best Business Books” in 2010 by [Strategy + Business magazine](#).

LEARNING FROM CATASTROPHES: STRATEGIES FOR REACTION AND RESPONSE

Howard Kunreuther and Michael Useem, editors
Foreword by Klaus Schwab, Founder and Executive Chairman, World Economic Forum

www.ftpress.com



Wharton Risk Center Issue Brief

How long do homeowners keep their flood insurance coverage?



An analysis of insurance tenure under the National Flood Insurance Program

Many people who live in flood-prone areas do not have flood insurance, even when it is required as a condition of their mortgage.

The Wharton Risk Center’s analysis of more than 40 million NFIP flood insurance policies from 1978 to 2009 reveals that the median tenure of flood insurance in the United States is 2 to 4 years.

Risk Center issue briefs are on the web at <http://lopim.wharton.upenn.edu/risk/issuebriefs.php>

Long-Term Contracts and Short-Term Incentives for Managing Catastrophic Risks

by Howard Kunreuther, Co-Director, Wharton Risk Management Center; James G. Dinan Professor; Professor of Decision Sciences & Business and Public Policy, Kunreuther@wharton.upenn.edu

Individuals tend to focus on short time horizons when making their decisions. This behavior has particular significance when it comes to developing strategies for managing catastrophic risks where there is a need to engage in long-term thinking.

To highlight this point, consider the decision making process with respect to investment in protective measures for reducing losses from natural disasters. Most homeowners are not willing to incur the upfront costs associated with risk reducing measures because they focus on the benefits accruing to them over the next couple of years rather than over the expected life of their property.

Behavior with respect to the purchase of insurance follows an even more extreme pattern. Relatively few individuals insure against catastrophic risks voluntarily prior to a disaster often because they perceive the likelihood of suffering a loss as sufficiently low that it is below their threshold level of concern. Following a flood or earthquake, individuals are interested in protecting themselves against future disasters and decide to purchase insurance; however, many cancel their policies after several years if they have not suffered another loss during this period.

Insurance is currently sold as a one-year contract. This creates unnecessary volatility and might also be why many individuals let their insurance policy lapse very quickly. A detailed analysis by Erwann Michel-Kerjan, Sabine Lemoyne de Forges and myself of the entire data base of the National Flood Insurance Program from 2001 to 2009 reveals that the average tenure with respect to flood insurance policies is 2 to 4 years, even though most of these homeowners were required to have coverage as a condition for a federally insured mortgage.

The dual problem of volatility of insurance premiums combined with homeowners' failure to properly insure against future disasters, suggests that the design of insurance contracts needs to be modified from one-year contracts to multi-year policies.

To determine whether there would be a demand for multi-year insurance policies, the Wharton Risk Center recently conducted a controlled experiment where subjects had opportunities to purchase one-year

contracts, two-year contracts or no insurance against the risk of a hurricane causing damage to their property. The demand for two-year contracts was more than twice as high as for one-year insurance policies, even when one-year contracts were priced at the actuarially fair premium and the two-year contracts were priced either 5 percent or 10 percent higher than its actuarial risk. The findings suggest that if insurers offer a multi-year policy with stable premiums there will be considerable interest by individuals in purchasing this coverage.

Changes in the flood risk over time may occur and should be considered in determining what premiums should be charged for multi-year coverage. New building, such as malls or housing developments could lead to more runoff from storms, thus increasing the flood risk in riverine areas. In addition, climate change is likely to impact sea level rise and increase storm surge from more intense hurricanes. Similarly, if the U.S. Army Corps of Engineers decommissions certain levees that are not providing sufficient protection from floods, this also needs to be reflected in flood insurance rate changes. On the positive side, updated risk maps may reveal that certain areas are less prone to flooding than had previously been thought, in which case rates should reflect this decreased risk.

To deal with changes in risk over time due to natural phenomena as well as more careful study and mapping of hazard-prone areas, we propose that flood premiums be reviewed by a credible scientific body every five years. Appropriate changes in flood insurance prices should reflect these new estimates.

The National Flood Insurance Program (NFIP), a federally-run insurance program, offers an opportunity to change how insurance is currently structured. At the same time, the Federal Emergency Management Agency (FEMA), which operates the program, should ensure that other features of the program are enforced so as to reduce future losses.

The attached side bar proposes six key principles for rethinking insurance in the context of a risk management program for reducing future flood losses and addressing the issue as to who should pay for damages after they occur.

Six Principles for Managing Flood Risk More Efficiently and Equitably

- Flood insurance premiums should reflect risk so that individuals are aware of how safe they are, and to enable premium reductions to be given to those who invest in risk reduction measures.
- Insurance vouchers (similar to food stamps) should be provided to those currently residing in flood hazard areas who need financial assistance to pay for insurance and/or to preserve property values should there be an unexpected change in the flood risk, such as a levee being decommissioned.
- Flood risk maps must be accurate and updated regularly to determine how risky certain flood areas are, and whether levees are sufficient to protect communities against riverine flooding and storm surge from hurricanes.
- Multi-year loans for mitigation measures should be offered in conjunction with multi-year flood insurance policies. These loans should be tied to the property, not the individual. The annual premium reduction is likely to be greater than the annual cost of the loan, thus providing short-term financial incentives to invest in protection.
- Banks and financial institutions must ensure that those who are required to purchase flood insurance as a condition for a federally insured mortgage maintain their coverage.
- Building codes and land-use regulations must be enforced to reduce future flood losses.

We need bold leadership for developing long term strategies for dealing with low-probability, high-consequence events. If Congress authorizes a study that examines these and other proposals when the NFIP comes up for renewal in September, we will have taken a major step forward in setting a tone for addressing the challenges of managing catastrophic risks.

What We Know (and Don't Know) about Hurricane Preparedness Decisions: Evidence from Real-Time Surveys

by Robert Meyer, Co-Director, Wharton Risk Center; Gayfryd Steinberg Professor of Marketing, meyerr@wharton.upenn.edu

Here is a short quiz to test your knowledge about how coastal residents make decisions to prepare for hurricanes. For each statement below, indicate whether you believe that it is either “true” or “false.” Give yourself one point for each correct answer.

1. By and large, when storms threaten, residents are overly optimistic about the odds that their home will be not hit by hurricane winds.
2. Friends and neighbors are a major source of information about storm facts and when to start preparing.
3. When hurricanes threaten, most residents prefer to ride out the storm in place; as such, the percent who choose to evacuate tends to be less than the percent who are ordered to do so.
4. When hurricane warnings are issued, most residents who own storm shutters put them up.

If you answered “false” to each statement your score is 100%. But if you answered “yes” to one or more you would not be alone. Each of the above statements represents a bit of “street wisdom” that often arises in both academic and lay discussions of hurricane risk perception, with some being so obvious—such as the importance of friends and neighbors as sources of information—they have barely seemed worth testing.

That is, until now. During the 2010 hurricane season, the Wharton Risk Center began a program of collaboration with researchers at **Florida State University** and the **University of Miami** to conduct the first-ever “real time” surveys of how residents in threatened coastal areas think, feel, and act as hurricanes approach their homes. Although 2010 was a relatively quiet year for storms—only one (Earl) seriously threatened the coast—the surveys of residents in North Carolina and Massachusetts affected by Earl suggested that we may know far less than we think about how residents perceived hurricane risks and respond to them. Should 2011 bring a more serious string of landfalls, the research team is in place to begin a new wave of data collection.

The logic of the Hurricane Earl surveys was simple. Prior to this past year, almost all of the information we have had about hurricane response has come from field surveys conducted *after* storms have passed, when memories of perceptions and actions have likely faded. To gain a less biased view of residents’ responses to the storm, we began conducting phone surveys of 637 coastal residents at six-hour intervals up to 72 hours *before* the storm would likely make landfall—a time interval sufficient both to measure how risk perceptions changed over time as *objective* information about the threat was disseminated by the National Hurricane Center, and—perhaps more critically—how and when these risk perceptions were translated into preparatory actions. Although Earl never made landfall, in many respects it ended up being a textbook storm for such survey responses: a major (category 4) hurricane that threatened distinct geographic areas.

Many of the findings of the surveys were surprising. For example, when people were asked to state the likelihood (probability) that their home would be hit by hurricane force winds of 75mph or more, the average stated odds were in almost all cases considerably *higher* than the objective odds provided by the National Hurricane Center—a finding that went against the grain of long-standing beliefs that people tend to be overly optimistic about threats.

To illustrate, 48 hours before Earl was to make its closest approach to the Outer Banks, respondents believed, on average, that there was a 45% chance that their homes would experience hurricane-force winds at some point from the storm. The actual odds according to the National Hurricane Center at the time, however, were only 15%. How did this translate to preparedness? Here responses were even more puzzling. On one hand, consistent with an elevated fear of the storm, almost 20% of respondents indicated that they planned to evacuate from the storm, even though only 15% believed that they were in an evacuation zone. On the other hand, of the 20% of respondents

who indicated that they owned storm shutters, only 1% indicated that they were putting them up—suggesting limited actual fear of the threat. Why the mismatch? One possibility is that while residents believed that they were in for a 75mph (or more) storm, they also believed that such a wind would be insufficient to merit the time and effort to required to put up (and later take down) shutters, but sufficient to induce inconveniences such as lost power, sand-clogged roads, etc.—inconveniences to be avoided if at all possible by leaving.

To what degree were these responses driven by social norms? Apparently very little, it seemed. When asked where they got their most recent information about the storm, less than 1% indicated that it was from friends and neighbors; almost all relied on external information conveyed over the television (83%) or Internet (8%). Moreover when asked in general to what degree they turned to friends in neighbors as an information source for either storm facts or preparation, almost 40% indicated “none at all.” For North Carolinians responding to Earl, deciding how to respond to the threat was very much a solitary endeavor, a surprising finding that runs counter to what one often reads in textbooks about the centrality of social information flows in advance of storms.

These findings (hence our quiz answers), of course, come with a major caveat: as serious a threat that Earl may have been at the time, it was a storm that was never forecast to make landfall in a heavily populated area, and, in fact, imposed little damage on the Outer Banks and Nantucket. Were Earl to have made a direct bead on a major city such as Charleston, Miami, or New Orleans—when evacuation could have been a matter of life-or-death—some of the findings may have been quite different.

As the 2011 season gets underway, the Wharton-FSU-UM team is positioned to replicate the real-time Earl survey the moment a major storm again threatens the coast—while hoping that the opportunity will be delayed for yet another year.

Toward a Better Understanding of Household Hurricane Evacuation Timing

by Jeffrey Czajkowski, Wharton Risk Center Travelers and Willis Re Research Fellow, iczaj@wharton.upenn.edu

June 1 marked the beginning of the 2011 hurricane season with the U.S. National Oceanic and Atmospheric Administration (NOAA) forecasters initially predicting 12-18 named storms, 6-10 hurricanes, and 3-6 major hurricanes. This above-normal predicted hurricane activity (seasonal average of 11 named storms, 6 hurricanes, and 2 major hurricanes) follows on the heels of the third most active hurricane season on record in 2010 (with 19 named storms) and has forecasters urging coastal residents and emergency managers to be especially prepared, including planning for evacuations. Moreover, the recent historic natural disasters in the U.S. – flooding and tornadoes – as well as the earthquake and tsunami in Japan have served to further highlight the significance of proper disaster preparation and evacuation planning.

However, as noted in a recent *New York Times* article focused on evacuation, “the science behind herding thousands, sometimes millions, of people from danger to safety is uncertain at best” (Harris, 2011). Unfortunately this element is applicable in regard to hurricane evacuations: people may leave too soon and potentially incur substantial unnecessary costs, or people may leave too late and be exposed to heightened costs and the potential for higher risks associated with not getting out in time. Given population growth, the potential for casualties in high hurricane risk coastal areas has been rising significantly in recent decades. A better understanding of household hurricane evacuation decision making over time is essential to reduce hurricane fatalities and costs of evacuation.

In order to address this limited understanding about evacuation timing, I have developed a dynamic economic model of hurricane evacuation behavior over a typical five-day forecast period. As hurricane forecast advisories are issued every six hours, the objective of the model is to predict for each issued forecast advisory period an average household’s optimal choice of either evacuating, or waiting one more time period for a revised hurricane forecast. From an economic perspective this optimal evacuation choice over time has households trading-off the costs of immediate evacuation, such as hotel lodging costs or lost income, against the expected value of waiting to observe new forecast information.

The difficulty in the decision trade-off lies in the fact that the expected value of waiting for another hurricane forecast may be higher or lower all the way up to the eventual forecasted landfall due to the inherent uncertainty in the forecast in terms of the storm’s track, intensity and timing, and its associated affect on the costs of evacuation. For example, if one waits another period for an additional forecast and that additional forecast shows the storm intensifying as well as coming closer to their particular location, it would have been better to evacuate earlier to avoid the increased costs of congestion.

Likewise, if one chooses to evacuate during the current forecast period rather than waiting for the additional forecast which has the storm weakening or moving away from one’s location, incurring the costs of immediate evacuation may have been at the least too high if not completely unnecessary.

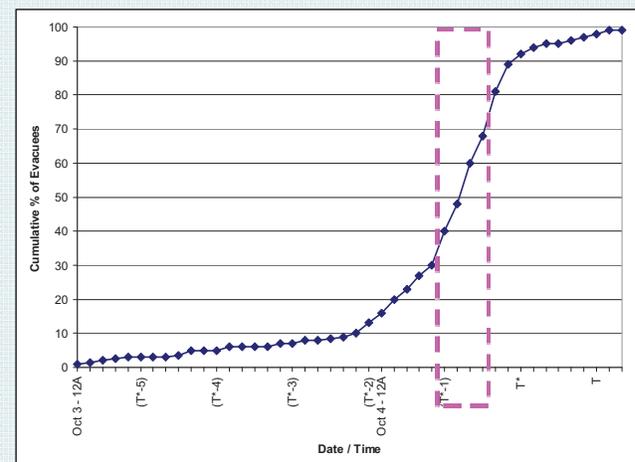
The model is calibrated with this probabilistic forecast data from a number of storms, observed evacuation cost data for evacuees, as well as expected injury/fatality cost data for non-

evacuees. Hence, the dynamic framework reflects a realistic multi-period evacuation scenario incorporating existing forecast and evacuation cost data in order to explain actual evacuation behavior for the designated Gulf of Mexico region.

For example, Figure 1 illustrates the cumulative evacuation timing outcomes for relevant coastal Alabama and northwest Florida counties from Hurricane Opal in 1995, which made landfall as a category 3 major hurricane in Pensacola, FL. We see from Figure 1 that the average (50th percentile) evacuee in these locations left twelve hours prior to landfall (the model’s designated (T^*-1) period), and the multi-period results from the model for these locations does in fact predict and simultaneously offer an economic explanation for this relatively late evacuation timing response.

Of course, not all evacuees left during this timeframe, and the model results can begin to offer explanations as to why, by flexing the relevant associated model inputs such as increasing the costs of not evacuating for high damage household types. Consequently and most significantly, the dynamic framework can be used to explore a number of relevant policy questions that plausibly affect the timing of household evacuations, sometimes providing the rationalization for seemingly counter-intuitive post-storm assessment evacuation results. For example, why does implementing contra-flow (the reversal of lanes which are normally configured for travel in one direction) actually cause some households to be less likely to evacuate? Since implementing contra-flow effectively lowers the rate at which costs of evacuation increase over time due to more lanes being available for evacuation purposes, only from a dynamic economic model perspective can one see that this provides the incentive for cost-minimizing households to wait for more forecast information over time as opposed to wanting to leave earlier as the contra-flow policy is intended to do.

Figure 1. Adapted Cumulative Evacuation Timing, Hurricane Opal



Source: Adapted from <http://chps.sam.usace.army.mil/ushesdata/Assessments/opal/Opal-frame.htm>

References: Harris, G. 2011. “Dangers of Leaving No Resident Behind,” *New York Times*, March 21.

2001-2011: 10 Years of Research on Terrorism Insurance Markets

by Erwann Michel-Kerjan, Managing Director, Wharton Risk Management Center, erwannmk@wharton.upenn.edu

With about \$37 billion in insured losses (2011 prices), the terrorist attacks of September 11, 2001 (9/11) remain the most costly man-made disaster in the history of insurance and second only to Hurricane Katrina among all insured disasters worldwide.

The shock of 9/11 first led insurers and reinsurers to stop covering this risk almost everywhere around the world or, when they did, charge a very high price for it. In the United States, by early 2002, 45 states permitted insurance companies to exclude terrorism from their corporate policies, leading to a call for some type of federal intervention.

A joint public-private program, TRIA (Terrorism Risk Insurance Act), was established at the end of 2002, creating a new terrorism insurance market

in the United States. TRIA provides free upfront reinsurance to insurers with the goal of encouraging availability of terrorism insurance, and will ensure that losses are spread widely across national and international insurance markets and the federal government, rather than being borne by the victims themselves. TRIA has been renewed several times and is set to expire at the end of 2014.

While no new attacks were successfully perpetrated on U.S. soil since 2001, attacks in Madrid (2004), London (2005) and Mumbai (2011), near-misses such as the bombs loaded in UPS and FedEx cargo in November 2010, and possible retaliation to the killing of bin Laden earlier this year, indicate that terrorism threats will remain with us for a long time to come.

Our team at the Wharton Risk Center has been very active in improving knowledge on terrorism insurance markets since 2001. In 2004 Howard Kunreuther and I published [*Challenges for Terrorism Risk Insurance in the U.S.*](#) (*Journal of Economic Perspectives*) in which we proposed ways to establish a sustainable program. The two of us, along with Dwight Jaffee at UC Berkeley, were the three U.S. representatives serving on the *OECD Terrorism Insurance Task Force* between 2003 and 2004, which produced an authoritative report providing an international perspective on the topic in 2005. That same year, the Wharton Risk Center released the report, [*TRIA and Beyond*](#), in conjunction with the

Center's industry partners, which focused specifically on the United States. This report has been considered by many to be the most comprehensive study on the topic.

From 2006 to 2011, we produced a series of new empirical studies thanks to a unique access to data on commercial insurance purchases. In [*Puzzling evidence from terrorism insurance markets*](#), published in the *Journal of Applied Corporate Finance* (2006), Burkhard Pedell and I showed that insurers charge much more for terrorism insurance in France, Germany and the U.K. than they do in the United States; this is still the case today. Insurance penetration varies highly across countries: from a low 10 to 15 percent in Germany where coverage is voluntary, to virtually 100 percent in France, where it is required.

In the United States, corporate demand for terrorism insurance rose from only 23 percent at the beginning of 2003 when TRIA had just been introduced, to 60 percent in 2006. Demand has remained stable since then, demonstrating that this public-private partnership has achieved its primary goal of increasing financial protection to make America economically more resilient in the aftermath of future terrorist events. ([*2001-2010: Evidence from a Decade of Terrorism Insurance Markets in the United States: Proceedings of the 2010 OECD International Conference on Terrorism, 2011.*](#))

We are also interested in measuring large corporations' sensitivity to terrorism insurance price. Benefiting from a research partnership with Marsh, one of the world's leading insurance brokers, Paul Raschky, Howard Kunreuther and I conducted an in-depth analysis of more than 1,800 of large corporations headquartered in the U.S. In that study, [*Corporate Demand for Insurance*](#), 2011, we find that the demand is fairly price inelastic—that is, an increase in terrorism insurance price would not significantly decrease the demand for it. Another finding is that smaller companies are more likely *not* to purchase terrorism insurance, maybe because they don't have the budget to pay for it or because they don't feel they are a primary target. But those smaller companies

might actually be the ones that will have a harder time raising capital in the aftermath of an attack, which obviously poses important business and policy question as to whether they will need to be rescued by taxpayers.

We also accessed data on the supply side (i.e., insurers providing terrorism insurance coverage to large corporate clients). Our interest is to learn whether the free reinsurance provided to insurers by the federal government under TRIA has had an impact on insurers' portfolio diversification strategy. In [*The Effects of Government Intervention on The Market For Corporate Terrorism Insurance*](#), published this spring in the *European Journal of Political Economy*, Paul Raschky and I found evidence that insurers in the U.S. are indeed much less client-diversified for terrorism coverage than they are for property lines of coverage (wind, flood). Whether this is a decision made purposefully by insurers or results mainly from market forces, is a matter of interest to many stakeholders.

Better understanding how people and firms perceive terrorism risks and act upon them, measuring who has insurance and who doesn't, and how the demand and supply sides of this new market interact with each other is critical. Taken together, these studies encompass a structured

research program which now provides a lot of empirical evidence that can be used in current and future debates about the role and responsibilities of the public and private sectors in providing and purchasing adequate financial coverage against the economic consequences of future attacks, here and abroad.

Benefiting from a research partnership with Marsh, one of the world's leading insurance brokers, we analyzed data on over 1,800 large corporations headquartered in the U.S.

During the past ten years we have discussed the results of these studies with top decision makers in corporations, insurers and reinsurers, trade associations, intelligence services, risk modeling firms, presidents of the national terrorism insurance programs and with governments of OECD member countries, including the U.S. Congress and the White House. I look forward to more collaborations with our research partners and encourage anyone to reach out to me about this work.

Estimating the Operational Impact of Container Inspections at International Ports

by Nitin Bakshi (London School of Economics), Stephen E. Flynn (Center for National Policy), and Noah Gans (Wharton School), gans@wharton.upenn.edu

Each year, ocean-going vessels transport millions of shipping containers to the United States. These containers provide terrorists with a potentially attractive way to hide a nuclear device destined for U.S. shores. If such a device were to be successfully smuggled and detonated, the results would be disastrous. In addition to lives lost, the consulting firm Abt Associates estimates that the detonation of a nuclear device in a port could lead to losses in the range of \$55-\$220 billion. Even if it were not detonated, the successful smuggling of a nuclear device into a U.S. port has the potential to disrupt global supply chains: anxiety that other containers may contain nuclear devices would result in stepped-up inspections that would cause congestion throughout the global intermodal transportation system.

U.S. Security initiatives in place at international ports

To counter this threat of nuclear terrorism, the United States has initiated various security measures, both at domestic and at foreign ports. Two important security measures implemented at international ports, the Container Security Initiative (CSI) and the Secure Freight Initiative (SFI), seek to detect the presence of nuclear devices in shipping containers at overseas ports, *before* such a container is loaded onto a vessel bound for the United States.

CSI, a program administered by U.S. Customs and Border Protection (CBP), uses an automated targeting system that employs rules-based software to identify containers that are at risk of being tampered with by terrorists. A key input to this system is the container's shipping manifest, which contains information about the container's sender, recipient, and contents. CBP mandates that an ocean carrier transporting a container to the U.S. provide manifest information to CSI officials at least 24 hours prior to the container's lading onto the vessel. Manifests and other data are analyzed at CBP's National Targeting Center in Arlington, Virginia, and containers that are identified as suspect are flagged to be

* **Nitin Bakshi** (London School of Economics) was an Ackoff Doctoral Student Fellow of the Risk Center while earning his PhD at Wharton. **Stephen E. Flynn** (Center for National Policy), and **Noah Gans** (Wharton School) are Senior Research Fellows of the Risk Center.

Our study is based on detailed data on the movement of more than 900,000 containers at two of the world's largest international container terminals.

inspected by the local customs authority at the port of origin, before they are shipped to U.S. ports. These customs officials typically use gamma or high-energy x-ray radiography and hand-held, mobile, or stationary radiation detection technology to screen the high-risk containers and ensure that they do not contain a nuclear weapon or radiation dispersal device.

SFI is a joint initiative of CBP, the U.S. Department of Energy, and the U.S. Department of State. Its purpose is to leverage learning from other port security initiatives, such as Operation Safe Commerce, and to serve as a pilot for a system that might be capable of scanning 100 percent of U.S.-bound containers. Under SFI, all U.S.-bound containers arriving at participating overseas seaports are scanned with both non-intrusive radiographic imaging and passive radiation detection equipment placed at terminal entrance gates. Optical Character Recognition is used to identify containers and classify them by destination. Sensor and image data gathered through this primary inspection is then transmitted in near real time to the National Targeting Center in Virginia. There, CBP officials incorporate these data into their overall scoring of the risk posed by containers and target high-risk containers for further scrutiny overseas. Any container that triggers an alarm during primary inspection is automatically deemed to be high-risk and undergoes a more sensitive inspection.

One-hundred percent scanning requirement

A 2007 U.S. law, "Implementing Recommendations of the 9/11 Commission Act of 2007," popularly called the 9/11 Commission Act, requires that, before *any* cargo bound for the United States is loaded onto a ship at an international port, it must be scanned to detect radiological contraband. The deadline for compliance with this law is

July 1, 2012, unless the Secretary of Homeland Security grants extensions, which can be offered in two-year increments. This law is a significant deviation from CBP's CSI approach of scanning only cargo it identifies as being high-risk, and the operational feasibility of 100 percent scanning has been questioned by a wide range of participants in the maritime supply chain: CBP and European customs officials, trade associations such as the U.S. Chamber of Commerce and the National Association of Manufacturers, and corporate leaders. The most commonly expressed concern is that this security requirement will generate congestion which will increase the cost of doing business and hurt commerce. In the face of this resistance to the legislative protocol, DHS Secretary Janet Napolitano has already indicated that she intends to grant a two-year extension.

Benefits and costs of 100 percent scanning

An obvious goal of 100 percent container scanning is to detect and neutralize any nuclear weapons and to curb the illegal movement of radiological material. A stringent security regime also serves to deter terrorists from attempting to infiltrate the maritime supply chain in the first place. A less obvious benefit is associated with disaster recovery. In the case that an unfortunate event were to occur, it would be imperative to identify the stage in the global supply chain at which the security breach occurred. The images and scan information gathered through 100 percent scanning would provide vital information to facilitate this task.

At the same time, there are three broad ways in which the 100 percent scanning requirement may be detrimental to trade. First, if there is limited scanning and radiation detection capacity, then delays resulting from waiting in inspection queues could require containers to sit idle at ports. Second, even with adequate equipment, the scheme could generate more alarms than there is human inspection capacity to resolve, and the result would again be delays as containers wait in inspection queues. Finally, the diversion of containers from

Under the Container Security Initiative (CSI), containers undergo inspection upon arrival to the terminal, before they are placed in the stacks.

to identify the stage in the global supply chain at which the security breach occurred. The images and scan information gathered through 100 percent scanning would provide vital information to facilitate this task.

(Continued on page 8)

(Continued from page 7)
 their usual movements within terminals, through a centrally-managed government inspection facility, has the potential to engender significant terminal congestion. No matter what the source of the problem, these extra delays would lead to increases in transportation lead times, higher inventory levels in supply chains, and ultimately higher costs for consumers.

Evaluating the impact of 100 percent scanning on terminal operations

Given the economic importance of maritime trade, a rigorous quantitative analysis of the impact of 100 percent scanning on container terminal operations is critical for policy makers, as well as for companies with an economic interest in the efficient movement of containers within the international supply chain. Our 2011 *Management Science* article, “Estimating the Operational Impact of Container Inspections at International Ports,” reports the results of just such an analysis.

Our study is based on detailed data on the movement of individual containers collected from two of the world’s largest international container terminals. Among other features, these datasets mark the entry and exit times of every container passing through each of the terminals over the course of one month, along with an indication of whether or not the container is bound for the U.S. Between the two ports, we have movement records for more than 900,000 containers.

We use these historical records as the basis for a simulation analysis that estimates the effect of a number of inspec-

tion protocols on terminal operations. The simulations provide us with insights into the impact each protocol may have on three key attributes of the inspection schemes: the transit delays that would be incurred by inspected containers, the additional real estate the terminals would need to stage in-process containers, and the average the handling cost per container.

Results and implications

Our simulation suggest that a variant of the SFI inspection scheme, that we refer to as an “Industry-Centric” inspection scheme, is capable of being scaled up to satisfy the scanning and radiation detection requirement mandated by the 2007 U.S. law. Its use of rapid screening by relatively low-cost drive-through portals allows it to handle 100 percent of all container traffic – bound for the U.S. as well as other destinations – on a cost-effective basis. In turn, the relatively small percentage of containers that fail this rapid primary inspection can be scanned in a cost-effective manner by more sensitive drive-through equipment. In contrast, the current CSI protocol would face significant hurdles were it to be scaled up to scan more than a small fraction of U.S.-bound container traffic.

The economy and robustness with which the Industry-Centric scheme operates follows, in large measure, from the type of equipment used. The current CSI protocol relies on highly sensitive high-energy x-ray radiography to scan containers that are thought to pose a potential threat. This is a time-consuming procedure. In contrast, the Industry-Centric inspec-

tion scheme performs a rapid initial scan of 100 percent of inbound traffic with lower-cost drive-through radiation and medium energy x-ray radiographic portals. While this equipment is less sensitive than that used under CSI, it is precise enough to verify the safety of the vast majority of containers, thereby reducing the demand on more sensitive inspection equipment.

Our results clearly imply that the equipment and inspection protocol used in the Industry-Centric scheme are relevant in guiding the choice of the appropriate inspection regime for international ports.

Furthermore, a qualitative analysis of the two schemes’ logistical requirements also suggests that disruptions to terminal operations would be much more severe under CSI than the Industry-Centric approach. Under the CSI scheme, containers targeted for inspection must be pulled from a terminal’s storage stacks only hours before the time at which they normally would be retrieved for their vessel loadings. This disrupts the highly optimized sequence in which terminals order yard cranes’ movements within the stacks. Under the Industry-Centric scheme, in contrast, targeted containers undergo inspection upon arrival to the terminal, before they are placed in the stacks. Thus, the Industry-Centric inspection regime avoids the disruptions and delays that would follow from the early removal of even a small fraction of containers from the terminal’s stacks.

This contribution is a based on the authors’ article, “Estimating the Operational Impact of Container Inspections at International Ports.” Management Science, Vol. 57, No. 1, January 2011, pp. 1–20.

Comparison of the CSI and SFI Protocols

	CSI	SFI
Percent of Containers Inspected	Inspects about 5% of U.S.-bound containers based on manifest information	Inspects 100% of containers, U.S.-bound as well as bound for other destinations
Process Flow	Containers are moved from stack to inspection facility 24 hours before scheduled departure	Containers inspected upon arrival at terminal and then taken to stack
Technology Used	Handheld scanners for passive radiation detection; High energy x-ray scanners for nonintrusive imaging	Portal monitors for passive radiation detection; Gamma ray radiography for nonintrusive imaging; Optical character recognition to record container ID
Equipment Location	In the interior of the terminal or at an off-site location	At terminal entrance
Cost per Inspected Container	Approximately \$110	Approximately \$15

Ongoing Involvement with DHS Homeland Security Center of Excellence at USC

The Homeland Security Act of 2002 granted the **Department of Homeland Security** the authority to create university-based **Centers of Excellence**. The Centers, chosen by the Department's Science and Technology Directorate through a competitive selection process, bring together leading experts and researchers to conduct multidisciplinary research and education for homeland security solutions. Each Center is led by a university in collaboration with partners from other institutions, agencies, laboratories and the private sector to provide cross-cutting technology and basic research needs for DHS and the nation. The Wharton Risk Center is a partner of the **Center for Risk and Economic Analysis of Terrorism Events (CREATE)**, at the **University of Southern California**, which develops tools to evaluate the risks, costs and consequences of terrorism, and guides economically viable investments in countermeasures that will make our nation safer and more secure. The Risk Center has recently completed two projects with CREATE; a third project is underway.

Experiments in Interdependent Decision Making Under Uncertainty

Interdependent security (IDS) research investigates the behavior of individuals and groups in situations of uncertainty. In research supported by the **U.S. Department of Homeland Security** through the **Center for Risk and Economic Analysis of Terrorism Events (CREATE)** the Wharton Risk Center undertook several studies involving controlled laboratory experiments on individual and group behavior, performance of alternative decision rules, and design of risk management strategies.

Punishment and Cooperation in Stochastic Social Dilemmas

Erte Xiao (Carnegie Mellon University)
Howard Kunreuther (Wharton School)

Experiments investigated how punishment affects cooperation in a two-person stochastic social dilemma environment where each person can decide whether or not to cooperate and the outcomes of alternative strategies are specified probabilistically. The findings provide useful information for designing efficient incentive mechanisms to induce cooperation in a stochastic social dilemma environment.

Why Do Groups Cooperate More than Individuals to Reduce Risks?

Min Gong (Columbia University; Ph.D. in Psychology 2009, University of Pennsylvania; Wharton Risk Center Ackoff Doctoral Fellow),
Jon Baron (University of Pennsylvania)
Howard Kunreuther (Wharton School)

Previous research found that groups cooperate less than individuals in a deterministic prisoner's dilemma game but cooperate more than individuals when uncertainty is introduced into the game. We conduct two studies to examine three possible processes that may have driven groups to be more cooperative than individuals to reduce risks: group risk concern, group cooperation expectation, and social pressure.

A Framework for Computational Strategic Analysis with an Application to Repeated Interdependent Security Games

Steven O. Kimbrough (Wharton School)
Howard Kunreuther (Wharton School)
Eugene Vorobeychik (University of Pennsylvania)

This project developed 14 strategies for iterated 2x2 IDS games and implemented them in new software written for [NetLogo](#) for conducting strategy tournaments in 2x2 IDS games. The software program, [IDS-experiments.nlogo](#), can represent and support play in any IDS game, regardless of payoffs. NetLogo is freely available and runs on all common computing systems (including applets on the Web). See <http://opim.wharton.upenn.edu/~sok/AGEbook/nlogo/IDS-2x2-Tournaments.nlogo>

Enhancing Post-Disaster Economic Resiliency

The **U.S. Department of Homeland Security** has awarded a five-year renewal grant to **CREATE** to contribute to the security of the United States. As one of USC's partner institutions, the Wharton Risk Center's contribution on "Enhancing Post-Disaster Economic Resiliency," will provide the first empirical analysis of corporate demand for insurance coverage of catastrophic and non-catastrophic risks and quantify the key factors that explain which corporations are more likely purchase terrorism insurance. (See page 6.) Based on these results, the Risk Center will examine the practical application of solutions that could incentivize insurance purchase so as to reduce federal relief post disaster. The Risk Center will also analyze individuals' decisions to purchase flood insurance, a risk over which DHS has management responsibility.

National Academies of Science

The **National Academies**, through its **National Research Council**, is conducting a study on "Increasing National Resilience to Hazards and Disasters." Howard Kunreuther is a member of the NRC committee which organized a conference in January, 2011 in the Gulf Coast region in the New Orleans-Biloxi area on mitigation/adaptation to hazards and disasters.

The workshop provided information as to why some communities are less resilient than others, and what can be done to increase resilience in conjunction with government authorities and the private sector. The Committee has traveled to other locations (Cedar Rapids, Iowa and Irvine, California) to hear from stakeholders concerned with tornados, floods and earthquakes. They are now writing their report as the study draws to a close with an anticipated publication date in early 2012. The summary of the Gulf Coast workshop is available at http://www.nap.edu/catalog.php?record_id=13178. For additional information, see <http://www8.nationalacademies.org/cp/projectview.aspx?key=49259>.

The Penn Symposium on Fostering and Financing Long-Term Investments in Prevention and Protection

The cascade of catastrophic events that has marked the start of the twenty-first century — natural disasters, pandemics, looming health care budgets — has brought to the forefront the need for innovative approaches to minimize the risk and/or impact of such events. Within the domain of health care, the importance of preventive action has long been well known, and this same importance is increasingly recognized in property-loss management, where rapidly escalating annual losses from natural disasters in recent years have underscored the need for long-term investments in structural mitigation.

Yet, as transparent as the benefits of preventive investments may be, they have been difficult to enact. In the same way that it is often difficult to persuade patients to adhere to regimes of preventive care, homeowners and communities are also often loathe to make pre-emptive investments in mitigation that would make their residences and businesses more sustainable.

To foster cross-learning in how these challenges are currently being addressed in different fields, the Wharton Risk Center, the **Wharton School**, the **Penn School of Medicine** and the **Leonard Davis Institute** organized the [Penn Symposium on Fostering and Financing Long-Term Investments in Prevention and Protection](#) on December 13-14, 2010.

Over 40 scholars, public policy analysts, and practitioners discussed the challenges posed by long-term prevention and how these challenges might be overcome. Participants presented new research, and discussed mechanisms that might encourage planning for future catastrophic losses (in both health and property) even when decision makers act myopically. Among these innovations are multi-year insurance products that offer guaranteed renewability and provisions that provide greater stability in future premiums, as well as ways to attach insurance coverage and mitigation/prevention investments to property assets which persist over time, even as ownership and insurance firms change frequently.

A key aim of the conference was the creation of new interdisciplinary research projects to be considered for seed funding by the Wharton Risk Center and Leonard Davis Institute.



Paul Kusserow, SVP and Chief Strategy Officer of Humana, Inc. gave the keynote on ways that Humana is fostering prevention. People have difficulty changing health behaviors because doing so requires trade-offs

between immediate consumption and delayed and often intangible benefits.

Humana is encouraging healthy behavior through a program of incentives, accountability and information. For example, Humana's Personal Health Allowance offers lower copays to members who participate in healthy behaviors and/or clinical programs.



Robert Meyer (Wharton), conference co-director, led the group in brainstorming new interdisciplinary research projects. **David A. Asch, MD (Penn Medical School)**, **Howard Kunreuther (Wharton)**, and **Mark Pauly (Wharton)** served as academic co-directors for the conference.



Eric Nelson, VP of Risk Management for Travelers, noted that FEMA estimates that for every \$1 spent in mitigation, future loss costs are reduced by \$4.

To encourage homeowners to mitigate their homes, Travelers offers a discount of up to 35 percent on premiums for homes qualifying for the [Travelers Fortified Home Program](#). Better land use requirements are also essential components of a comprehensive mitigation strategy.



From left: **Klaus Wertenbroch (INSEAD)**, **Dan Goldstein (London Business School and Yahoo)**, **Gal Zauberman (Wharton)** and **Punam Keller (Dartmouth)**.



Debra Ballen, General Counsel and Senior Vice President of Public Policy of the [Institute for Business & Home Safety](#), presented a [video demonstration](#) of IBHS' state-of-the-art, multi-risk applied research and training facility in Chester County, South Carolina.

The IBHS "Storm Lab" can simulate a variety of disaster conditions, such as Level 4 hurricane winds, to study the effectiveness of disaster-resistant building materials and design features.

Findings from the lab will also provide an objective, scientific foundation for improved public policy, such as enhanced building codes.



The house on the right incorporated several low-cost risk mitigation measures, including doors that open outwards, not inwards.

Effective Corporate Leadership and Governance Practices in Catastrophe Risk Management

Are firms that have experienced a catastrophe more likely to prepare for future adverse events than those that have not experienced such a loss in the past?

Are firms in industries where there has been an active dialogue among company leaders and government officials about managing exceptionally adverse risks more likely to be more proactive in managing extreme risk than companies in other industries without such dialogues?

Are Boards of Directors more proactive in catastrophe risk management today than five years ago?

In interviews with **CEOs and Chief Risk Officers of S&P 500 companies**, the project directors of **Effective Leadership and Governance Practices in Catastrophe Risk Management** are learning that a company's "near-death" experience may be the wake-up call it needs to prepare for future catastrophes.

The research study is a joint venture between **The Travelers Companies, Inc.**, the **Wharton Risk Management Center**, and the **Wharton Center for Leadership and Change Management**, as part of the **Travelers/Wharton Partnership for Research on Risk Management and Leadership** launched in 2010 with funding from Travelers.

Catastrophic risks include natural hazards, operational risks and other threats such as financial risks, disease pandemics, and disruptive technologies. The research project is intended to help identify and understand effective company governance and executive practices in the private sector for preparing for catastrophic risks and responding to large-scale disasters.

The project is one **of the first to examine catastrophic risk management practices in corporations**, and in this sense will be a significant contribution to advancing the field, with a number of complementary research papers. The study will tie benchmarks based on the interviews and data analyses to concepts to risk assessment, biases/choices processes used by S&P 500 firms and risk management strategies.

The study is particularly concerned with the actions that executives and directors take in building and sustaining effective practices to reduce the likelihood and consequences of catastrophes, and how other companies can learn from such experiences to better prepare their own practices for anticipating and responding to extreme events.

Project directors **Howard Kunreuther**, **Erwann Michel-Kerjan**, and **Michael Useem** anticipate that outcomes will include both basic research analysis and practical policy guidelines for large companies worldwide that may face extreme hazards.

Ultimately, the project will:

- Develop a framework for understanding how firms make decisions regarding catastrophic risks
- Highlight the diversity of processes firms have utilized both prior to and after catastrophes to build and sustain effective practices to reduce the likelihood and consequences of future catastrophes
- Test specific hypotheses regarding firm behavior
- Using lessons learned, develop benchmarks for other companies to better manage catastrophic risks based on our understanding of firm behavior
- Provide guidelines and make specific recommendations for ways that the private and public sectors can work together to manage catastrophic risks more effectively

In addition to interviews, the project team is analyzing publicly available data, such as the S&P Insurance Industry Enterprise Risk Management Report, independent ratings from credit rating agencies and other sources, proxy statements, SEC filings (including 10-Ks for Risk Factors and Disclosures about Market Risk), and financial history.

The project is guided by an Advisory Board that includes:

- **The Travelers Companies, Inc. (Chair)**
- **Bank of America**
- **IBM**
- **Merck & Co., Inc.**
- **Governor Tom Ridge, U.S. Secretary of Homeland Security, 2003-05**
- **Simpson Thacher & Bartlett LLP**
- **Paul Slovic, President, Decision Research**
- **Swiss Reinsurance Company**

ITEM 1A. RISK FACTORS

The risks described below could materially and adversely affect our business, financial condition, or results of operations, either directly or indirectly, and may be more severe than those currently known to us or those that we do not currently consider to be material.

General economic conditions could impact our business adversely in various respects.

A slowdown in the U.S. economy or other economic conditions affecting disposable consumer income, business conditions, fuel and energy costs, consumer debt levels, lack of available credit, interest rates, and other factors could adversely affect our business by reducing overall consumer spending or by causing customers to shift their spending to products sold by us that are less profitable than other product choices, all of which could result in lower sales and lower profitability. The current global economic uncertainty, the impact of realignments of financial institutions and the related impact on available credit may impact our suppliers and our ability to access liquid funds. Other risks include the bankruptcy of our suppliers or landlords, and other impacts, which we are currently unable to fully anticipate.

Our profitability is vulnerable to cost increases, inflation and energy prices.

Future increases in our costs, such as the cost of merchandise, shipping rates, freight and fuel, could reduce our profitability. These cost changes may be the result of inflationary pressures, changes in operating costs, including changes in energy prices, wage rates and other factors, and other factors that could reduce our profitability. For example, increases in the cost of energy could increase our overall operating costs and possibly lower our profitability.

Form 10-K: Item 1A. Risk Factors
[Securities and Exchange Commission](#)

Roles for Third Parties in Improving Implementation of EPA's and OSHA's Regulations on the Management of Low-Probability, High-Consequence Process Safety Risks

In late October 2010, a massive oil refinery near Elizabeth, New Jersey sent plumes of fire into the air, visible for miles around. The fire was intentional, part of an emergency response to reduce pressure from a fuel backup that had occurred from an unexplained power failure. The plant is located just off the New Jersey Turnpike and employs over 800 workers. "The potential for an explosion was there," the fire chief said. Fortunately, there was no explosion and no one was injured. But the power failure and resulting fuel backup and fire are reminders of the extreme risks involved in certain industries.

Underlying the public cries for better or increased inspections that often follow an industry disaster or near-disaster is a fundamental problem of virtually every regulatory agency and regulated industry: the number of regulated firms far exceeds the resources of agencies to inspect those firms.

In November, just weeks after the New Jersey refinery incident, the **Wharton Risk Center** co-hosted a workshop with the **Penn Program on Regulation** to address a potential solution to the perennial resource shortage: using third party inspections to reduce the risk of accidents and disasters in regulated industries.

The day-long workshop, entitled "Roles for Third Parties in Improving Implementation of EPA's and OSHA's Regulations on the Management of Low-Probability, High-Consequence Process Safety Risks" brought together researchers, government officials, representatives from non-governmental organizations, and industry experts, including Risk Center corporate partners, **FM Global** and **Willis Re**.

The workshop grew from a series of studies on the feasibility of third party inspections conducted by **Isadore "Irv" Rosenthal**, a senior research fellow at the Risk Center, and his colleagues at the Center beginning over a decade ago. (A background paper is available at http://opim.wharton.upenn.edu/risk/library/WP2010-10-01_IR_ThirdPartyRoles.pdf.)

The studies note the effectiveness of third party inspections with regard to boiler and pressure vessel regulations: Almost every state in the U.S. requires annual inspections of pressure vessels. Firms normally purchase insurance against

boiler accidents, and boiler accidents are rare. The aim is to explore ways this protocol can be extended to other industries.

The first of the workshop's three panels focused on the distinct challenges of using third party inspectors. For example, who pays for the inspection? If the company pays, can the company's relationship with the inspector be set up in a way that avoids a conflict of interest? What is the relationship between the third party and the regulatory agency, particularly in light of the fact that the third party has no inherent authority to enforce the regulations?

The second panel examined incentives for insurance companies to act as third party auditors of a facility's compliance with safety regulations to encourage firms to reduce their safety risks. Specifically, firms that take steps to reduce risk can be rewarded with lower insurance premiums. Private sector institutions (for example, banks) can also play a role, such as by requiring insurance as a condition for a mortgage. **Howard Kunreuther**, who facilitated the panel, noted, "Because individuals tend to focus on short-term horizons and often regard potential disasters as below their threshold of concern, well-enforced multi-year insurance contracts that include short-term economic incentives are needed."

The third panel focused on the challenges associated with integrating third party audits into a larger system of process safety regulation. Many of the same challenges facing third party inspectors

also confront government inspectors, such as how to determine how well a company manages its overall process safety system over time.

"The challenge of regulation is daunting," explained **Cary Coglianese**, Edward B. Shils Professor of Law and professor of political science at the University of Pennsylvania, director of the Penn Program on Regulation, and Wharton Risk Center senior fellow. "Therefore, you have to look at innovative alternatives. Third party auditing is a prime candidate." He noted, however, that third party audits also can pose their own challenges.

Despite the challenges to deploying third party inspectors to increase safety, Rosenthal remains optimistic. Given that the United States is faced with decreasing resources for regulatory enforcement, he said, it seems likely that firms will need to be encouraged to assist in the process of keeping themselves within the law.

For more information, contact Cary Coglianese at cary_coglianese@law.upenn.edu and Irv Rosenthal at rosenthal@wharton.upenn.edu.



Cary Coglianese and Irv Rosenthal organized the conference to introduce and discuss proposals to improve OSHA's and EPA's implementation of their respective process safety regulations.



Erwann Michel-Kerjan (Wharton Risk Center); Don Nguyen (Siemens Energy, Inc.); Mike Marshall (OSHA); Cary Coglianese (University of Pennsylvania Law School); Howard Kunreuther (Wharton Risk Center); Bob Whitmore (OSHA - retired); Irv Rosenthal (Wharton Risk Center); Jim Belke (U.S. EPA); Laurie Miller (American Chemistry Council); William Doerr (FM Global Research); Scott Berger (American Institute of Chemical Engineers); Manuel Gomez (U.S. Chemical Safety Board); Tim Cillessen (Siemens Energy, Inc.); Mike Wright (United Steelworkers); Jennifer Nash (Northeastern University); Michael Perron (Willis Re).

Near-Misses: New Techniques for Dynamic Risk Assessment

The imperative to prevent fatalities as well as avert huge economic losses which may jeopardize companies' existence have increased the need for methods to more effectively identify near-misses which are often indicators of future accidents.

In April 2011, the Wharton Risk Center, together with the **Chemical and Biomolecular Engineering Departments of the University of Pennsylvania and Drexel University** received a three-year **NSF Collaborative Research grant** to study "*Synergistic Improvement of Process Safety and Product Quality Using Process Databases*" under the NSF's Grant Opportunities for Academic Liaison with Industry (GOALI) program.

Led by **Ulku Oktem (Wharton Risk Center)** and **Warren Seider (University of Pennsylvania)**, the research will develop and introduce new methods for dynamic risk assessment of chemical plants, investigating challenges to: (1) efficiently handle large and complex event trees associated with alarm databases; (2) systematically conduct near-miss utilization and management to develop leading indicators; (3) introduce and test a new Bayesian analysis method; (4) develop a method of identification of special causes from available process information at each time instant; (5) develop a method of predicting possible near-future accidents from available process information at each time instant; (6) efficiently handle the alarms associated with highly correlated variables; and (7) introduce a computationally-efficient method for estimating profit losses associated with near-misses.

Prototype software will be developed to test the new techniques and to perform dynamic risk analysis. The methods will be implemented and tested on several industrially important processes through simulations and in real-time at **Air Liquide Research and Development** in Newark, DE. These new methods will permit more thorough risk analyses utilizing large dynamic databases, thus, safer chemical plants. The new risk-assessment techniques and software will be available to the chemical process industries and in design and control courses at universities. The proposed work is multidisciplinary in nature involving chemical engineers, risk analysts, and statisticians. While the project focuses on near-misses and failure probabilities in processing plants, these techniques can be easily utilized in other industries/organizations, such as the aviation, healthcare and nuclear industries.

These studies build on the investigators' earlier work that developed a mathematical model to estimate the failure probabilities of various critical accident scenarios associated with a chemical process given abnormal events and accident precursor data. Using large amounts of alarm data recorded in plants, and improving upon the existing technologies in the field of quantitative risk analysis, the Wharton, Penn and Drexel research team developed new methods for estimating performance indicators and leading indicators of shut-downs ("trips") and accidents to assist process operators and management in recognizing near-misses and making adjustments to improve their process safety and reliability, and prevent the occurrence of dangerous and costly incidents. Findings have been published in the *American Institute of Chemical Engineering Journal*:

Dynamic Risk Analysis Using Alarm Databases to Improve Process Safety and Product Quality: Part I – Data Compaction

Dynamic Risk Analysis Using Alarm Databases to Improve Process Safety and Product Quality: Part II – Bayesian Analysis

For more information, contact Ulku Oktem (Risk Center Research Fellow), at Oktem@wharton.upenn.edu.

Wharton Initiative for Global Environmental Leadership (IGEL)

The **Initiative for Global Environmental Leadership (IGEL)** at Wharton works to support a sustainable business paradigm through research, partnerships and education. Over the past year, the Wharton Risk Center and IGEL, under the direction of **Eric Orts, Guardsmark Professor, Legal Studies and Business Ethics** and senior research fellow of the Wharton Risk Center, have collaborated on several programs focused on risk and the environment.

As members of IGEL's faculty advisory committee, Howard Kunreuther and Erwann Michel-Kerjan, co-director and managing director of the Risk Center, provided insights on IGEL's annual conference workshop – this year on business challenges and opportunities in growing water scarcity – and IGEL's Knowledge@Wharton report on water risks for business. (A copy of this report, sponsored by the **Xerox Corporation**, is available at <http://environment.wharton.upenn.edu/newresearch.html>.)

The Risk Center also teamed with IGEL and the **U.S. Department of Energy** on grant initiatives and the **Alliance for Research on Corporate Sustainability (ARCS)** 2011 Conference, held at Wharton.

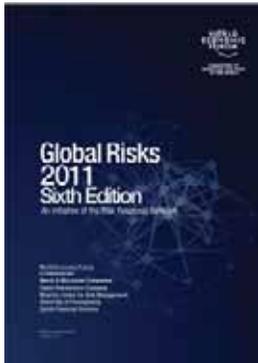
This practical and useful focus on businesses' environmental risks has inspired meaningful research and conversations amongst IGEL's corporate sponsors. IGEL benefits from partnerships with corporations at the forefront of environmental risk management and corporate social responsibility. **Altria, BASF, the Coca-Cola Company, Dow, GE, Merck, SAP, Shell, and United Water** are members of IGEL's Corporate Advisory Board.

These organizations are pursuing environmental risk management in a variety of innovative ways, for example, pursuing broader water portfolios (United Water), new technology developments to reuse water (GE), water efficiency in product manufacturing (Coca-Cola), metrics to measure and encourage sustainable water use (**the Nature Conservancy**), the inclusion of water risk in investment decisions (**Goldman Sachs**), and scientific ability in recycling and reuse (**Dow**). IGEL is partnering with **Bank of America** to deliver an environmental speaker series in conjunction with **Wharton's Global Alumni Forums**, and with **SAP** to deliver an Executive Education program in business and the environment. All of these companies are contributing to a better business environment by sharing knowledge and resources to help solve the most pressing environmental issues of our time.

The Risk Center and IGEL will continue to collaborate as IGEL plans events for the next academic term: a special event on sustainable careers, attendance at the Wharton Energy Conference, and IGEL's conference-workshop in May 2012, where the tentative theme is on environment, business and supply chain management.

For more information please contact IGEL director Eric Orts at ortse@wharton.upenn.edu or associate director Joanne Spigonardo at spigonaj@wharton.upenn.edu.

World Economic Forum's Global Risks Report 2011



Economic disparity and global governance failures are central risks in the global risk landscape, exacerbating and driving a range of other risks. The **World Economic Forum's Global Risks 2011, Sixth Edition** has identified economic disparity and global governance failures as central risks in the global risk landscape, exacerbating and driving a range of other risks. The report identifies economic imbalances and unfunded liabilities as containing the seeds of potential future fiscal and financial crises and urges concerted coordinated action to manage them.

Global Risks 2011 identifies a number of underlying risks that contributed to and were exacerbated by the financial crisis and global economic downturn. The report highlights three risk clusters of particular concern:

- The relationship between illicit trade, crime, corruption and state fragility
- A set of interconnected risks (including climate change) tied to water, food and energy
- Risks related to global macroeconomic imbalances

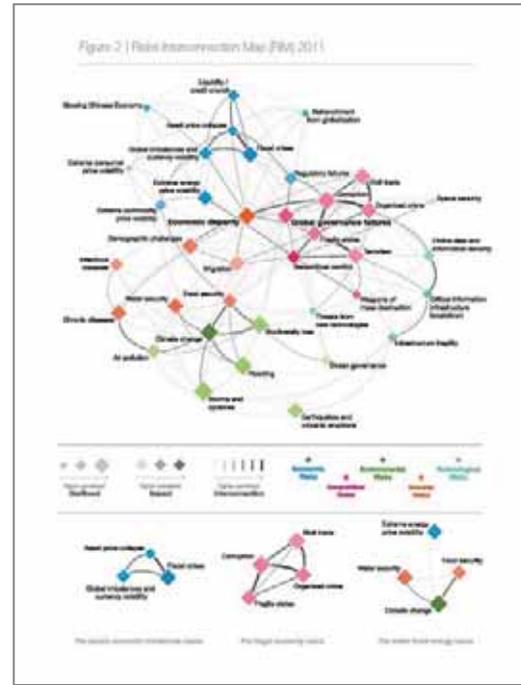
In addition to these three clusters of risk, *Global Risks 2011* identifies five emerging risks to watch:

- **Cybersecurity:** the new frontier for controlling information, from hackers and massive service failures to the little-understood possibility of cyberwarfare between nation states
- **High population growth:** in fragile, resource-constrained countries, population growth may result in "population cluster bombs," increased violence and state collapse
- **Resource scarcity:** limits on commodities, water and energy put stringent limits on growth and create conflict hotspots
- **Retrenchment from globalization:** as economic inequality grows, a backlash against globalization could fracture economic and political integration
- **Nuclear and biological weapons threats** are of renewed concern in a fragile world

Produced in cooperation with **Marsh & McLennan Companies, Swiss Reinsurance Company, the Wharton Risk Center** and **Zurich**, the report draws on the insights of 580 expert respondents to the Forum's Global Risks Survey 2010 across stakeholder groups and regions, measuring perceptions of risk likelihood, impact and interconnections for 37 global risks over a 10-year time horizon.

The Wharton Risk Center has been the academic partner of the World Economic Forum since 2005. Risk Center directors Howard Kunreuther and Erwann Michel-Kerjan, who lead this Wharton initiative, attended the World Economic Forum's annual meeting in meeting in Davos in January 2011.

World Economic Forum's Global Risks 2011 Risks Interconnection Map



Source: **World Economic Forum, 2011**
An interactive version of the Risks Interconnection Map is available at <http://riskreport.weforum.org/>

Risk Response Network

The **World Economic Forum** has recently created the **Risk Response Network** (<http://www.weforum.org/community/risk-response-network>) to bring a new approach to addressing the complexity of risk that leaders are facing and help enable them to avoid the downsides of risk and capture the upsides. The Risk Response Network will build a community of company and country risk officers, develop an overarching framework within which the Risk Officers Community will operate, and facilitate cross-sector collaboration.

A flagship effort of the Forum's Risk Response Network, the **Leading Practices Exchange** aims to bring together broad-based expertise from across the Forum's industry, government and thought leadership communities. The LPE platform will be set up as a peer-to-peer platform to facilitate the exchange of insights on mitigation and response to external risks affecting organizations. This will be done via the presentation of case studies, ongoing discussions and the sharing of insights, via connecting in person meetings and also supported by a virtual community environment.

Faculty of **Harvard University's Kennedy School of Government**, the **Wharton Risk Center** and the **Wharton Leadership Center** are among those involved in the initiative.

Rebuilding Haiti's Schools

The death toll of the 2010 earthquake in Haiti was to a great extent due to poorly designed buildings. After observing the terrible loss of life, the **Global Risk Network**, at the urging of the **World Economic Forum's Global Agenda Council on Humanitarian Assistance 2010** began to look at the achievable goal of improving the construction of schools.

In defining a program for disaster mitigation and earthquake risk management in any country, the structural integrity of the nation's schools has time and again proved to be a matter of critical importance. As part of the initiative to make schools more seismically resistant, the Risk Center's report, "[Mitigating Earthquake Damage for Schoolchildren: Four Case Studies](#)" draws on examples such as the Field Act of 1933 to make schools in California safer from earthquakes (triggered by the 1933 Long Beach earthquake), as well as examples of the failures of schools in recent earthquakes in other countries.

Agricultural Insurance in Argentina

The Risk Center and research partners are examining interdependencies among Argentinian farmers with regards to groundwater and land use, particularly issues of interdependence among farmers sharing a shallow water table. Also of interest is the status of agricultural insurance in Argentina. Project partners include **Columbia University**, **Manhattan College**, and the **University of Miami**.

Chile Looks for Solutions

Chile's massive earthquake in February 2010, has spurred the Chilean government to investigate new strategies to protect itself against low probability, high consequence events. In May 2011, the **Ministry of Finance of Chile** hosted this year's **Government Borrowers Forum (GBF)** organized by the **World Bank Treasury**. The GBF is an annual forum for senior representatives of official-sector issuers in the capital markets to share debt management strategies and experiences. Erwann Michel-Kerjan addressed senior debt managers from about thirty-five countries on the theme of *Expanding Risk Management Solutions for Sovereigns*. Among the topics discussed: What contingent liabilities do governments face, and what are sovereign debt managers doing to plan for them?

The **OECD Secretary-General Advisory Board on Financial Management of Catastrophes**, chaired by Wharton's Erwann Michel-Kerjan, responded to Chile's request to discuss options for mitigating earthquake risks and how best to alleviate the financial burden borne by the government after an earthquake, by organizing a high-level roundtable with 35 leading international decision makers, ambassadors and heads of insurance programs at the OECD headquarters in Paris in June 2011.

A key component of the roundtable is the case-study of the **2009-2012 Mexican MultiCat bond program**. The development of this solution is analyzed in "[Catastrophe Financing for Governments](#)" a joint initiative of the **Wharton Risk Center**, **OECD**, and the **World Bank**.

World Economic Forum Summit on Middle East and North Africa 2010 Navigating Risk in an Interdependent World

Strong risk interconnections, such as those between energy security, water scarcity and underinvestment in infrastructure expose the Middle East and North Africa (MENA) to internal and external shocks.

At the **World Economic Forum's** summit in Marrakesh on October 27, 2010, Erwann Michel-Kerjan (Wharton Risk Center managing director) served as an expert on a panel among world leaders discussing proposals to address catastrophic risk in the MENA region. The objective: to arrive at innovative solutions through "open source" collaboration.

In a unique synergy, **students representing Wharton MBA clubs from the MENA region** (Africa, Arabia, Israel) participated in the event live via video link. The question before them: *What can policy makers/business leaders/civil society/academia do to foster systemic resilience vis-à-vis evolving global risks?* Following a break-out discussion, they reported back to audience of over 60 members of the World Economic Forum. Among their recommendations: Appointees to the proposed position of National Risk Officer should be government leaders who are already well-known and trusted by the populace of the respective countries.

More information about the Summit can be found at:

<http://www.weforum.org/en/events/WorldEconomicForumontheMiddleEastandNorthAfrica/index.htm>



Wharton MBA students from the MENA region took part in the World Economic Forum's Summit on the Middle East and North Africa via live video link. During the session, they refined key proposals submitted by Forum experts according to their feasibility, and addressed the Forum on actions necessary to implement the proposals.

(Africa): Fatima Abdulla, Olumide Adebayo, Sameh Mohi el deen, Aymen Adam Mohib, Tembwe Mutungu, Abiodun Sanusi
(Arabia): Anthony Haddad, Mehdi Khachani, Fahad Najam, Alain Saade, Talal Salman, Saleh Shaya, Salma Zahr
(Israel): Dan Barak, Kosta Breydo, Asaf Horesh, Gilad Raichshtain, Shauli Rozen

New Post-Doctoral Fellows and Visiting Scholars

The Risk Center is delighted to welcome our postdoctoral researchers and several visiting scholars to our research team. They are among the nexus of people — over 50 faculty, fellows and doctoral students — devoted to furthering the practical understanding of how to manage situations of risk involving safety and the environment, economics and finance.

Post Doctoral and Research Fellows



Jeffrey Czajkowski

Jeffrey Czajkowski is assistant professor of economics at Austin College in Sherman, Texas. Currently on leave while he conducts research on

environmental economics and the economics of natural hazards, he serves in a dual role at the Wharton Risk Center as the **Travelers Research Fellow** and **Willis Re Research Fellow**.

Jeff holds an M.S. in Environmental and Urban Systems, and a Ph.D. in Economics from Florida International University (FIU). Through September 2009 he was recognized as an adjunct assistant research professor at FIU's International Hurricane Research Center, where he was awarded two National Oceanic and Atmospheric Administration Florida Hurricane Alliance research grants.

At the Wharton Risk Center, Jeff directs research on understanding household hurricane evacuation timing. Much of the decline in U.S. hurricane fatalities since 1950 is attributed to improvements in hurricane forecasts and warnings which have allowed for more timely evacuations from storm-surge zones. This research will develop a dynamic economic model of hurricane evacuation behavior over a typical five-day forecast period. The objective of the model is to predict for each issued forecast advisory period an average household's optimal choice of either evacuating, or waiting one more time period for a revised hurricane forecast. Because hurricane forecasts inherently have a large amount of uncertainty, the model will be tested using data from a number of storms, observed evacuation cost data for evacuees, as well as expected injury/fatality cost data for non-evacuees.



Dena Gromet

Dena Gromet received her Ph.D. in Psychology from Princeton University in 2009, where she was a Woodrow Wilson Scholar.

As a graduate student, she conducted research at the RAND Corporation as a Summer Associate in 2008. For the last two years, Dena has been a Postdoctoral Fellow for the MacArthur Foundation Law and Neuroscience Project, investigating perceptions of risk in the context of personal health outcomes.

Dena's research is primarily concerned with investigating how people react to harmful events and behaviors. She has published articles and books chapters on what factors influence people's responses to criminal harms and injustices, and their support for punitive and restorative methods of responding to these events.

In her role as **Travelers Postdoctoral Fellow** at the Risk Center, Dena will investigate people's responses to catastrophic events and their aftermath, including judgments of risk people make about such events, their reactions towards those affected by catastrophes (both individuals and entities), and their judgments about fair and just compensation following catastrophes. The consideration of possible negative outcomes (particularly outcomes which are outside of a person's control, such as natural disasters or terrorist attacks) will likely elicit both cognitive and affective reactions. Her research will investigate how such reactions can lead people to make sub-optimal insurance decisions, and what types of interventions can improve risk-related decision-making.



Chieh Ou Yang

Chieh Ou-Yang has been the **Willis Re Postdoctoral Fellow** at the Wharton Risk Center from 2009-2011. Chieh received his Ph.D. from the

Wharton School, focusing on insurance and risk management. While at Wharton, he was awarded a **Russell Ackoff Doctoral Student Fellowship** for his research on "*Parimutuel Insurance for Hedging against Catastrophic Risks*." Before attending Wharton, he studied at Hong Kong University of Science and Technology, which he now joins as faculty.

Chieh's research interests focus on catastrophic risk management and asset pricing, especially alternative risk transfer instruments such as financial derivatives and insurance-linked securities, which are designed to hedge against catastrophic risk. More specifically, he evaluated the performance of catastrophe bonds with alternative risk transfer instruments to determine conditions under which hybrid trigger catastrophe bonds have less basis risk than other non-indemnity (or index-based) trigger mechanisms while eliminating moral hazard. Chieh has investigated both analytically and through simulations the impact that climate change will have on the magnitude of claims with and without adaptation measures in place. He has developed an analytic solution to this problem and, using empirical data from property in the Caribbean island of St. Lucia, has evaluated systematically how climate change is likely to affect premiums charged by insurers if they issue long-term contracts. He has also evaluated the positive role that adaptation can play in reducing their claim payments under such an arrangement.

Visiting Scholars



Jingqiu (Claire) Chen (China)

Visiting: October 2010-July 2011

Claire Chen is Assistant Professor, Organization Management Department, Antai College of Economics and Management, Shanghai Jiao Tong University. Her research interests are judgment and choice, happiness and subjective wellbeing, cultural psychology, and organizational behavior. She is currently studying the influence of Chinese thinking styles on judgment and decision making through a grant from the National Natural Science Foundation of China. At the Wharton Risk Center, Claire is collaborating with Risk Center faculty to study the efficacy of multi-year homeowner insurance contracts in China.



Barbara Klimaszewski-Blettner (Germany)

Visiting: April - Sept. 2010

Barbara Klimaszewski-Blettner is a recent Ph.D. of Ludwig Maximilians Universität's Institute for Risk and Insurance Management, Munich, Germany. Her work focuses on economic aspects of public-private partnerships in catastrophe risk management. She is undertaking an empirical investigation examining property insurers' responses to catastrophic events, comparing the reaction among personal and commercial lines, and working on an experiment on the demand for multi-year insurance against catastrophic risk. Following her stay at Wharton, she became the Executive Assistant and chief of staff to Dr. Werner Zedelius, Board of Management of **Allianz SE**, coordinating projects and preparing research on industry relevant topics.



Diemo Urbig (The Netherlands)

Visiting: November 2010

Diemo Urbig received his Ph.D. in management science from Radboud University, Netherlands in 2010, and holds a degree computer science from Humboldt University. His research focuses on economic and managerial psychology, especially individual decision-making and learning under risk and uncertainty. Using economic experiments as well as survey and secondary data, he studies perceptions of and preferences over structures of risk and uncertainty, which includes source- and effect-dependency of risk taking. At Wharton, he researched interdependent security games to identify situations and public policy strategies that might mitigate or even resolve interdependency problems.

Professor Wenge Zhu, Fulbright Scholar (China)

Visiting: September 2010 - July 2011



Wenge Zhu is professor of finance and insurance at Shanghai University of Finance and Economics, China. His research focuses on risk and insurance, with a particular interest in the assessment, financing and management of catastrophe risk. He was selected by the Council for International Exchange of Scholars (CIES) as a Fulbright scholar to conduct research in the United States for ten months. While at Wharton, he published "[Ambiguity aversion and an intertemporal equilibrium model of catastrophe-linked securities pricing](#)" *Insurance: Mathematics and Economics* 49 (2011) 38-46.

Risk Regulation Seminar Series

The Risk Regulation Seminar Series brings distinguished speakers inside and outside the Wharton School to address topics of importance to academia, industry and public policy makers.

The series is jointly sponsored by the Penn Program on Regulation; the Program on Law, the Environment and the Economy; the Wharton Risk Management and Decision Processes Center; the Institute for Global Environmental Leadership; and the Fels Institute of Government. Information on upcoming seminars can be found at <https://www.law.upenn.edu/academics/institutes/regulation/seminars.html>

March 22, 2011

Enron and Goldman: A Tale of Two Scandals.

William Wilson Bratton, Professor of Law and Co-Director, Institute for Law and Economics, University of Pennsylvania Law School

February 22, 2011

Insurance Incentives for Improving Health Care Behavior.

Tom Baker, Deputy Dean and William Maul Measey Professor of Law and Health, University of Pennsylvania Law School

Kevin Volpp, Associate Professor of Medicine & Health Care Management; Director, Leonard Davis Institute of Health Economics, Center for Health Incentives, University of Pennsylvania

Jan.25, 2011

Induced Development in Risky Locations: Fire Suppression and Land Use in the American West.

Sheila Olmstead, Fellow, Resources for the Future

November 16, 2010

Long-term Strategies for Reducing Losses from Extreme Events.

Howard Kunreuther, James G. Dinan Professor; Professor of Business and Public Policy; Co-Director, Wharton Risk Management Center
Erwann Michel-Kerjan, Managing Director, Wharton Risk Management Center

September 28, 2010

Regulating from Nowhere: Environmental Law and the Search for Objectivity.

Douglas Kysar, Joseph M. Field '55 Professor of Law, Yale Law School

Discussants: **Kathleen Segerson**, Department of Economics, University of Connecticut

Matthew Adler, Leon Meltzer Professor of Law, University of Pennsylvania Law School

October 26, 2010

Capture by Information: How Information Warfare is Waged in the Administrative State.

Wendy Wagner, Joe A. Worsham Centennial Professor, University of Texas School of Law

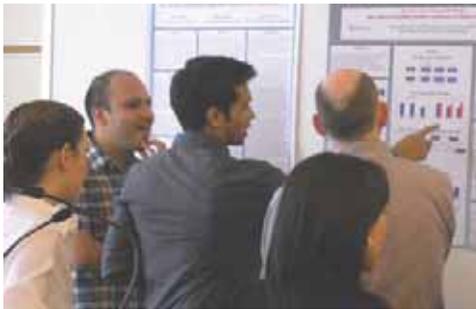
Russell Ackoff Doctoral Student Fellowship Awards, 2011

The **Russell Ackoff Doctoral Student Fellowship** program of the Wharton Risk Management and Decision Processes Center provides grants to doctoral students across Wharton and other departments at the University of Pennsylvania who are pursuing research in decision making under risk and uncertainty. The awards can be used to fund data collection, conference participation, and other direct research expenses.

The Fellowships are funded by an endowment provided to the Wharton School by the **Anheuser-Busch Charitable Trust**. Prof. Emeritus Russell Ackoff's (1919-2009) pioneering work was dedicated to furthering our understanding of human behavior in organizations. Information about the competitive application process and call for proposals is available at http://opim.wharton.upenn.edu/risk/ackoff/WRC-Ackoff_rfp.pdf. Information on prior years' research awards can be found at <http://opim.wharton.upenn.edu/risk/ackoff.html>.

The Wharton Risk Center is pleased to announce the fellowships which were awarded this year to 19 doctoral students at Penn.

RECIPIENT	DEPARTMENT	RESEARCH FOCUS
Victoria Acevedo-Perez	Health Care Management	<i>Implications of Choice and Guaranteed Issue in Insurance Markets</i>
Jonathan Berman	Marketing	<i>Reducing Choice Conflict from Trade-offs Between Self-benefiting and Prosocial Options</i>
Amit Bhattacharjee	Marketing	<i>Construction and Expression of Core Beliefs</i>
Cindy Chan	Marketing	<i>Pride and Preference</i>
Hengchen Dai	OPIIM	<i>How Feelings Towards Whom We Know Carry Over To Others Sharing Their First Names</i>
Katrina Fincher	Psychology	<i>Moral Spillover: Understanding Biases in the Judgment of Moral Trajectories</i>
Stephanie Finnel	Marketing	<i>Feeling Torn – Coping with Ambivalence and Conflicting Identities in Consumption</i>
Simin Gao	Penn Law School	<i>Will the Green Shoots Blossom from the Withered Wood? Regulatory Intervention, Bankruptcy Reorganization and Distressed Financial Firms' Recovery</i>
Arun Gopalakrishnan	Marketing	<i>The Effect of Compensation Structure on Agent Decision Making under Uncertainty in a Multi-period Setting</i>
Wendy Ham	Management	<i>Giving Randomness a Chance: Strategy vs. No Strategy in Knowledge Acquisition</i>
Tae Wan Kim	Legal Studies and Business Ethics	<i>The Role of Civility In Decision Making Under Risk</i>
Livia Levine	Legal Studies and Business Ethics	<i>When the Price Isn't Right: A Decision Processes Approach to Ethics in Price Setting</i>
Jessica Pickett	Health Care Management	<i>Behavioral Constraints to Insuring Health Expenditures in Developing Countries</i>
Daniel Sacks	Applied Economics	<i>Annuity Demand and Health Insurance</i>
Eric Schwartz	Marketing	<i>Beyond the Basic Bandit Problem in Interactive Marketing</i>
Aditi Sen	Health Care Management	<i>The Effect of Insurance Changes on the Demand for Health Care: Evidence from Massachusetts</i>
Dina Shapiro	Annenberg School	<i>What will people think of me? Measuring the anticipated risk of disease related stigma</i>
Jihae Shin	Management	<i>Intrinsic Motivation and the Assessment of Creativity</i>
Alison Wood Brooks	OPIIM	<i>I'm so sorry it's raining! The positive effects of superfluous apologies</i>



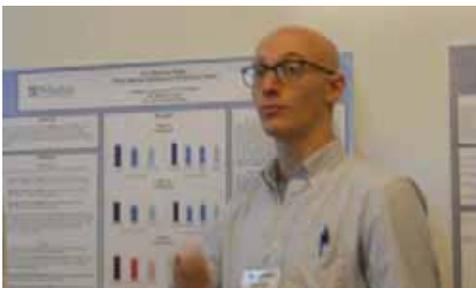
Recipients of the **2010 Ackoff Doctoral Fellowship Awards** presented their research findings to faculty and students at the annual Ackoff Fellowship luncheon, May 5, 2011. Photos (from the top):

Amit Bhattacharjee (Marketing) (center) discusses his research on "Tip of the Hat, Wag of the Finger: How Moral Decoupling Enables Consumers to Admire and Admonish." **Jose Guajardo's** (OPIM) (left) was a finalist at the 2010 MSOM student paper competition for his 2009 Ackoff research "Impact of Performance Based Contracting on Product Reliability: An Empirical Analysis."



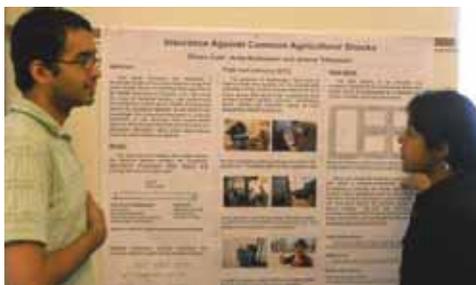
Prof. Howard Kunreuther and Alison Wood Brooks (OPIM), with her poster "Glad to be Mad: When Negotiators Strategically Choose to Feel Angry." Her paper (with advisor Prof. Maurice Schweitzer) "Can Nervous Nelly negotiate?" was published in *Organizational Behavior and Human Decision Processes* 115 (2011) 43-54.

Jonathan Berman (Marketing) presents "For Want of a Want: When Imposed Selfishness is Preferred to Choice."



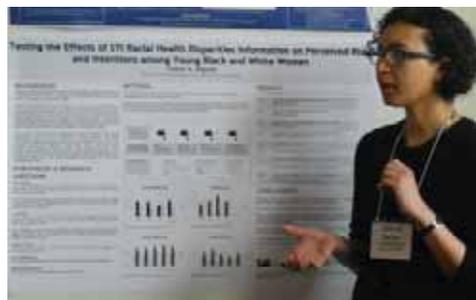
Anita Mukherjee (Applied Economics) (right) discusses her research on "Insurance Against Common Agricultural Shocks" with **Arun Gopalakrishnan** (Marketing), 2011 Ackoff Fellowship recipient.

Cabral Bigman (Annenberg School) presents her research on "Testing the Effects of STI Racial Health Disparities Information on Perceived Risk and Intentions among Young Black and White Women." She will present the work at the American Public Health Association annual meeting in November.



Not pictured: **Shawnika Hull** (Annenberg School) (2009 Ackoff award) had two papers accepted for the annual meeting of the National Communication Association. "Perceived Risk as a Moderator of the Effectiveness of Framed HIV Test Promotion Messages Among Women" was accepted for publication in *Health Psychology*.

Ben Shiller (Business and Public Policy) (2009 Ackoff award) presented "Digital Downloads and the Prohibition of Resale Markets for Information Goods" at the NBER Summer Institute, Economics of IT and Digitization session.



PIMM: Penn Interdisciplinary Meeting of Minds

Beginning in September 2010, the Wharton Risk Center has funded a bi-weekly gathering of Ph.D. students who call themselves PIMM: Penn Interdisciplinary Meeting of Minds. Founded and led by Alison Wood Brooks, a fourth-year doctoral student in the Operations and Information Management Department, the group consists of approximately twenty doctoral students from different departments who study closely-aligned topics (e.g., judgment and decision making, consumer behavior, organizational behavior, applied economics, and cognitive and social psychology).

At bi-weekly gatherings, PIMM members discuss current research questions, share the struggles and triumphs of graduate student life, and focus on one or two cutting-edge journal articles. Over the course of the academic year, the diverse set of discussion topics included pre-cognition, self-deception, superstition and performance, money and happiness, moral decision making, and even the effect of Botox injections on emotional expression. PIMM serves as a unique opportunity for students to practice presenting their own research and guiding their peers through academic articles, to develop cross-disciplinary relationships, and to discuss current issues at Wharton, Penn, and their broader research communities. Carrying PIMM into the 2011-2012 academic year are third-year Ph.D. students Katrina Fincher (Psychology) and Jonathan Berman (Marketing).

Undergraduate Research

The Risk Center thanks its undergraduate research assistants for their contributions to these projects:

Sourav Bose (Wharton '11) "Effective Leadership and Governance Practices in Catastrophe Risk Management"

Laura Boudreau (Wharton '10) "Effective Leadership and Governance Practices in Catastrophe Risk Management"

Mike Chen (Wharton '13 degree candidate) "Catastrophe Financing for Governments: Learning from the 2009-2012 MultiCat Program in Mexico"

Greg Chianetta (Wharton '13 degree candidate) "Catastrophe Financing for Governments: Learning from the 2009-2012 MultiCat Program in Mexico"

Pete Eschenbrenner (U. of P. '09) "The Costs and Benefits of Reducing Risk from Natural Hazards to Residential Structures in Developing Countries"; "Flood Risk, Mitigation and Insurance in Texas"

Christina Zima (Wharton '12 degree candidate) "Managing and Financing Risk in a New Era of Catastrophes" Disaster Risk Reduction Project, UNDP; Bureau for Crisis Prevention and Recovery

RECENT PUBLICATIONS more at <http://opim.wharton.upenn.edu/risk/papers.php>

- Nitin Bakshi, Stephen E. Flynn, Noah Gans, **Estimating the Operational Impact of Container Inspections at International Ports**, *Management Science*, 57(1):1-20, January 2011
- Alison Wood Brooks and Maurice Schweitzer, **Can Nervous Nelly Negotiate? How Anxiety Causes Negotiators to Make Low First Offers, Exit Early, and Earn Less Profit**, *Organizational Behavior and Human Decision Processes*, 115:43-54, 2011
- Laure Cabantous, Denis Hilton, Howard Kunreuther, Erwann Michel-Kerjan, **Is Imprecise Knowledge Better than Conflicting Expertise? Evidence from Insurers' Decisions in the United States**, *Journal of Risk and Uncertainty*, 42(3):211-232
- Chris Carrigan and Cary Coglianese, **The Politics of Regulation: From New Institutionalism to New Governance**, *Annual Review of Political Science*, forthcoming, 2011
- Cary Coglianese, **The Law and Economics of Risk Regulation**, in James J. Cochran, ed., *Wiley Encyclopedia of Operations Research and Management Science*, forthcoming, 2011
- Jeffrey Czajkowski, **Is It Time to Go Yet? Understanding Household Hurricane Evacuation Decisions from a Dynamic Perspective** *Natural Hazards Review*, May, 2011 1-13
- Guy David and Scott E. Harrington, **Population Density and Racial Differences in the Performance of Emergency Medical Services**, *Journal of Health Economics*, 29:603-615, 2010
- Stephen Flynn, **Recalibrating Homeland Security**, *Foreign Affairs*, May-June 2011
- Sarthak Gaurav, Shawn Cole, and Jeremy Tobacman, **Marketing Complex Financial Products in Emerging Markets: Evidence from Rainfall Insurance in India**, *Journal of Marketing Research*, forthcoming
- Dwight Jaffee, Howard Kunreuther, and Erwann Michel-Kerjan, **Long-Term Property Insurance**, *Journal of Insurance Regulation*, 29(07):167-187, 2010
- Narayan Janakiraman, Robert Meyer and Stephen Hoch, **The Psychology of Decisions to Abandon Waits from Recurrent Queues** *Journal of Marketing Research*, in press
- Steven O. Kimbrough, **On the Production and Ramification of Cooperation: The Cooperation Afforded with Framing Hypothesis**, *Philosophy of the Social Sciences*, doi: 10.1177/0048393110387883
- Howard Kunreuther, **Reducing the Risks of Catastrophes**, *NBER Reporter*, 2011, Number 1: Research Summary
- Howard C. Kunreuther and Erwann O. Michel-Kerjan, **Overcoming Myopia -- Learning From the BP Oil Spill and Other Catastrophes**, *The Milken Institute Review*, Fourth Quarter, 2010, pp. 49-57
- A. Peter McGraw, Alexander Todorov, and Howard Kunreuther, **A policy maker's dilemma: Preventing terrorism or preventing blame**, *Organizational Behavior and Human Decision Processes*, 115:25-34, 2011
- Erwann O. Michel-Kerjan, **Catastrophe Economics: The National Flood Insurance Program**, *Journal of Economic Perspectives*, 24(4):165-86, Fall 2010
- Erwann Michel-Kerjan, Sabine Lemoyne de Forges and Howard Kunreuther, **Policy Tenure under the U.S. National Flood Insurance Program (NFIP)** *Risk Analysis*, (in press 2011)
- Erwann Michel-Kerjan and Howard Kunreuther, **Redesigning Flood Insurance**, *Science*, 333, July 22, 2011
- Erwann Michel-Kerjan and Paul Raschky, **The Effects of Government Intervention on the Market for Corporate Terrorism Insurance**, *European Journal of Political Economy*, doi:10.1016/j.ejpoleco.2011.03.006, 2011
- Erwann Michel-Kerjan, Ivan Zelenko, Victor Cardenas and Daniel Turgel, **Catastrophe Financing for Governments: Learning from the 2009-2012 MultiCat Program In Mexico**, OECD Working Papers on Finance, Insurance and Private Pensions, No. 9, May 2011
- Eric W. Orts, **Climate Contracts**, *Virginia Environmental Law Journal*, (forthcoming)
- Ankur Pariyani, Warren D. Seider, Ulku G. Oktem, Masoud Soroush, **Dynamic Risk Analysis Using Alarm Databases to Improve Process Safety and Product Quality: Part I – Data Compaction, Part II – Bayesian Analysis**, *AIChE Journal*, doi:10.1002/aic.12643, March 2011
- Mark V. Pauly, **Health Reform Without Side Effects: Making Markets Work for Individual Health Insurance**, *Hoover Institution Press*, Stanford, CA, 2010
- Mark V. Pauly, Kai Menzel, Howard Kunreuther, Richard A. Hirth, **Guaranteed Renewability Uniquely Prevents Adverse Selection in Individual Health Insurance**, *Journal of Risk and Uncertainty*, forthcoming
- Devin G Pope, Maurice Schweitzer, **Is Tiger Woods loss averse? Persistent bias in the face of experience, competition, and high stakes**, *American Economic Review*, 101, 129-157, February 2011
- Deborah Small (2010), **Reference-dependent sympathy**, *Organizational Behavior and Human Decision Processes*, 112, 151-160
- Haitao Yin, Alexander Pfaff and Howard Kunreuther, **Can Environmental Insurance Succeed Where Others Fail? Conceptual Framework & the Case of Underground Storage Tanks**, *Risk Analysis*, 31(1):12-24, 2011
- Wenge Zhu, **Ambiguity aversion and an intertemporal equilibrium model of catastrophe-linked securities pricing**, *Insurance: Mathematics and Economics*, 49(2011):28-46

RISK CENTER IN THE NEWS more at <http://opim.wharton.upenn.edu/risk/facultynews.php>

Spring 2011, *Wharton Magazine*, [The Year in Risk](#)

Discussion with Howard Kunreuther and Erwann Michel-Kerjan on global risks in 2011, and how those risks are interconnected.

May 29, 2011, *Los Angeles Times*, [Many in GOP who oppose health insurance requirement used to favor it](#)

Prof. of Health Care Management Mark Pauly comments on President Obama's new healthcare law.

May 2011, *Foreign Affairs*, [Recalibrating Homeland Security](#)

Article by Stephen Flynn: "The United States has made a mess of homeland security..."

April 10, 2011, *Newsweek*, [Are Ethics for Suckers?](#)

Prof. of Legal Studies and Business Ethics and Management Eric Orts discusses the role of ethics in the financial sector.

March 30, 2011, *Knowledge@Wharton*, [U.S. Energy Policy after Japan: If Not Nuclear, Then What?](#)

As the crisis at Japan's crippled Fukushima Daiichi plant has raised questions in the United States about the role that nuclear power should play in the country's energy future.

March 23, 2011, *The Economist*, [Business-school research: No longer all at sea](#)

Prof. Noah Gans' co-authored research on port security with Stephen Flynn and Nitin Bakshi is highlighted.

March 17, 2011, *PBS Nightly Business Report*, [President Obama Tries to Calm U.S. Nuclear Radiation Fears](#)

Prof. Howard Kunreuther is interviewed on the question of GE's liability for the nuclear plants in Japan.

March 15, 2011, *CNN.com*, [Calls for better U.S. quake preparation](#)

Erwann Michel-Kerjan is quoted on US preparedness for earthquakes in the aftermath of the March 2011 earthquake in Japan.

February 23, 2011, *Knowledge@Wharton*, [Turmoil in Arab World Ushers in 'New Reality' for All Governments](#)

Interview with Neil A. Doherty, Frederick H. Ecker Professor of Insurance and Risk Management and Erwann Michel-Kerjan, managing director of the Wharton Risk Management and Decision Processes Center.

February 2, 2011, *Knowledge@Wharton*, [Report from Davos: Risk Management Survivors Offer Cautionary Tales](#)

Wharton management professor Michael Useem joined heads of state, politicians, CEOs, and others at this year's World Economic Forum in Davos, Switzerland.

January 24, 2011, *The Washington Post*, [The Davos Barometer: Risks Ahead](#)

Op-ed by Erwann Michel-Kerjan.

January 17, 2011, *The Australian*, [Covering the cost of natural devastation](#)

Since December, Australia has been facing historic flooding that surprised the entire country. Three-quarters of Queensland has been declared a disaster zone.

January 14, 2011, *Insurance Networking News*, [5 Emerging Risks to Watch](#)

World Economic Forum's *Global Risks Report 2011* finds current global governance systems lack capacity.

January 13, 2011, *Bloomberg TV*, [Inside Track](#)

Erwann Michel-Kerjan discusses the findings of the World Economic Forum's *Global Risks Report 2011*.

Fall 2010, *Milken Institute Review*, [Overcoming Myopia Lessons from the BP Oil Spill and Other Catastrophes](#)

By Howard Kunreuther and Erwann Michel-Kerjan.

Fall 2010, *Wharton Magazine*, [The Lessons of Deepwater](#)

Howard Kunreuther and Robert Meyer offer thoughts on why the spill happened and what we should learn from it.

October 14, 2010, *Popular Mechanics*, [How to Disaster-Proof Your Life](#)

Prof. Robert Meyer, co-director of the Risk Center, is interviewed about the computer simulation game "Quake."

December 29, 2010, *Washington Post*, [On Leadership, In a networked world, no longer controlling our own destinies](#)

Op-ed by Geoffrey Heal and Howard Kunreuther

November 19, 2010, *Marketplace Public Radio*, [How much should we pay for health care?](#)

Prof. of Health Care Management Mark Pauly is interviewed about how much U.S. citizens should pay for health insurance.

In collaboration with some of our Research Sponsors

The World Bank

Reducing Risks in Developing Countries

The World Bank Global Facility for Disaster Reduction and Recovery (GFDRR) and the Wharton Risk Center have renewed their partnership on disaster risk financing.

The collaboration recognizes the leadership of both institutions in their respective roles and the potential benefits of joint work on managing and financing catastrophe risks. Among a variety of goals, the collaboration will lead to research initiatives that have practical applications for the World Bank and will promote the integration of activities and policy formulation for disaster risk reduction, recovery, and financing in the context of sustainable development for emerging economies.

The project builds on findings from the Risk Center's report, [The Costs and Benefits of Reducing Risk from Natural Hazards to Residential Structures in Developing Countries](#) (2011) prepared for the World Bank with support from the GFDRR by the Wharton Risk Center and project partners from International Institute of Applied Systems Analysis (IIASA) and Risk Management Solutions.



In 2010, Howard Kunreuther (Wharton Risk Center) collaborated with FM Global on their 2010 report [Flirting with Natural Disasters: Why Companies Risk It All](#). The two organizations will be working more closely, as FM Global has now become a research sponsor of the Risk Center. FM Global is one of the world's largest commercial property insurers and providers of engineering solutions to protect businesses from fire, natural disasters and other types of property risk.

Touring FM Global's Research Campus in West Glocester, R.I. are:

Steve Zenofsky (FM Global, assistant vice president)

Howard Kunreuther (Wharton Risk Center)

Jeff Czajkowski (Wharton Risk Center)

Louis Gritzko (FM Global, vice president and research manager)

Erwann Michel-Kerjan (Wharton Risk Center)

Ruud Bosman (FM Global, vice chairman)

New Partner: Endurance Reinsurance Corp.

The Wharton Risk Center is pleased to welcome Endurance as a new partner. Launched in 2001, Endurance is a global specialty provider of insurance and reinsurance, with current holdings of approximately \$8.4 billion in assets and \$2.4 billion in shareholders' equity.

Swiss Re

Measuring Flood Risk in Texas

When the National Flood Insurance Program (NFIP) was established in 1968, one of the hurdles to privatizing flood insurance was the inability of insurers to effectively quantify the financial risk of insuring properties with the potential for catastrophic losses. In recent years, however, the development of catastrophe models has refined insurers' ability to determine the financial impact of large scale flooding, which would enable them to set premiums that reflect risk. The Risk Center and Swiss Re in partnership with CoreLogic, are undertaking a series of analyses focusing on flood risk in Texas. They will evaluate the cost/benefit of individual and collective mitigation measures in Galveston and Travis Counties and how much a private insurance market for flood hazard would charge compared to current premiums levied by the NFIP.

Willis Re

Climate Change and Multi-Year Insurance

Potential climate change will create challenges in catastrophic risk management. The consequences can be limited if effective adaptation measures and appropriate risk sharing arrangements are implemented in advance. Adaptation measures have been shown to effectively reduce losses for all parties involved even with potential climate change. Multi-year insurance contracts can incentivize adaptation measures but will increase risk capital and premiums due to the increased uncertainty regarding future losses for longer time scales. The comparison between multi-year insurance contracts with an annual renewal contract with and without adaptation for different climate change scenarios is a key focus of a joint research project between the Risk Center and the Willis Research Network.

The Risk Center and research partner Willis Re have conditioned a catastrophe risk model taking climate change into account. Several analyses have been conducted to quantify the impact of climate change and mitigation on losses for different time horizons. The impact on the pricing of multi-year insurance has also been measured using a catastrophic loss event table provided by Willis Re for hurricane risk in Florida. The results of this project will facilitate the measurement of the impact of climate change, encourage mitigation measures, and enhance catastrophic risk management.

Oliver Wyman

Understanding Financial Capital

As part of ongoing research initiative in managing and financing extreme events, the Wharton Risk Center and Oliver Wyman's Global Risk Center are collaborating on a study of the costs associated with financial capital in property and casualty insurance and reinsurance firms. The study will provide clarity on a number of issues of interest to the insurance industry, policymakers and researchers related to the constraints associated with holding capital and the effect on the operations of insurance companies.

Become a Partner of the Wharton Risk Center!

Research Sponsors and Corporate Associates are a vital part of the Wharton Risk Center's operations.

In addition to providing crucial support for the Center's operations, **Corporate Associates** participate in roundtable discussions and offer insight into the value, direction and timing of research projects. **Research Sponsors** provide funding for specific research initiatives of mutual interest and regularly interact with Risk Center directors, faculty and fellows to discuss these initiatives. Associates and Sponsors attend our workshops and conferences at no cost. These meetings offer an opportunity to consult with experts and policy makers from research institutions, industry and government agencies from the U.S. and abroad.

The Risk Center is inviting interested organizations to become **Strategic Partners**. With a five-year commitment, Strategic Partners play a key role in the Center's research which can enable these organizations to impact the future of their industry. Strategic Partners will also benefit from greater visibility and customized relationships across the Wharton School through membership in the Wharton Partnership, Wharton's primary vehicle for fostering industry-academic collaboration.

Corporate Associate, Research Sponsorship, and Strategic Partnership contributions to the Risk Management and Decision Processes Center of the Wharton School are tax-deductible.

We thank our Corporate Associates, Research Sponsors and Strategic Partners for their support and involvement.

American Insurance Association

Endurance Reinsurance Corporation

FM Global

Liberty Mutual

Oliver Wyman / Marsh & McLennan

**Property Casualty Insurers Association
of America**

State Farm Fire & Casualty Company

Swiss Re

Travelers Companies, Inc.*

U.S. Congressional Research Service

U.S. Department of Homeland Security

U.S. Environmental Protection Agency

U.S. National Science Foundation

**WeatherPredict Consulting, Inc.
(a division of Renaissance Re)**

Willis Re

The World Bank Group

Zurich and Farmers Financial Services

* Strategic Partner

For information on becoming a Wharton Risk Center research partner, please contact:

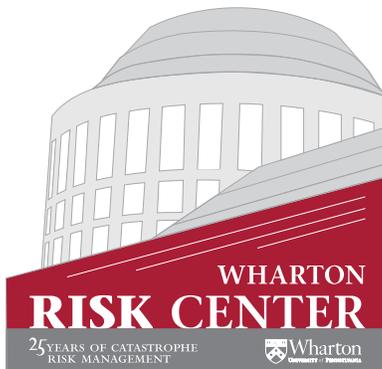
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For over 25 years, the Risk Management and Decision Processes Center at the Wharton School has been at the forefront of basic and applied research to promote effective corporate and public policies for low-probability events with potentially catastrophic consequences. The Wharton Risk Center has focused on natural and technological hazards through the integration of risk assessment and risk perception with risk management strategies. After the attacks of September 11, 2001, research activities were extended to include 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 is 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.

In the past several years, the Center has significantly increased its size to now include 50 faculty, research fellows, students and visiting scholars to undertake large-scale initiatives.

Providing expertise and a neutral environment for discussion, the Center team 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. Our Newsletter, Project Snapshots and Issue Briefs provide updates of Center activities and publications.

Risk Center on the World Wide Web

**Visit the Wharton Risk Management and Decision Processes Center
on the Internet at: <http://opim.wharton.upenn.edu/risk/>**