

# Risk Management REVIEW

Wharton

RISK MANAGEMENT  
AND DECISION  
PROCESSES CENTER  
FALL 1999

## Accident Epidemiology Project Gears Up for RMP\*Info



Arthur F. Burk and Catherine St. Claire, DuPont, at a Wharton Roundtable to discuss RMP\*Info Data.

Nine years after passage of the authorizing legislation, and amidst a flurry of last-minute controversy, accident history and risk management data under the RMP Rule has finally begun to roll in to the Chemical Emergency Preparedness and Prevention Office (CEPPO) of the U. S. Environmental Protection Agency. The last-minute controversies concerned which companies would actually be required to file Risk Management Plans (RMPs) under the Rule (for example,

propane distributors asked for and received a last-minute exemption from filing), and what information would be made generally available to the public once the data are entered into an Internet-accessible database (for example, worst-case data will not be Internet-accessible, at least for a while). The database itself has been named RMP\*Info. Decisions relating to these controversies have now cleared the way for the real work to be done — the analysis of the data itself. The Risk Center expects to  
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### Risk Center on the World Wide Web

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

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

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The Wharton School  
University of Pennsylvania

Center Activities in the New Millennium

As we enter the new Millennium it seems an appropriate time for us to take stock as to where the Wharton Risk Management and Decision Processes Center has been since its inception in 1986 and prospects for the future. From its inception the mission of the Center has been to understand

and improve the decision making processes with respect to low probability-high consequence (LP-HC) events. The Center has always had a problem-focused approach. Studies have ranged from individual choices regarding the use of seat belts and health prevention behavior, to firm decision making related to dealing with chemical accidents and risk management plans, to social questions related to areas such as siting noxious facilities and managing catastrophic risks.

A guiding principle for Center research has been linking descriptive analysis with prescriptive recommendations. On the descriptive side, considerable attention has been given to understanding the decision processes associated with protective activities for LP-HC events. A five-year grant on protective behavior was awarded to the Risk Center from the National Science Foundation shortly after the center was established. It enabled researchers from several disciplines to undertake controlled laboratory experiments



Howard C. Kunreuther

as well as field surveys to explore the rules of thumb utilized by individuals when they decide to protect themselves against events that affect their health and safety. This activity has continued to be an important part of Center activities.

On the prescriptive side, there has been an increasing appreciation of the importance of understanding the institutional arrangements and decision processes surrounding a particular problem as a basis for developing a strategic plan for meeting a set of objectives. Recent research on managing catastrophic risks from natural hazards illustrates this point. This joint effort between the Financial Institutions Center and the Risk Center has shown all of us how the decision processes of residents in hazard-prone areas requires a combination of policy tools such as insurance, well-enforced building codes and monetary incentives to increase the likelihood that cost-effective loss reduction measures will be adopted. Such a strategy implies that private sector organizations such as the insurance/reinsurance industry, financial institutions, real estate and construction industry will need to work together with local, state and federal agencies to achieve these objectives.

It is important that the Center takes advantage of new developments

in scientific modeling and information technology to direct its future research activities. Given the improved understanding of scientific phenomena of hurricanes and earthquakes, we are now better able to estimate the risks associated with these hazards, although one needs to recognize there is still considerable uncertainty surrounding these figures. New databases with respect to catastrophic risks from chemical accidents coupled with the tools and methods of epidemiology are enabling us to better understand the predictors and causes of illness in humans.

A major objective of our future Center research activities is to utilize these data to develop risk management tools for dealing with risks to humans and the environment from technological accidents and natural disasters. How do we construct improved approaches for preventing major chemical accidents? How can we mitigate catastrophic losses from earthquakes, floods and hurricanes and provide funds for recovery? How can the private market based mechanisms such as the use of third party inspections reduce losses from environmental risks?

These issues have important global significance. The Bhopal accident in India is a reminder of the challenges that one faces in dealing with chemical accidents in other parts of the world. The recent catastrophic earthquake in Turkey raises a whole set of questions as to the appropriate strategies

## Risk and Return in the E-Economy

What began as a trickle at the beginning of the decade has now turned into a torrent. E-Commerce and the E-Economy are here to stay. And with these currents come new business models and new risks as well. As we move toward the Millennium, we have been asking ourselves and our corporate associates and sponsors what the implications of these changes are for the Center's research agenda. I would like to share here some of the early signals we see from this on-going dialogue.

Throughout the 1990s, restructuring initiatives liberated hundreds of billions of dollars of working capital and waste from supply chains in U.S. companies alone. As companies became leaner and more agile in their supply chains, they also began to realize the importance of core competencies and properly sized business units. Outsourcing and right-sizing of both companies and their constituent businesses were seen as the new necessities for remaining competitive. In North America, the results have been rewarding by any yardstick, leading to the greatest sustained period of economic growth in this century.

A key development resulting from this period of organizational restructuring has been the recognition of the importance of informational integration across organizational boundaries. This began with supply chain redesign and optimization, but such integration is now clearly evident also in emerging redesigns

of support functions such as Insurance and Risk Management, Environment, Health and Safety, Human Resources, Market Research, and Research and Development. The era of restructuring has led inexorably to a "plug-and-play" world in which a company's value-added activities are assembled in business units, together with agile, perhaps outsourced, support functions on an as-needed basis, and stitched together through an internal and external network of information technology and data management systems.

The centrality of information technology (IT) in the new business models emerging from this murky mist of change has not been lost on senior executives. But no one seems to have much of a clue yet about how to integrate IT with business strategy. Just to take one key example for the Center, the risks associated with the new E-World are potentially serious. Y2K is but one of these. Other risks include the loss of channel power through disintermediation, blindsiding or leap-frogging of established product lines through global competitors who can now free-wheel through the Internet, cyber-terrorism, and simply market share erosion through lack of required competence to make intelligent IT investments to keep pace with demanding customers. When coupled with the unbundling



*Paul R. Kleindorfer*

of corporate support functions through the outsourcing movement of the 1990s, and the increasing use of enterprise-wide software and data management systems, the vulnerability of some companies to major disruptions could be significant.

The challenges for the Risk Center in understanding how to cope with these changes under different industry and market conditions will be enormous. Against the rapidly changing background of the E-World, an enduring puzzle for strategy and risk management remains determining the appropriate balance between retaining the necessary in-house capabilities in areas such as EH&S and assuring flexibility and efficiency through right-sizing and outsourcing. While IT and E-Commerce seem to be key elements of any solution to this puzzle, their appropriate positioning in the development of company and business unit strategy remains itself an unsolved puzzle. How this plays out in the Center's research agenda remains to be seen, but echoes of the E-Economy will clearly reverberate for some time to come.

— Paul R. Kleindorfer  
*Co-Director*

## Accident Epidemiology Project Gears Up for RMP\*Info

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play a major role in this regard through its continuing Accident Epidemiology Project, which is being undertaken, in cooperation and with the support of CEPPPO. The project is a joint effort with the Center for Clinical Epidemiology and Biostatistics of the Medical School of the University of Pennsylvania.

The initial studies to be undertaken using the RMP\*Info database will be descriptive analyses of the data. The descriptive statistics to be produced will show frequencies of specific risk incidence (or outcome) measures for various groups of plants and types of event, organized by salient characteristics. To begin with, we will describe the characteristics of the population of plants in the database, classified according to characteristics such as Type of Chemical/Process, Size of Plant, Size of Parent Company, Age of Plant, and so forth. While it was originally thought that some 66,000 plants/facilities would file RMPs under the Rule, the actual number (given the resolution of the controversies noted above) is now expected to be closer to 15,000, containing some 2,000 reported accidents. The primary interest in the initial studies will be to understand what types of facilities have submitted RMPs (and what types have not), and what the accident frequency and severity profiles are for various subsets of the RMP\*Info database, including statistics across the five-year period and (to show trends) for each of the five years in the data available.



*Wharton Roundtable to discuss analysis of RMP\*Info data submitted under section 112(r) of the Clean Air Act.*

The structure for our initial analyses of RMP\*Info has been refined over the past two years through a series of Roundtables, the most recent being held at Wharton on April 23. At this past Roundtable, companies shared experiences on the resources expended to comply with the Rule and on difficulties they encountered along the way. One of the most interesting summary comments that seemed to be shared across Roundtable participants was the importance of the RMP process in improving company and plant Risk Communication programs. Other lessons from the Center's RMP Roundtables can be obtained from the EPA Cooperative Agreement Spotlight, accessible through the Center's homepage on the World Wide Web at <http://opim.wharton.upenn.edu/risk/>.

The Project Team is also using the Internet to gather hypotheses about RMP\*Info. The Project website will also be available through the Center's website and contains a menu-driven program to collect hypotheses from researchers and practitioners interested in contributing

their ideas and predictions about what will be found in the RMP\*Info database. If you haven't done so yet, sign on to the Project website and have some fun constructing a proper epidemiologic hypothesis and seeing what predictions others have made concerning the nature of accident precursors and plant demographics in the RMP\*Info database.

The use of medical epidemiology to study major accidents is a new field although it has significant roots in health and safety research and in occupational medicine and industrial hygiene, both of which have a rich history. What is clearly new here is the existence of the first tranche of hard-won data on a significant portion of the U.S. chemical industry, including its accident history over the past five years. As we begin to analyze these data, we are mindful of the tremendous effort that went into collecting them and of the opportunities that they will provide for understanding precursors of major industrial accidents and for prioritizing mitigation and regulatory strategies for preventing such accidents in the future. ■

## Managing Catastrophic Risks

The Wharton Risk Management and Decision Processes Center joint research project with the Wharton Financial Institutions Center on managing catastrophic risks from natural disasters held its Spring 1999 industry forum at the University of Pennsylvania on June 14 and 15. At the opening dinner Brian Duppereault, Chairman, President and CEO of ACE Ltd. of Bermuda, led a discussion on the conflict between the traditional insurance regulatory view of “looking backward,” and the view supported by new modeling technologies of “looking forward.”

The meeting the next day was divided into two thematic pieces: the financing of catastrophic risks, and research initiatives related to insurance regulation and mitigation. David Cummins and Neil Doherty discussed their efforts to develop a theoretical and empirical analysis of the capacity of the U.S. property-liability insurance industry to finance major catastrophic property losses. Depending on the damage distribution and coverage spread on the one hand and between insurer losses and industry losses on the other, the prospect of a mega-catastrophe brings the real threat of widespread insurance failures and unpaid insurance claims.

Cummins, David Lalonde of Applied Insurance Research and Richard D. Phillips of Georgia State University described a study that provides new information on the basis risk of index-linked CAT securities. The principal finding was that insurers of all sizes could hedge effectively using statewide loss indices.

Neil Doherty and Kent Smetters discussed their recent work on moral hazard. Moral hazard arises in insurance contracts because the insured usually has control over factors that influence the probability or severity of loss, but the insurer pays the bill. Doherty and Smetters then outlined a model that predicts that moral hazard should result in excess losses, and the use of experience and retrospective ratings. Applying this model to panel data of U.S. property liability firms, they find that moral hazard imposes real contracting costs in traditional reinsurance relationships.

David Croson and Howard Kunreuther presented their findings on how reinsurance coupled with capital market instruments can expand coverage to those residing in areas subject to catastrophic losses from natural disasters. In their paper they showed how catastrophe-linked financial instruments can utilize models so that the price of protection can be lowered from its current level. After examining a series of plausible scenarios, they asserted that only a combination of insurance, reinsurance, CAT bonds, and some amount of “government reinsurance” as the financial instrument of “last resort” could possibly meet the objectives of all the differing stakeholders.

Paul Kleindorfer and Robert Klein, of Georgia State University provided a brief overview of the extent of their current research on insurance regulation. The intent of their study is to empirically address interactions across multiple stakeholders, i.e., homeowners, businesses, insurers, reinsurers, the construction

and real estate sector, and regulatory institutions. In their analysis they will utilize detailed premium record data obtained from ISO on insurance transactions, supplemented by information on expected costs for different policies and risk characteristics. The data will, for the first time, provide an empirically grounded understanding of the supply and demand for CAT-related coverage provided in residential insurance policies. The study will seek to identify the factors that most affect supply and demand and the magnitudes of their relative effects, including the pricing of CAT coverage and alternative policy provisions.

Patricia Grossi of the University of Pennsylvania and Kunreuther reported on their work related to mitigation of commercial structures in the context of three model cities, Oakland and Long Beach (earthquake hazard), and Miami/Dade County (hurricane hazard), which are being undertaken jointly with the Applied Insurance Research, EQE and Risk Management Solutions. In the analyses, structural mitigation techniques to commercial structures were examined and direct economic losses only (i.e., building and content damage) were analyzed. Mitigation proved to be beneficial to insurers via lower insolvency probabilities, lower expected losses, and increased profitability through lower capacity restrictions. Future analyses will include the effects of business interruption on losses and the average cost of these mitigation measures. ■

## Philip G. Lewis, Selected Chair of the Advisory Committee

The Risk Center is pleased to announce that Dr. Philip G. Lewis has agreed to become Chair of the Risk Center's Advisory Committee. Phil is Vice President of Safety, Health and Environment for the Rohm and Haas Company. He has been with Rohm and Haas since 1983 and was elected Vice President in 1993. Prior to joining Rohm and Haas, he served as Chief of Preventive Medicine Activity and Epidemiology for the III Corps and Darnall Army Hospital in Fort Hood, Texas.

First, this continues a long tradition with the Rohm and Haas Company. Donald L. Felley, President of Rohm and Haas, was the first to chair the Center's Advisory Committee, and John P. Mulrone, who succeeded Don as President of Rohm and Haas, was the second. In addition to the wonderful service that Don and Jack provided, the Center has had many other personnel connections with the company, including Irv Rosenthal, for many years a Senior Research Fellow at the Center, who last year was appointed by President Clinton to the U.S. Chemical Safety and Hazard Investigation Board.

The second reason Phil's appointment is significant is because it comes at a critical time in the Center's research programs and reflects on Phil's background. Phil has had broad experience in

public health and epidemiology and in general preventive medicine. He holds both an MS degree in Public Health in Epidemiology and an MD from Johns Hopkins University School of Medicine.

He currently serves on a number of important committees, including the Pennsylvania Environmental Equity Work Group, which is concerned with permitting and siting of environmental facilities and the risks associated with them.

From the article on the first page of this newsletter you can see the Center's strong interest in epidemiology and in public health. The Risk Center expects to play a major role in this regard through its continuing Accident Epidemiology Project, which is being undertaken in a joint effort with the Center for Clinical Epidemiology and Biostatistics of the Medical School of the University of Pennsylvania, and is supported by the EPA's Chemical Emergency Preparedness and Prevention Office (CEPPO). This project and many other Center research activities will benefit greatly from the interest and guidance of the Advisory Committee's new Chair, Dr. Lewis.

In addition to his technical skills, Phil brings a warmth and friendliness so necessary in the education of students and the operation of faculty at the University. It is a pleasure to welcome him and we look forward to exciting times. ■



*Philip G. Lewis*

### "Can We Talk?"

*Philip G. Lewis*

First let me thank Howard Kunreuther and Paul Kleindorfer for their very kind invitation to me to chair the Advisory Committee for the Risk Center; it is indeed a great honor. The Center has become well known for its work to bring a sense of reason to what are often thought of as impossibly intractable problems. That said, I have in the last few moments found myself drawn to what is surely a politically incorrect question: what would put the Center out of business? Or stated more reasonably, what state of affairs in

the world would allow the considerable talents of Howard and Paul and the many others who do such fine work at the Center to be redirected to even more fun and profitable endeavors? It is not unlike the question, "If there were no illnesses, what other good things might doctors do?" I tend to think about that one a good deal.

In the case of the Center, one answer to the question would be a world without risk or one in which the occurrence and response to risk were well enough understood and predictable that it would not take businesses, governments or societies by surprise. Risk might then be planned for, properly insured for and life much happier. Given our basic understanding of the world, it does not seem reasonable to expect we will soon, if ever, live in a risk-free world. Looking down the business end of an asymptotic curve quickly makes it clear that in our universe there is always some risk of an untoward event, even while sitting at home in an easy chair. We are becoming better and better at quantifying and predicting risk so that at least its occurrence may soon be known. What we are doing less well is the response to risk or even the discussion of how to control risk.

Consider for a moment the case of community exposure limits for toxic materials. We all understand there is a point at which the

cost of controlling unwanted effects associated with toxic materials outweighs the benefit derived from such control. We understand there is a point of diminishing returns. However, even the discussion of such a concept relative to toxic materials is fraught with danger.

The classic approach to setting exposure limits is called the "safety factor" approach, in which a no-observable-effect level in animals is translated into an appropriate anticipated no-observable-effect level in humans and then a "safety factor" is applied, usually somewhere in the range of 10- to 1000-fold. The resulting lower exposure levels are said to be safe, yet the level of residual risk associated with them can be unacceptably high. For instance, the risk of cancer associated with some OSHA workplace exposure limits is on the order of one in a thousand compared to the one in one million that most reasonable people say is safe.

As it turns out, there are systems for setting toxic material exposure limits that would have the society exposed to lower risks and allow businesses and insurance companies to know when toxic material risks are well managed and their control reaching a point of diminishing returns. One would think that the discussion and pursuit of such systems would be a good thing. It is actually more risky for a company to think about going to these truly

safer systems than to stay with the less protective, but more accepted, conventional systems. If you have any doubt about that last sentence ask the next litigation or plaintiff's lawyer you see.

Setting toxic material exposure limits is only one small piece of the fields of concern that can affect business and around which the Center must do its work. Yet, when we are in the state of affairs where even talking about going to a better, lower risk system is laden with danger for an enterprise, you know there is much to do. So do not fear, the Center will have a long life and I look forward to working with you.

*In addition to his responsibilities at Rohm and Haas, Dr. Lewis is a teaching associate in the Division of Occupational Medicine in the Department of Environmental Health at the Johns Hopkins University School of Hygiene and Public Health. He is a Presidential appointee to the Board of Directors of the Mickey Leland Urban Toxics Research Center and a Fellow of both the American College of Preventive Medicine and the American College of Occupational and Environmental Medicine.*

*Dr. Lewis has won many awards over the years, including the George M. Sternberg Medal for Excellence in Preventive Medicine and Epidemiology. He is widely published and has lectured extensively on preventive, occupational and environmental medicine and public health.* ■

## Investigating the Use of Third Party Auditors in Environmental Regulations

As our country's population increases and our industrial technology becomes more complex, one of the challenges we face in a democratic society is determining what kinds of risks we are willing to take and how we should manage them. Which environmental laws and regulations should we enact and how should we enforce them?

One of the recent pieces of environmental legislation currently in the news is section 112(r) of the Clean Air Act (the Rule). The objective of the Rule is to prevent accidental chemical releases from facilities that manufacture or process dangerous chemicals. As such, it is intended to augment other existing regulations aimed at improving the quality of air that we breathe and to result in improved public health. This past summer, facilities regulated under the Rule were required to file a Risk Management Plan (RMP) with the Environmental Protection Agency no later than June 21. The RMP, which contains a five-year history of past accidental releases and the consequences of a worst-case release that might occur, must be based on the risk management program that the facility has in place to prevent accidental chemical releases and to mitigate the consequences of releases that might occur. Several thousand facilities filed RMPs.

Over the past few years, under a cooperative agreement with the Environmental Protection Agency's Chemical Emergency Preparedness



*Training session for third party auditors at Delaware's Department of Natural Resources and Environmental Control.*

and Prevention Office (CEPPO), the Risk Center has become interested in the public policy problems associated with ensuring compliance with the Rule. Because the Rule covers thousands of facilities, many of which are small businesses lacking substantial financial reserves and technical human resources, its use raises the questions: "How can small firms comply with the Rule?" and "What is the best way for federal and state agencies to ensure compliance without having to allocate substantial additional human resources?" Wharton is interested in determining if there is a way to utilize market forces in order to avoid continued reliance on command and control enforcement of environmental regulations.

Although third parties are being used more and more in industry, their use in the Clean Air Act raises a number of technical, legal, financial and public awareness

issues. Currently, Risk Center personnel and representatives from CEPPO, EPA Region III and Delaware's Department of Resources and Environmental Control (DNREC) are cooperating in a task force to conduct a pilot experiment. The group is in the process of selecting appropriate industrial sectors to participate in the pilot, establishing criteria for accepting and evaluating third party auditors, developing incentives for facilities to use third party auditors, and defining measurements needed to evaluate the effectiveness of the pilot.

DNREC personnel will initiate the pilot in Delaware but the task force hopes soon to expand it to facilities in Pennsylvania. In late July, personnel from DNREC and EPA Region III spent two days conducting an intensive training session for voluntary third party auditors. Training included review

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of both the risk management program and the RMP required by the Rule, as well as process safety management practices characteristic of the industrial sectors selected for the pilot — chlorine-treatment

water facilities and ammonia-refrigerated warehouses. Although the voluntary audits are expected to take place this fall, the evaluation of their results from the standpoint of the facilities that participate, the

attractiveness to third party auditors, the value to enforcement agencies and the acceptability of the process to communities will extend into the next twelve months. ■

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## Wharton Impact Conference on Environmental Issues

On September 24 and 25, 1999 a series of international speakers will address the Wharton Impact Conference at the University of Pennsylvania Law School, titled “Environmental Contracts and Regulatory Innovation: Comparative Approaches in Europe and the United States.” The aim of the conference is to have a direct impact on public policy through critical debate about what works and what doesn’t, resulting in a recommendation for future legal practice and reform.

This impact conference is being sponsored by the Institute for Environmental and Energy Law, the University of Leuven, Law Faculty, Belgium; Seminar in Theories of Environmental Practice, the University of Pennsylvania Law School; and the Legal Studies Department and Risk Management and Decision Processes Center, the Wharton School of the University of Pennsylvania. The conference has received special grant support from the German Marshall Fund, the IUS Commune Research School,

and the Ford Motor Company Fund.

The conference will bring together leading figures in academia, business, government and public interest organizations to discuss recent innovations in the use of environmental contracts or agreements as a method of regulation in Europe and the United States. This approach is widespread in Europe, and comparable experimental programs are in progress in the United States. The conference will focus on the use of contracts — the preeminent market-based legal instrument — as an aid to environmental regulation. Problems remain concerning how broad-based contracting may fit within the structure of different legal and political systems. But experiments in the use of environmental contracts have begun on both sides of the Atlantic, so that the comparative study to be offered at this conference is especially timely and valuable.



*Eric W. Orts*

Any comparison of environmental regulation in Europe and the United States must take account of differences in legal context and culture. Two very different kinds of federal systems are at work. In Europe, the Federalist principle of “subsidiarity” is very important in environmental regulation, and

in the United States the issue of federalism in environmental law has recently become equally prominent. The topic of comparative federalism must inevitably frame any discussion of environmental law in Europe and the United States.

The major papers at the conference will be published.

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## Chemical Accident Risk Assessment Thesaurus (CARAT)

For some time the Risk Center has been investigating the creation of an improved tool for understanding international laws, regulations and guidelines pertaining to the risk assessment of chemical accidents at fixed facilities. This work is being done at the request of the Organization for Economic Cooperation and Development (OECD) and under a cooperative agreement with the Environmental Protection Agency's Chemical Emergency Preparedness and Prevention Office (CEPPO). Recently, Wharton researchers achieved three significant program goals. They completed the development of the computer system designed to analyze risk assessment processes, installed the system on the OECD's computer in Paris, and conducted a data-entry workshop for OECD member countries in Sweden.

In the past this project has been referred to as the OECD Dictionary/Thesaurus. However, OECD believes that a name translatable into a pronounceable acronym is essential. Accordingly, the name for the system has been changed to "Chemical Accident Risk Assessment Thesaurus" (CARAT).

### CARAT Finalization

Because the early development work on the CARAT did not require security features and mechanisms to separate work in progress from information publicly accessible, it

became necessary to provide these features before the OECD could make the system publicly available. Some additional features to improve the ease of the data entry process and clarity of the query modules were also required. All of these changes were incorporated into the final version of the CARAT.

### Installation in Paris

As part of the agreement to make the CARAT a regular asset of the OECD Working Group on Chemical Accidents, it was necessary that the system be physically located on the OECD computers in Paris. These computers are robust enough to handle whatever usage would occur over the Internet and the OECD information technology group has the resources to manage the system on a 24-hour basis. Furthermore, the risk assessment group at the National Institute of Public Health and the Environment in the Netherlands (RIVM) will manage day-to-day technical issues arising from users of the CARAT. The entire system, formerly located on the Wharton computers, was successfully installed on the OECD computers in Paris. Recent testing within Europe and the United States indicated satisfactory performance.

### Training Session

In conjunction with the decision to accept the CARAT as a sponsored facility, the OECD Working Group recognized that a critical mass of quality data would be necessary in

the system when it is opened to the public. To this end, the Risk Center personnel conducted a training session in Rosersberg, Sweden, on the proper entry of data into the CARAT. Individuals from eight OECD Member countries (Belgium, Canada, Germany, Netherlands, Sweden, Switzerland, United Kingdom and the United States) and one individual representing the European Commission participated. The attendees used the CARAT to enter documents that were important to their government or agency. This is a critical first step in the successful operation of the CARAT.

### Future Events

The transfer of the CARAT to Paris does not conclude work on this project. The Risk Center will continue to train the CARAT Application Manager on the intricacies of the system and will support the technical aspects of the CARAT until the system is fully supported by the OECD Working Group on Chemical Accidents. In the meanwhile, Risk Center researchers are exploring other uses of the system, especially with those who have expressed an interest in obtaining the source code for related uses. ■

## Environmental Justice: Siting Rules Need to Balance Openness and Privacy

Felix Oberholzer-Gee

Executive Order 12898, signed by President Clinton on February 16 1994, requires each federal agency to “make achieving environmental justice part of its mission.” The impetus for the order came from several studies indicating that areas with a larger number of hazardous waste sites tended to be the areas where low-income and minority families lived. While the relationship between environmental burdens and socio-economic status is not yet fully understood, federal as well as state agencies now struggle with the question of how to best achieve the goal of environmental justice. Should we disallow the siting of new facilities in all communities where health is below a particular standard? And if so, who determines this standard? Do we consider average health or should we base our decision on the health status of the poorest families in a community? Does it matter whether or not poor health is the consequence of environmental conditions or the result of a particular lifestyle?

It is unlikely (to say the least) that we will ever reach consensus on these questions. Nor should we try to. Take a waste processing facility that produces negative environmental externalities (within the limits of the law). The facility also creates jobs and generates additional tax revenue. Is the community better off with or without this facility? This is a question of values. Some may feel that it is worth accepting the risk; others may have a different

view. However, this being a question of values, no outsiders, including state and federal agencies, should be allowed to impose the facility on the community. Nor should outsiders be allowed to withhold a facility from a community that wants to have it. Achieving environmental justice is not a matter of specifying equitable *outcomes*. Rather, environmental justice concerns require new *decision rules* by which communities decide if they wish to host a particular facility.

What should these decision rules look like? In a recent study, jointly written with Howard Kunreuther, we have analyzed how local public officials decide whether or not to support the siting of a controversial facility in their district. The context for our study is the siting of a radioactive waste repository in Pennsylvania. To see how public officials make these decisions, we conducted a survey among more than 500 Pennsylvania township supervisors. Not surprisingly, we find that expectations matter: Supervisors are more likely to favor the siting of the repository if they expect it to provide greater benefits (jobs, taxes) and if they think it poses smaller health risks. In addition, we also find important social influences. In particular, many township supervisors are reluctant to support the facility because



Felix Oberholzer-Gee

they fear that they might lose respect in their community if they advocate a facility that few citizens like.

This finding has important implications for the design of siting rules that are consistent with environmental justice. As many facilities are politically contentious, residents of the

host community may be reluctant to offer their true views in public. If we find that township supervisors hesitate to publicly state what they think, this is likely to be true for ordinary citizens as well. One solution to this problem is to make the final siting decision in a local referendum. Referenda have the advantage that citizens are guaranteed their privacy in the voting booth. Thus, no one needs to feel pressured to vote in a particular way.

In most areas of (environmental) policy-making, openness is to be preferred to secrecy. Wherever possible, information should be shared and risks should be discussed openly. However, the final stage of a siting decision appears to be the exception to the rule. Where social pressure is high, we might be better off by granting citizens more privacy. Local referenda are one way to have citizens truly speak their minds. ■

*Felix Oberholzer-Gee is Assistant Professor of Public Policy and Management in the Wharton School.*

## Cost-Benefit Study of Earthquake Mitigation Measures for Lifelines

The Risk Center is involved in a project to develop modules for benefit-cost analysis of mitigation measures as part of a National Science Foundation Center's grant to the National Center for Engineering Research at the University of Buffalo. The Center is focusing on the use of benefit-cost analysis for evaluating the direct and indirect benefits of mitigation measures for an electricity lifeline in Memphis, Tennessee.

With respect to the direct benefits of mitigation, we will characterize the costs to restore the damage from an earthquake when mitigation has been undertaken and when it has not. Indirect benefits from having lifelines function after an earthquake involve the reduction in business interruption as well as reduced costs to residents who



*Earthquakes are driving research on mitigating the effects of natural hazards.*

might otherwise have to leave their homes due to lack of power.

The research for this project involves an interdisciplinary team that includes Adam Rose from Penn State University, Joanne Nigg and Kathleen Tierney from the University of Delaware, Stephanie

Chang from Washington State University, William Petak and Masanobu Shinozuka from the University of Southern California and Patricia Grossi and Howard Kunreuther from the University of Pennsylvania. ■

## Center Activities in the New Millennium

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for mitigating earthquakes and providing funds for catastrophic relief in emerging economies. How Europe deals with environmental protection may provide insights into ways that the United States can utilize regulations coupled with other policy tools for dealing with these risks.

For our next Advisory Committee meeting on September 23 the Center is planning a set of activities that will address these

issues. In particular we will focus on future Center projects that take advantage of new advances in modeling risks and information technology to link science with policy. We will also be considering ways that our current research activities can be expanded to address global issues.

In this spirit, the Wharton Impact Conference on September 24 and 25 on "Environmental Contracts and Regulatory Innovation" following

our AC meeting will compare European and American systems so that both parts of the world can learn from each other.

Future newsletters will elaborate on these initiatives. We always welcome your thoughts and ideas of research that will keep the Center abreast of new developments and involve both the private and public sectors in our efforts.

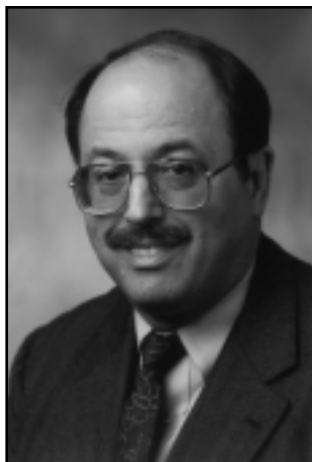
— Howard C. Kunreuther  
Co-Director

## Changing of the Guard

**Robert P. Irvan**, Senior Vice President and Chief Financial Officer for CIGNA Property & Casualty, who has been a member of the Risk Center's Advisory Committee since 1992 and its Chair since 1998, retired from the Advisory Committee at the end of July when his retirement from CIGNA became effective.

Before his assignment as CIGNA's CFO, Bob also served the company as vice president and chief actuary, and as senior vice president in charge of international reinsurance. In addition to his duties within the company, Bob was extremely active in the insurance industry and led many insurance industry task forces, including the 1992 multinational Business Task Force and the Quality 88 Claims Task Force. He was always at the cutting edge of understanding the character and magnitude of risk that the industry faced and as a result, his understanding contributed to the Center's various research programs and helped its personnel better understand public policy issues associated with low probability-high consequence risk.

In addition to his technical guidance, Bob was always available to consult with faculty and students at the University and shared risk information freely. The Risk Center wishes to thank Bob for his contributions and for the deep and invaluable friendship he offered



*Robert P. Irvan*



*David M. Ferguson*

to everyone here. We wish him well and hope that low probability-high consequence risk will never intrude on his new activities.

**David M. Ferguson**, General Manager, Safety Health & Environment, ICI Specialty Chemicals, who has been a member of the Advisory Committee since 1992, resigned from the committee at the end of August, consistent with his retirement from ICI.

David's knowledge of the chemical industry and its relationship to the research interests of the Center has been invaluable. He recognized the challenge that low probability-high consequence risks meant to the chemical industry and the public policy and regulatory issues associated with the social

charter under which firms operate. His background as a physiologist/chemist with 33 years experience with ICI in various management roles in Europe and the United States gave him the insight to focus on the risk concerns important to both the industry and the Center. His additional experiences, such as his year in Copenhagen with the World Health Organization as Toxicology Officer for the European Region, provided further insight into the risks posed by various technologies extant in our modern society. From this framework he advised and guided the Center in its research initiatives.

The committee wishes David well in his new activities and thanks him sincerely for his meaningful contributions to the Risk Center. ■

**Advisory Committee Meeting**

The Center will hold a semi-annual meeting of its Advisory Committee on September 23, 1999 in the Dean's Conference Room, 1020 Steinberg Hall-Dietrich Hall, the Wharton School of the University of Pennsylvania. The meeting will begin at 9:00 a.m. and end at 4:30 p.m.

The meeting will begin with a review of the Center's research initiatives, including the following:

- The Epidemiology Project Using the RMP\*Info Database
- The Use of Third Parties in the Clean Air Act (Pilot Experiment in Delaware)
- The Chemical Accident Risk Assessment Thesaurus (CARAT)
- Two projects involved with Managing Catastrophic Risk

Before lunch the Advisory Committee will break into small groups to discuss future research initiatives and opportunities that the Center has, based on current activities:

- Large-Scale Chemical Accidents
- The Role of Market Mechanisms in Dealing with Environmental Risk
- Managing Catastrophic Risks from Natural Disasters

The intent of the discussion will be to take advantage of information technology and risk assessment modeling. The key challenge for all of the projects will be to link science with policy. At the same time, the Center will consider opportunities to expand its activities to other parts of the world consistent with the globalization trend.

The speaker at lunch will be Jim Makris, Director, EPA's Chemical Emergency Preparedness and Prevention Office. His topic will be "RMP\* Data Base and the off-site consequences of Public Law 206-40."

After lunch we will ask the small discussion groups to address the following questions:

- What potential research project could take place in your area?
- What public and private sector organizations would be interested in participating in such projects?
- What are the potential sources of funding for this research?

The meeting will conclude with recommended action plans.

**Comings and Goings**

**Heinrich Rommelfänger** will be visiting the Center this fall. Dr. Rommelfänger is a professor of Operations Research and Statistics at the University of Frankfurt, and he will be visiting the OPIM Department and the Center as the Metzler Foundation Professor. His current research interests are in the area of "fuzzy" optimization and inference. This is an area of some interest in risk management since a number of risk problems exhibit qualitative indicators; these can be expressed more easily using fuzzy logic than other approaches.

**Paul Kleindorfer** is spending the coming academic year in France, where he will continue his research on accident epidemiology and catastrophic risks. He will be a visiting scholar at the European Institute of Business Administration (INSEAD) in Fontainebleau and will also be working with the OECD in Paris.

The Corporate Associates program is a vital part of the Risk Center's operation. Corporate Associates sit on the Center's Advisory Committee, participate in Roundtable meetings and offer information and insight into the value, direction and timing of research projects. In addition, Corporate Associates provide the Center with important financial support.

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## Keeping in Touch

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If you want to be removed from our mailing list, please let us know.

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