

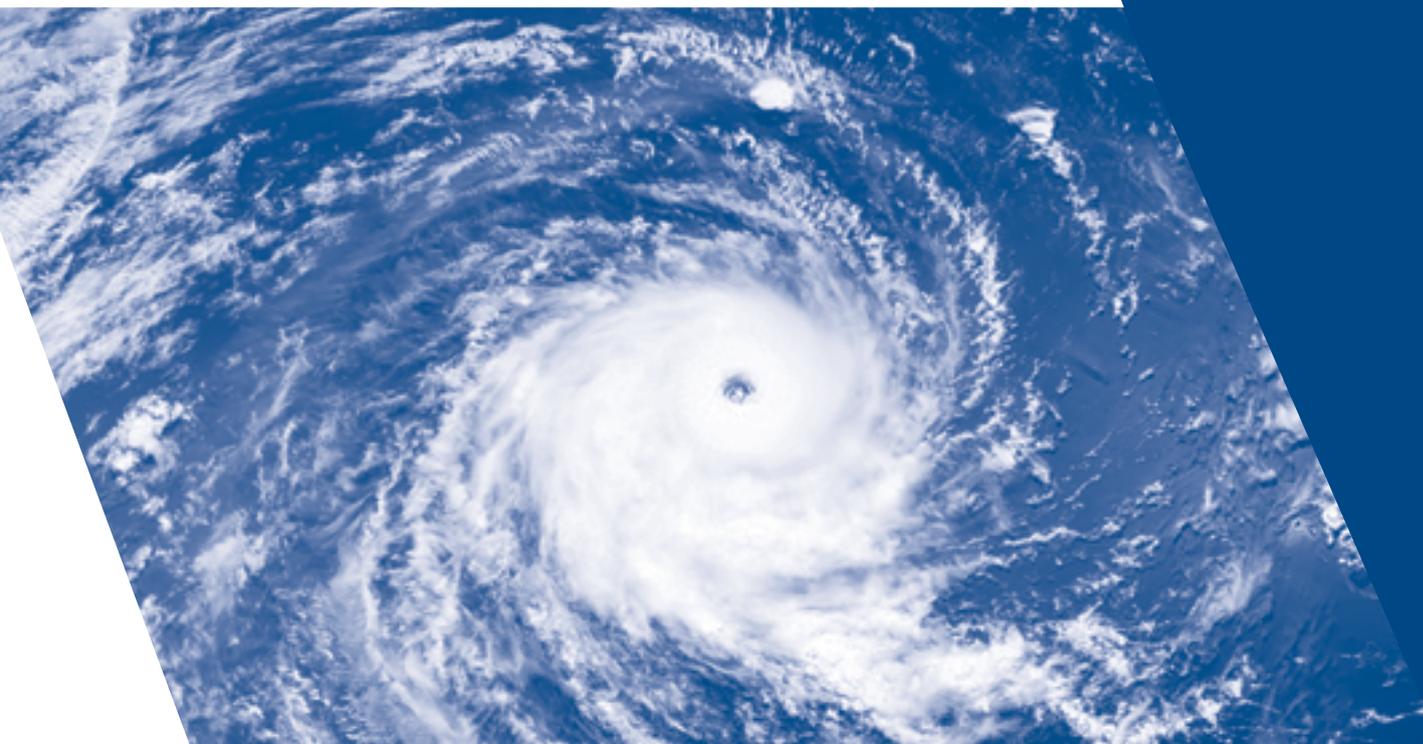


RISK MANAGEMENT AND
DECISION PROCESSES CENTER

Annual Report

2018

Research to promote effective corporate and public
policy for risk management and decision-making





RISK MANAGEMENT AND DECISION PROCESSES CENTER

ABOUT THE CENTER

Providing expertise and a neutral environment for discussion, the Center actively engages multiple viewpoints, including top-level representatives from industry, government, international organizations, interest groups and academics to promote dialogue through publications, seminars and forums.



Decision Process

Understanding and improving individual decision-making in the presence of uncertainty.



Risk Management

Researching and evaluating strategies for risk communication, risk reduction, and risk transfer.



Public Policy

Engaging decision-makers in designing effective risk management policies.



Table of Contents

Initiatives	4
Research	6
Outreach	18
In the News	28
Research Team and Partners	30

For more than three decades,
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.

LETTER FROM OUR DIRECTORS

From its inception, the Wharton Risk Management and Decision Processes Center has focused on understanding how individuals, communities, private firms and public sector organizations make decisions with respect to low-probability events that can cause significant losses and disruptions when they occur. We are committed to research that leads to public policies that encourage relevant parties to invest in cost-effective protective measures that reduce catastrophic losses.

Over the past 35 years, the Wharton Risk Center has conducted research and held conferences on topics ranging from chemical safety to natural disasters and terrorism, bringing together key interested parties in a neutral forum. We have also created partnerships with organizations who share our view that it is important for residents and businesses in risk-prone areas to undertake protective measures now rather than waiting until the next disaster occurs. Our ongoing activities focus on increasing our understanding of decision processes through field and controlled experimental research. Risk management programs emphasize insurance, mitigation and communicating information on the likelihood and consequences of extreme events. Policy recommendations involve social media as well as partnerships between the private sector and government.

Research in psychology and behavioral economics has found that human decision-making is often guided by biases that impede our ability to make good decisions about how to prepare for low-probability, high-consequence events. This past year, the Center has focused on how we might overcome these biases through a blend of novel approaches to both risk communication and risk management policies. Two examples are the behavioral risk audit and the Wharton Policy Incubator. The behavioral risk audit is a tool that can be used to anticipate decision mistakes and suggest means of avoiding them. The Policy Incubator takes these ideas one step further by providing a testbed where researchers and policy makers can work together to develop and evaluate new implementable solutions to risk management problems.

The monumental losses due to natural disasters that occurred this past year across the globe serve to highlight the importance of the work undertaken by the Center. We are excited about the many new directions the Center is pursuing with key stakeholders to address these challenges, and we hope you will join us.



Howard Kunreuther

Howard Kunreuther
Co-Director, Wharton Risk Center



Robert Meyer

Robert Meyer
Co-Director, Wharton Risk Center

Initiatives

MANAGING AND FINANCING EXTREME EVENTS

The past several decades have seen an upward trend in economic losses from natural disasters. This rise is correlated with population and exposure growth in high hazard areas, interdependencies in economic and social systems that increase vulnerability to disruptions, and potentially exacerbated risks due to climate change impacts.

The Wharton Risk Center is working with its partners through the Managing and Financing Extreme Events project to examine long-term sustainable strategies for reducing losses from natural disasters and providing funds for recovery following a catastrophe. Overall, this initiative is concerned with (re)insurance and other risk transfer instruments in managing catastrophic risks, the role of risk reduction measures, and the role that the public sector can play in partnership with the private sector.

Among these approaches is an investigation into the current and future role of the private insurance market in closing the existing flood insurance gap in the United States. Along with expanding flood insurance market penetration, pre-event flood risk mitigation by homeowners is critical to enhancing flood resiliency. We are comparing the expected benefits with the costs of various flood mitigation techniques today and under future flood hazard scenarios, and also developing resiliency metrics that can aid infrastructure managers in their understanding of insurance needs and other ways to facilitate recovery from an event. Additionally, we are investigating different risk communication strategies that can nudge individuals, firms and communities to improve disaster preparedness.

For more information, please contact Howard Kunreuther, kunreuth@wharton.upenn.edu and Jeffrey Czajkowski, jczaj@wharton.upenn.edu.

POLICY INCUBATOR

The Risk Center's Policy Incubator supports novel approaches for increasing resilience through the development of visionary ideas, encouragement of innovative thinkers, and the advancement of workable on-the-ground solutions.

The Policy Incubator takes inspiration from business incubators. A business incubator helps launch and increase the odds of success for creative entrepreneurs or promising product or business ideas. Similarly, the policy incubator takes early-stage policy ideas and provides the needed development and support to advance an idea to piloting or implementation.

In practice, policy incubation involves many types of activities including: developing novel solutions and outside-the-box approaches; data analysis, rigorous empirical research, and stress testing of proposals; convening disparate stakeholders and interested parties for problem-solving and facilitated refinement of ideas, scoping of challenges and development of creative partnerships; well-specified assumptions, models, and relationships through field studies and surveys; ongoing interaction with the households and communities that would be affected by new policies; outreach and engagement to make sure messages effectively reach their audience using a range of media; publishing and disseminating findings; and coordinating briefings, meetings, and presentations.

For more information, please contact Carolyn Kousky, ckousky@wharton.upenn.edu.

TECHNOLOGY AND BEHAVIORAL SCIENCES

Advances in consumer technology are transforming every aspect of daily life. Billions of social media posts are shared every day, millennials are glued to their phones, and personal tracking devices (e.g., Fitbits) and AI interfaces (e.g., Alexa and Google home) are becoming a more and more ubiquitous. But while it is clear that these technologies are changing how we communicate and interact with the world, less is known about their behavioral effects.

The Technology and Behavioral Science Initiative addresses these and other questions as it works to improve the impact of technology on our lives. Wharton and Penn's resources in computer science, psychology, engineering, and management provide us with a unique opportunity to take a leadership position in this emerging area. By bridging these diverse disciplines, the initiative will increase understanding in a broad range of domains, from health and politics, to information and commerce. These insights can then be applied to enhance wellbeing, from improving customer service and disaster preparedness to building systems to identify and control the spread of hate speech and false information.

For more information, please contact Robert Meyer, meyerr@wharton.upenn.edu.

Research



FLOOD INSURANCE

The Wharton Risk Center has been examining multiple aspects of flood insurance. Our research is developing policy recommendations aimed at closing the flood insurance gap in the United States.

MITIGATION

Building codes, property retrofitting, and land-use planning can help reduce avoidable property damage and prevent unnecessary loss of life when an event strikes.

RISK COMMUNICATION

Risk information is often not well communicated to households and decision-makers. The Risk Center is investigating different strategies for communicating the risks to overcome cognitive biases that impact decision-making.

EMERGING AND MAN-MADE RISKS

Man-made risks are figuring prominently within the (re)insurance industry and on their impacts to public welfare. The Risk Center is advancing research in these areas.

SOCIAL MEDIA

While television and word-of-mouth play an important role in how consumers and other stakeholders learn about hazards, smartphones and social media are increasingly becoming a major source of news and advice.



Flood Insurance

The National Flood Insurance Program (NFIP) has been providing flood coverage to residents of participating communities for the past 50 years. The NFIP is more than just an insurance program, though, contributing to other aspects of flood risk management, such as providing risk information, requiring communities to develop building codes and land-use regulations, and encouraging investments in hazard mitigation. The program currently faces several challenges: a large flood insurance gap nationwide, maps that do not effectively communicate variations in flood risk, and balancing affordable premiums with fiscal soundness. The Wharton Risk Center has been examining multiple aspects of flood insurance in the U.S. We highlight just two projects here.

Flood Risk Management in Portland, Oregon

The Lents and Powellhurst-Gilbert neighborhoods of Portland, Oregon routinely suffer flooding from Johnson Creek. Roughly 600 buildings in these neighborhoods are mapped into the 100-year floodplain. Homeowners there that have a mortgage from a federally backed lender must purchase flood insurance.

For many low- and middle-income families in these neighborhoods, flood insurance costs are becoming unaffordable due in part to elimination of insurance discounts by the National Flood Insurance Program. The Portland Housing Bureau developed an innovative program, the Flood Insurance Savings Program, to help lower the costs of flood insurance and improve flood resiliency in these neighborhoods.

The Wharton Risk Center's Policy Incubator teamed up with Reed College and the Portland Housing Bureau to conduct a study in these neighborhoods. The study will improve our understanding in three related areas: flood insurance literacy, willingness to pay for flood insurance, and flood risk perceptions. Results will be available in early 2019.

For more on this project, see:

<https://riskcenter.wharton.upenn.edu/incubator/upgrading-flood-insurance/portland-flood-insurance-study/>

The Emerging Private, Residential Flood Insurance Market

As of April 2018, more than 4.8 million residential NFIP policies were in force nationwide, representing slightly more than \$1.17 trillion in coverage. Recently, a small private market for residential flood insurance has emerged. Policymakers are increasingly interested in learning whether the expansion of this market could help meet goals of increasing the number of homeowners with flood insurance and offering coverage that is more affordable.

Stakeholders—via congressional testimony, op-eds, reports, and other forums—have offered diverging opinions as to the appetite of the private market in writing more flood insurance, on the existing barriers to private coverage, and on the implications for the NFIP. The present state of the market is unclear, particularly since there is no nationwide data collection. This makes it difficult to evaluate the market’s future evolution and relationship to the NFIP.

In July 2018, the Wharton Risk Center released a report on this new market. The report, *The Emerging Private Residential Flood Insurance Market in the United States*, has two objectives:

- To document the current state of the private residential flood insurance market across the United States; and
- To identify the main factors influencing the number and form of flood insurance policies offered by the private market.

The private insurance market today is less than 5% of all residential flood policies purchased nationwide. Most policies are written by surplus lines firms, but there is a growing presence by admitted companies. The largest homeowners companies, however, have been hesitant to enter the private flood insurance market. Growth to date has been largely driven by reinsurer interest in covering U.S. flood; reinsurers often hold in excess of 90% of the risk.

Private policies take a number of forms, but the report identifies two prevalent types. The first is “NFIP+” policies, largely marketed in the FEMA-mapped 100-year floodplain. These policies have higher limits and broader coverages than an NFIP policy. A second type is a lower coverage endorsement to homeowners policies outside the highest risk areas.

There are parts of the country and types of properties that the private sector believes are too risky to insure. There is a need for greater investment in flood risk mitigation in these areas. While the private residential flood market is likely to continue to grow in the coming years, there will continue to be a dominant role for the NFIP.

The report is available online at <https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/07/The-Emerging-Private-Residential-Flood-Insurance-Market.pdf>. The project was funded by the Science and Technology Directorate of the US Department of Homeland Security for the Flood Apex Program under Contract HSHQDC-17-C-B0032.



Mitigation

The Vital Risk Reduction Role of Pre-Event Mitigation

While insurance transfers the risk of loss and thus speeds recovery after an event it does not ultimately eliminate or reduce the actual damage incurred. On the other hand, pre-event mitigation in its various forms—building codes, property retrofitting, land-use planning—can help reduce avoidable property losses and prevent unnecessary loss of life when an event strikes. Unfortunately, disaster after disaster reveals the underinvestment in mitigation activities and escalating costs that ensue.

The vast majority of federal disaster spending is allocated towards recovery as opposed to pre-event mitigation, despite documentation that risk reduction activities have been shown to be economically efficient; losses avoided are about \$6 for every \$1 invested. So why isn't more risk reduction being undertaken, especially as it makes economic sense to do so?

In an effort to increase investment in, and uptake of ex-ante mitigation activities across a variety of hazards—and consequently reduce the severity of avoidable impacts—the Risk Center has a number of ongoing research efforts focused at both the individual and community level. Moreover, as insurance can also be a useful lever to promote ex-ante mitigation, we explore the linkage between mitigation and insurance where applicable.

Key recent and ongoing mitigation research portfolio activities include:

- Assessing the degree to which stronger and well-enforced building codes can reduce wind-related property losses, as well as what drives homeowner support for such publicly-adopted measures
- Determining the key factors, including relevant economic incentives, that lead to the adoption of mitigation activities in high tornadic risk areas of the U.S. and in chronically flood-prone communities

- Providing an in-depth analysis over time of key aspects of the NFIP's Community Rating System (CRS) — the only national program linking flood insurance to community efforts to better prepare for flood risk. Additionally, we are undertaking studies to link the CRS scoring approach to a more holistic community flood resilience measurement framework
- Determining the economic efficiency of a number of household flood mitigation techniques as well as broader community mitigation efforts
- Understanding how various risk communication strategies surrounding probability and impact information lead to the increased likelihood of mitigation adoption behavior



Focus on Building Codes

Over the past few years, a team of researchers led by the Wharton Risk Center has set out to substantiate the degree to which communities with well-enforced, up-to-date building codes exhibit better loss experience. Through a series of published studies, this research has:

- Quantified a 72% reduction in windstorm property damages stemming from the implementation of the statewide Florida Building Code (FBC)
- Further quantified the effectiveness of the FBC against not only the impacts of high wind speeds, but also against extended duration of strong winds and large wind directional change
- Demonstrated additional Florida windstorm loss reductions through the intensity of building code implementation at the local level, by utilizing Building Code Effectiveness Grading Schedule (BCEGS®) rating data

- Determined the economic efficiency of the stronger code by comparing the reduced property damages (i.e., benefits of the stronger code) with the costs of compliance. For every dollar spent complying, property damages are reduced between \$2 and \$8.
- Demonstrated enhanced economic effectiveness of stronger codes under expected increases in hurricane wind speeds due to climate change

For more on this building code research, see:

<https://muse.jhu.edu/article/690441>

<https://ascelibrary.org/doi/abs/10.1061/AJRU6.0000947>

<https://onlinelibrary.wiley.com/doi/abs/10.1111/rmir.12086>



Risk Communication

Risk information is often not well communicated to households and decision-makers, and has not kept pace with advances in scientific understanding. The Wharton Risk Center is investigating different ways of communicating the risks associated with natural disasters to nudge individuals, firms and communities to improve disaster preparedness.

Behavioral Risk Audit

To design an effective risk management program, one must counter the cognitive biases that cause property owners to underinvest in insurance and preventive measures. A behavioral risk audit articulates effective strategies that work *with* rather than *against* people's natural decision biases.

Almost everyone has their own Achilles' heel when it comes to making decisions about protection against disaster losses. By recognizing the biases that impact behavior, strategies for addressing them may improve the decision-making process. A behavioral risk audit helps to enhance preparedness by targeting biases such as:

Myopia: Focusing on short-time horizons when appraising protective measures

Amnesia: Forgetting the lessons of past disasters when making decisions

Optimism: Underestimating the likelihood of a loss before it occurs

Inertia: Maintaining the status quo when the likelihood of a loss or insurance premiums change

Simplification: Focusing on only one dimension of the risk—either the low-probability prior to the event or the consequences after experiencing a loss

Herding: Basing one's choices on the observed actions of others

The behavioral risk audit process includes these steps:

- Identify biases: indicate the reasons that people prepare in inefficient ways for a hazard due to emotions coupled with previous experience
- Examine impact on beliefs: note the extent to which each of the biases will impact the mix of beliefs about the severity of the risks posed by the hazard
- Define manifestation in preparedness: specify how beliefs will result in protection and insurance purchasing errors
- Offer remedies: specify a strategy for individual behavior that is consistent with deliberative thinking to determine whether to purchase insurance and adopt cost-effective protective measures

Increasing the Salience of Future Disasters

Individuals, communities and firms need to understand the risks they face so that they can consider the value of adopting protective measures prior to rather than after a disaster. Partnering with the Travelers Companies, the Risk Center is examining the effectiveness of different ways to communicate the likelihood and consequences of future disasters to homes and businesses in hazard-prone areas in a transparent manner. Our goal is to provide property owners and communities with structure-specific risk information so that they will be encouraged to invest in cost-effective mitigation measures to reduce their future losses, and to purchase insurance to assist them in their recovery from natural disasters.

Stretching the Time Horizon

In particular, we are running a number of web-based experiments to determine how to provide risk information that increases the salience of events and outcomes that will lead property owners to undertake protection. We are examining the impact of stretching the time horizon for characterizing the likelihood of a disaster to see whether this framing promotes an increased take-up of insurance. Experiments conducted by the Risk Center indicate that homeowners facing

a 1-in-100 chance of flood next year are more likely to purchase flood insurance when the probability is presented as a greater than 1-in-4 chance of experiencing at least one flood over a 30-year period.

Risk Visualization Tools

With colleagues from the Travelers Companies, the Risk Center is examining the effectiveness of different ways to communicate risk — probability versus outcomes (images, simulations, stories) — in motivating people to prepare for rare disasters. Perceived efficacy and cost are shown to be among the most important considerations.

Understanding and Managing 21st Century Risks

The Wharton Risk Management and Decision Processes Center jointly with Decision Research in Eugene, Oregon, has received a grant from the Alfred P. Sloan Foundation to advance research on how individuals perceive risk and make decisions with respect to risk preparedness. The research will comprise field surveys, web-based experiments and analysis of natural language datasets to assess the personal and societal impacts of these perceptions and decisions, and develop risk management strategies that improve individual and social welfare.



Emerging and Man-Made Risks

Emerging and man-made risks are figuring prominently within the (re)insurance industry and on their impacts to public welfare. Significantly, wildfire, terrorism, and cyber risks have potentially catastrophic consequences that are inherently difficult to model given their often unpredictable and evolving nature. The Risk Center continues to play a leading role in advancing research in these areas.

Wildfire

In California and other western states in the U.S., the frequency and severity of catastrophic wildfires are escalating, leading to rapidly growing costs. Development in the wildland-urban interface (WUI) is putting more property and lives at risk while increasing the likelihood of ignitions. Prolonged droughts, invasive species, and past fire suppression practices have dried out millions of trees and other flora, allowing fires to quickly expand and intensify.

Yet those in a position to undertake cost-effective risk reduction actions may not have strong incentives to do so. Without adequate risk reduction, costs will likely continue to rise.

In response to these challenges, the Wharton Risk Center is undertaking a series of projects to better understand who ultimately bears the burden of increasing wildfire risk and recommend policy changes to more optimally combine pre-event risk reduction with post-event disaster financing.

Projects include:

- Examining how wildfire costs are distributed among homeowners, insurers, local governments, state and federal government agencies, electric utilities, and other stakeholders
- Developing tools to visualize wildfire risk, including the potential impacts of climate change and increasing development in the WUI
- Conducting hedonic analyses to estimate the degree of capitalization of wildfire risk into property values
- Analyzing incentive effects and distributional impacts of shifting more wildfire costs to local governments and residents of fire-prone areas

Terrorism

The Terrorism Risk Insurance Act (TRIA), passed in the aftermath of 9/11, established a public-private partnership among the U.S. federal government, private insurers and all commercial enterprises operating on U.S. soil. Renewed several times, this program requires insurers to offer terrorism insurance to their commercial policyholders while providing the insurers with financial protection up to \$100 billion against terrorist attacks in the U.S. With the federal government providing a financial safety net, the private sector can offer coverage against an uncertain risk that would otherwise be considered uninsurable, thus making terrorism insurance widely available and affordable. In 2015, the Act was modified and extended until December 2020.

TRIA remains untested for large losses so it is unclear how the market and policymakers will react should another large-scale insured loss occur. TRIA also raises concerns about the indemnification of individual victims of a terrorist attack. Terrorism coverage under TRIA applies only to events that are labeled as terrorism by the federal government. Some infrastructure managers choose not to purchase this insurance due to the limitations of TRIA, or they choose not to insure if they believe their location is not a target for terrorist attacks.

The Wharton Risk Center has been advancing knowledge on terrorism insurance markets since 2001, actively involved with key decision makers here and abroad in developing a long-term sustainable solution to terrorism risk financing. Our goal is to provide policymakers, key industry decision makers and other interested parties with an updated analysis of the roles the public and private sectors can and should play with respect to terrorism risk coverage in the United States and abroad in the post-9/11 world.

See: A Successful (Yet Somewhat Untested) Case of Disaster Financing: Terrorism Insurance under TRIA, 2002-2020. *Risk Management and Insurance Review* (2018) Vol. 21, No. 1, 157-180, DOI: 10.1111/rmir.12094. https://riskcenter.wharton.upenn.edu/wp-content/uploads/2018/03/J2018RMIR_TRIA-2002-2020.pdf.

Cyber

Cyber risks are on the rise, affecting organizations in both the public and private sectors including critical infrastructure sectors such as energy and transportation. Cyber insurance has been recognized as an effective way to improve resilience against rising cyber risk, being identified as the fastest growing line of business in the insurance industry. However, after some years of development, cyber insurance products are still relatively immature.

In addition to the unique and evolving nature of cyber risk, another major obstacle for insurers to provide better products is the lack of reliable risk assessment information. Cyber data is limited. Moreover, many organizations have just started to pay more attention to this relatively new type of risk, and have difficulties in understanding their own risk exposures. Therefore, improving cyber risk assessment is important for the cyber insurance market to grow and at the same time makes organizations feel more comfortable about using cyber insurance to enhance their resiliency against cyber incidents.

The Wharton Risk Center is developing research focused on two key issues: (1) limitations in data and data analysis that are inhibiting cyber risk mitigation and insurance, and (2) behavioral biases that are impacting cyber risk assessment and management. These issues will be tested through the collection of and subsequent analysis of loss data and working with identified insurance industry partners to extend our existing work that has included:

- Analysis of cyber incident data for transportation systems and interviews with transportation infrastructure managers and insurers to identify barriers to a robust cyber insurance market and improved cyber resilience for transportation infrastructure
- Assessment of corporate cyber risk perceptions in the Netherlands that elicited perceptions of cyber risk awareness and of the perceived probability and impacts of a successful cyber-attack, as well as the demand for cyber insurance

See: <https://link.springer.com/article/10.1057%2Fs41288-018-0082-7>

Social Media



Using Social Media Data to Better Understand Protective Decision Making in Response to Disasters

The advent of social media and smartphones has had a transformative effect on how we communicate. While traditional media channels such as television and word-of-mouth continue to play an important role in how consumers learn about hazards and make preparedness decisions, smartphones and social media are increasingly becoming a major source of news and advice.

These channels have also opened up major new research opportunities to study the dynamics of hazard response by investigating changes in the linguistic content of social media conversations and postings (e.g., on Twitter) over the course of extreme events. In this research, we will be using a suite of natural language processing tools to study how sentiment and conversation changes over the course of an evolving hazard event.

The work will help inform not only basic questions about the dynamics of risk response, but also how warning messages might be improved in the face of new threats.

By applying advanced computational tools to deepen behavioral understanding, Penn/Wharton can be at the forefront of this movement.

The initiative is currently supported by seed funding from the Wharton Dean's office. Current activities include:

- Behavioral Insights from Text, an annual conference initiated in 2018 that draws the world's leading scholars to discuss how natural language processing and text analysis can be used to shed light on all aspects of human behavior.
- Interdisciplinary lab group that brings together students and faculty from Wharton, Psychology and Computer Science to discuss shared interests, projects, and tools.

Smartphones as an Adult Pacifier

In this research, the authors explore the nature of the relationship that consumers form with their smartphones and show that many consumers derive not just practical benefits from their smartphone but also emotional ones—most notably, an enhanced sense of psychological comfort that provides relief from feelings of stress. In two experiments, participants are put under stress, and are then allowed to browse the same online material either on their smartphones versus a personal computer, or their own smartphone versus a similar phone belonging to a lab. As predicted, the data show greater relief from stress when participants can interact with their own phones.

The studies offer important insights into how phones might be used not just as a means of gaining information in times of stress (such as a natural disaster), but also as a calming aid that can help individuals make better decisions in such times. *For more details, contact the lead author, Shiri Melumad, melumad@wharton.upenn.edu.*

Selectively Emotional: How Smartphone Use Changes User-Generated Content

User-generated content (such as customer reviews) are increasingly generated on smartphones. In this research, the authors show that smartphones cause consumers to generate briefer content, which encourages them to focus on the gist of their experiences. This focus on gist, in turn, results in reviews that emphasize the emotional aspects of an experience.

Across two field studies and three controlled experiments, natural language processing tools and human assessments analyze the linguistic characteristics of user-generated content, finding that smartphone use indeed results in the creation of content that is less specific and more emotional in nature. *For more details, contact the lead author, Shiri Melumad, melumad@wharton.upenn.edu.*

Emotional Volatility and Cultural Success

Why do certain movies and books catch on and become popular, whereas others do not? This study looks at how period-to-period shifts in emotional tone play an important role. Automated sentiment analysis of thousands of movies demonstrates that more emotionally volatile movies are evaluated more positively. This relationship holds controlling for a range of other factors, and, consistent with the notion that emotional volatility makes experiences more stimulating, is stronger in genres where evaluations are more likely to be driven stimulation (i.e., thrillers rather than romance).

By manipulating emotional volatility in a follow-up experiment, the authors underscore its causal impact on evaluations, and provide preliminary evidence for the role of stimulation and engagement in driving these effects. Taken together, these results shed light on why things become popular, the time dynamics of emotion, and the psychological foundations of culture more broadly. *For more details, contact the lead author, Jonah Berger, berger@wharton.upenn.edu.*

Outreach



Distribution of leading-edge knowledge is as important as the creation of that knowledge. The Wharton Risk Center widely disseminates its research findings throughout a network of industry experts, representatives from the public sector, and scholars and students through our publications, conferences and outreach activities.

STUDENT ENGAGEMENT

Fundamental to the Wharton Risk Center's activities is support of student education. Several initiatives advance and draw upon emerging scholars to promote research, provide experiences and train leaders.

BOOKS AND PUBLICATIONS

The Risk Center publishes work on an array of topics involving risk management and decision-making. Our policy briefs distill research findings and how these findings can be applied to the management of catastrophic risks.

CONFERENCES AND SEMINARS

The Risk Center shares research findings and information on dealing with risk through its conferences, annual corporate sponsor meetings, interdisciplinary seminar series, and workshops and presentations around the country.

PUBLIC SECTOR INVOLVEMENT

Wharton Risk Center directors and fellows serve on national and international committees involved in public sector policy decision-making to improve preparedness for extreme events.

STUDENT ENGAGEMENT

Fundamental to the Center's research activities is support of student education in the areas of decision-making, risk communication and risk management. Several initiatives advance and draw upon emerging scholars to promote research, provide experiences and train leaders.

Russell Ackoff Doctoral Student Fellowship Awards

The Russell Ackoff Doctoral Student Fellowship program of the Wharton Risk Management and Decision Processes Center provides grants to University of Pennsylvania doctoral students who are pursuing research in decision making under risk and uncertainty. Prof. Emeritus Russell Ackoff's (1919-2009) work was dedicated to furthering an understanding of human behavior in organizations. Those receiving funding cut across a variety of topics including: Insurability and Risk Management; Managing Environmental, Health and Safety Risks; Psychology, Communications, Behavioral Economics; and Decision Processes. This year, fellowships were awarded to 23 doctoral students at Penn. The fellowships are funded by an endowment provided to the Wharton School by the Anheuser-Busch Charitable Trust. See <http://riskcenter.wharton.upenn.edu/russell-ackoff-doctoral-student-fellowships/>.

An important component of the Ackoff program is the opportunity for doctoral students and faculty involved in decision research to connect with each other. Recipients of the 2017 Doctoral Student Fellowships presented their research at the annual Ackoff luncheon in May 2018.



HACK-FOR-RESILIENCE

PennApps Hackathon

The Risk Center's Policy Incubator and the Insurance Information Institute teamed up to sponsor a "hack-for-resilience" route at this year's PennApps, the nation's first student-run college hackathon. The "hack-for-resilience" route engaged students to develop apps, tools, and other technologies that can effectively communicate risk to families and communities in hazard-prone areas. Such apps include ways to help people better understand the risks they face, the potential or historical impacts of disaster, the benefits of risk-reduction measures or insurance, and how to improve preparedness.

Students from around the country worked on innovative software and hardware solutions to real-world disaster resilience problems. Projects ranged in platform and application, including elements of web development, mobile applications, drones, and more. In total, 44 teams participated in the "hack-for-resilience," developing projects to improve various aspects of disaster preparedness, response, and recovery.

The top three projects were:

Babble, Emmanuel Eppinger, Conlon Novak, and Aneek Mukherjee

Babble is a chat platform that can be installed and used completely offline, providing a reliable form of communication in disaster and other situations where internet infrastructure is damaged, unreliable, or nonexistent.

Eleos, Ben Elo

Eleos is an online platform that allows people to donate goods and services directly to those in need after a natural disaster.

Cozy, Hannah Daniel, Mrinali Nakhre, Sahar Sami, and Eesha Sharma

Cozy is a Google Chrome extension that provides property-specific disaster risk information to users when they visit housing websites such as Zillow or Trulia.

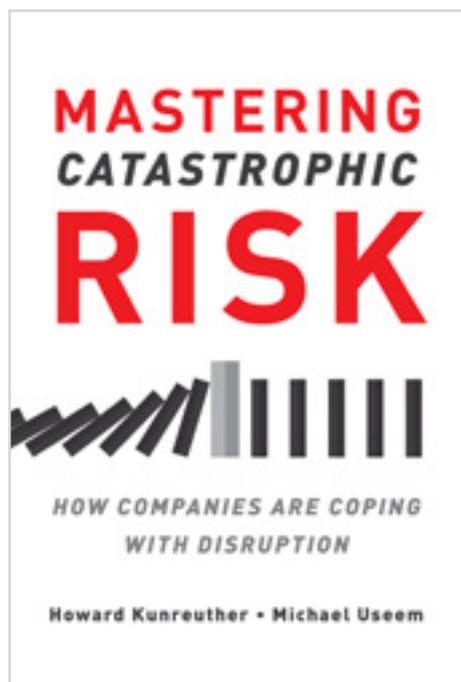
FILM SCREENING

Rising Waters

The Wharton Risk Center teamed up with Penn Sustainability and the McHarg Center at Penn's School of Design in a double screening of two award-winning films about adapting to sea level rise in radically different contexts. The films explore how people in different parts of the world are learning to adjust to rising waters. *Tidewater* examines how sea level rise is impacting the Hampton Roads area of Virginia, home to the highest concentration of military assets in the country. The second film, *Adaptation Bangladesh*, explores the resilience, flexibility and innovation of women in the floodplains of Bangladesh. Screening of the two films was followed by a moderated Q&A session with Rear Admiral (ret) Ann Phillips, a contributor to *Tidewater*, and from *Adaptation Bangladesh*, Alizé Carrère, Series Creator and a National Geographic Explorer. More than 100 students attended the screenings.



BOOKS

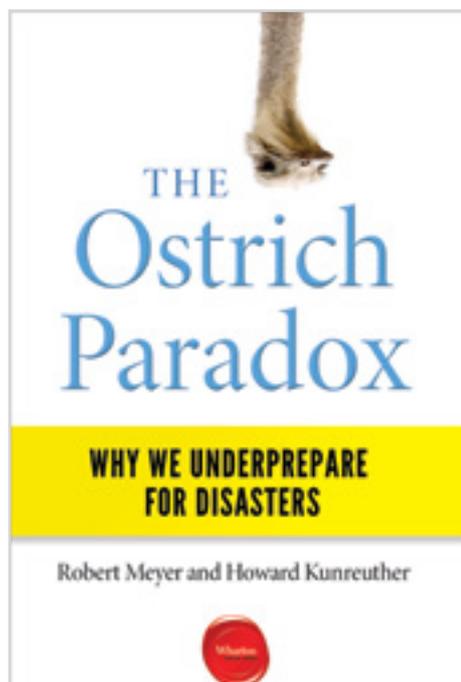


Mastering Catastrophic Risk: How Companies Are Coping with Disruption by Howard Kunreuther, and Michael Useem. Oxford University Press, 2018.

Executives and their governing boards face ever-more-challenging disruptions. Whether physical, financial or reputational, catastrophic risks threaten a firm's performance and even its existence.

With support from the Travelers Foundation, the Wharton Risk Management and Decision Processes Center and the Wharton Leadership Center undertook interviews with those responsible for more than a hundred companies in the Standard & Poor's 500 to further understanding of how large companies are dealing with adverse events. The book provides checklists that can guide companies in mastering catastrophic risk management.

248 Pages; ISBN: 9780190499402.



The Ostrich Paradox: Why We Underprepare for Disasters By Robert Meyer and Howard Kunreuther. Wharton Digital Press, 2017.

Our ability to foresee and protect against natural catastrophes has never been greater, yet we consistently fail to heed the warnings and protect ourselves and our communities. What explains the contradiction? How do people make decisions when confronted with high-consequence, low-probability events, and why do these decisions go awry?

Robert Meyer and Howard Kunreuther draw on years of research to develop the behavioral risk audit, a systematic approach for improving preparedness by recognizing these common decision biases and designing strategies that anticipate them.

130 Pages; ISBN-13: 9781613630792.

POLICY BRIEFS



A Framework for Managing Catastrophic Risks

This brief addresses the following questions: How do we harness the strengths of the private sector in financing disaster risk, and what are the complementary roles of the public and private sectors in promoting greater resilience?



Wildfire Costs in California: The Role of Electric Utilities

The costs emanating from a wildfire can be broad and impact many sectors. Depending on legal and regulatory regimes, costs can shift across different groups. In this brief, we focus on electric utilities and the share of wildfire costs that they pay in California for utility ignited wildfires.



Structure of the Residential Insurance Market

For the past 50 years, residential flood insurance in the United States has been almost exclusively provided by the NFIP. We estimate that private flood insurance currently accounts for roughly 3.5 to 4.5 percent of all primary residential flood policies purchased, but that share is growing.

JOURNAL ARTICLES

From January 2017 through October 2018 Risk Center researchers have produced nearly 70 publications on various topics involving risk management and decision-making. These research articles have been published in leading journals in risk management, insurance, economics, and behavioral and environmental science, including:

Behavioral Public Policy

Climatic Change

Geneva Papers on Risk and Insurance—
Issues and Practice

Global Environmental Change

International Journal of Disaster Risk Reduction

Issues in Science and Technology, journal of the
National Academies of Science

Journal of Environmental Economics and
Management

Journal of Extreme Events

Journal of Risk and Insurance

Judgement and Decision Making

Land Economics

Mitigation and Adaptation Strategies for Global
Change

Nature Climate Change

Philosophical Transactions of the Royal Society A

Proceedings of the IEEE.

Risk Analysis

Risk Management and Insurance Review

Science of the Total Environment

Scientific Reports

Water Economics and Policy

Water Resources Research

- 
- What features to capture?
 - Micro-level/period-to-period -emotional volatility
 - Macro-level - # of ups and downs and size

CONFERENCES AND SEMINARS

Behavioral Insights from Text. January 12, 2018.

Text analysis is an interdisciplinary discipline in which researchers mine social media such as Facebook and Twitter and other online conversations to extract behavioral insights. The first annual Behavioral Insights from Text Conference at Wharton brought together researchers from across the social sciences who are using natural language processing and related tools to better understand human behavior.

Sixteen presenters spoke on a wide variety of topics with promising uses for text analysis, such as indicators of depression, gender bias, and loan default. In a session on Opinions, Judgments, and Biases, Sudeep Bhatia presented “What do people know about real-world risk sources?” Computational analysis of over 10,000 risk-associated words showed that words strongly associated with risk were also words that were high in fear and low in happiness. Emotions such as disgust, sadness, and anger did not have a strong relationship with risk. Overall, these results show how insights from computational linguistics can be used to uncover knowledge representations underlying risk perception.

Keynote speaker Jamie Pennebaker, Regents Centennial Chair of Psychology at the University of Texas at Austin, ranks among the most cited researchers in the social sciences and helped establish the field of textual analysis. “We are at the beginning of the language world,” said Pennebaker. “None of us know what we’re doing. And I think that’s why it’s so exciting. Because we are the first people on earth to really be able to parse language like nobody else has.”

The conference was organized by Jonah Berger (above) and Robert Meyer.

Policy Options for Closing the Flood Insurance Gap. October 15, 2018.

In mid-October, the Risk Center convened experts from a range of backgrounds to evaluate policy approaches that could increase flood insurance take-up in the United States and help the Federal Emergency Management Agency (FEMA) achieve its “moonshot goal” of doubling flood coverage in the country by 2022. The workshop was supported by the Science and Technology Directorate of the U.S. Department of Homeland Security through the Flood Apex Program. It built upon findings from our recent report, *The Emerging Private Residential Flood Insurance Market in the United States*.

Risk Center affiliates Carolyn Kousky, Howard Kunreuther, Jeff Czajkowski, Brett Lingle, and Len Shabman moderated work groups discussing various policy options for closing the flood insurance gap. Discussions encompassed the role of risk communication and risk mitigation in increasing take-up rates, innovative policy designs and right-sizing policies to resident needs and risks, policies to support inclusion of flood coverage in homeowners policies, improving agent education, and helping low- and middle-income families afford coverage.

The workshop included roughly 50 stakeholders across sectors and disciplines: scholars, policymakers, risk modelers, insurer and reinsurer representatives, lenders, representatives from the real estate industry, and thought leaders from NGOs. This diverse group provided feedback and insights on proposed innovations. Representatives from FEMA briefed participants on modifications currently underway by the National Flood Insurance Program that will improve risk mapping and rating.

The project team will be synthesizing the discussion and findings from the workshop and producing policy briefs to inform NFIP reform discussions.



Brett Lingle, Len Shabman, Howard Kunreuther and Carolyn Kousky, with David Alexander of the U.S. Department of Homeland Security, Science and Technology Directorate.

CONFERENCES AND SEMINARS

Managing and Financing Extreme Events. December 7, 2017.

The annual meeting of the Wharton Risk Center's corporate sponsors featured presentations by the Risk Center directors and research team on the Center's current findings, followed by a discussion on directions for future research. Topics included "Why We Underprepare for Disasters," "The Importance of Risk-Rated Insurance Premiums and the Role of Communication" and "Tools to Measure and Enhance Community Resilience." Guy Nordenson, climate scientist, structural engineer and professor in the School of Architecture at Princeton University presented a keynote on "Probabilistic Coastal Flood Hazards Mapping."

The End of the World as We Know It? The Consequence of Extreme Climatic Disruption for Business and Democracy. April 18, 2018.

The conference gathered scholars, business leaders, and military and national intelligence services representatives to assess the risks associated with extreme weather events and their social consequences, as well as to propose risk management strategies for reducing future losses. Speakers considered how academic research can mitigate risks and promote policy change. The conference was co-hosted by the Wharton Initiative for Global Environmental Leadership (IGEL), with the Wharton Risk Management and Decision Processes Center, Zicklin Center for Business Ethics Research, Andrea Mitchell Center for the Study of Democracy, and the Penn Program in Environmental Humanities.

The Adaptation Blueprint. September 28, 2018.

Coastal communities must plan for and adapt to climate change. This daylong workshop convened leading scholars and practitioners across a range of disciplines to develop a new national agenda for designing and implementing coastal resilience. Attendees discussed innovative policy and financing solutions for climate adaptation along U.S. coasts. The conference was co-sponsored by the Risk Center's Policy Incubator, the Ian McHarg Center at Penn's School of Design, and the MIT Leventhal Center for Advanced Urbanism. An edited volume from the workshop will be produced in 2019.

Risk Regulation Seminar Series

The Wharton Risk Management and Decision Processes Center, in conjunction with the Penn Program on Regulation, and Program on Law, the Environment and the Economy, hosts an interdisciplinary seminar series on risk regulation. Recent topics include "Policy Shock: Recalibrating Risk and Regulation after Oil Spills, Nuclear Accidents, and Financial Crises" and "Economic and Demographic Effects of Emergency Risk Communication: Evidence from the Fukushima Daiichi Nuclear Disaster."



PUBLIC SECTOR INVOLVEMENT

Wharton Risk Center directors and fellows serve on national and international committees involved in public sector policy decision-making to improve preparedness for extreme events.

Technical Mapping Advisory Council (TMAC)

Howard Kunreuther serves on the Technical Mapping Advisory Council (TMAC), a federal advisory committee established to review and make recommendations to FEMA on matters related to the national flood mapping program authorized under the Biggert-Waters Flood Insurance Reform Act of 2012.

National Academies of Science/National Research Council (NAS/NRC)

Jeffrey Czajkowski and Katherine Greig serve as members of the National Research Council's Committee on Urban Flooding in the United States. The committee is exploring causes and extent of urban flooding in several metropolitan areas. Case studies will provide information on questions related to flood control, flood response, recovery, and mitigation both outside and inside the floodplain, and identify commonalities and variances among metropolitan areas on causes, adverse impacts, unexpected problems in recovery, and effective mitigation strategies.

New York City Panel on Climate Change

Howard Kunreuther serves as a member of the New York City Panel on Climate Change (NPCC). The NPCC is comprised of 15-20 experts on climate change from around the New York metropolitan region who are tasked with providing the latest climate information to the Mayor's Office of New York City to be used for policy and planning. Howard was an author in the NPCC 2015 Report and is an author in the upcoming NPCC 2019 report.

High-Level Advisory Board on the Financial Management of Catastrophic Risks, OECD

Howard Kunreuther serves on the High-Level Advisory Board on the Financial Management of Catastrophic Risks for the Organisation for Economic Co-operation and Development (OECD). Among other roles, the board advises research and analysis on topics related to the financial management of disaster risks, and identifies significant challenges and gaps in the financial management of disaster risks globally or in specific countries/regions, and policy issues that need to be addressed.

In the News

MEDIA QUOTES

Carolyn Kousky: “We have good data about flood risks. The challenge is getting it to people when they need it, in a way that’s useful.”

CityLab, October 11, 2018

Robert Meyer: “Recent years have seen tremendous advances in our ability to predict natural disasters that may become increasingly common as the climate changes. But these advances have done little to reduce the damaging cost of these events. The key to better preparedness is to design preparedness measures that anticipate them.”

The Washington Post, September 12, 2018

Howard Kunreuther: “There’s a tendency for all of us — not just firms, but individuals — to be myopic. It often takes a disaster to get people to pay attention.

NPR, August 31, 2018

Howard Kunreuther: “Flood insurance with artificially low premiums can perversely incentivize people to both live in flood-prone areas and underestimate their risk as well as encouraging property owners in high-risk areas to keep rebuilding after flood damage.”

U.S. News and World Report, July 31, 2018

Jeffrey Czajkowski: “Comparing the increased construction cost to the expected reduction in windstorm damage across the life of the home shows anywhere from \$2 to \$8 in expected damage reduction—the benefit—for every dollar of increased cost.”

Brink News, July 11, 2018

Carolyn Kousky: “The first few days after a disaster... are about emergency response: making sure people are safe, reuniting families, securing housing, filling necessities and restoring lifelines. But as days shift to weeks and then months and years, the slow process of rebuilding is undertaken. At every step of the way is the question of financing. Are there dollars available for what needs to be done? How will the costs be shared?”

The Hill, September 15, 2017

Howard Kunreuther: “It gives people a feeling of complacency if they are not required to buy insurance.”

The New York Times, September 5, 2017

Robert Meyer: “If you’re just starting to think about it, you’re kind of too late.”

Scientific American, August 25, 2017

AWARDS

Our partners can be proud of the recognition the Risk Center has received this past year.



Carolyn Kousky, Director of the Policy Incubator at the Wharton Risk Center accepted the award from Queen Sofia of Spain at Fundación MAPFRE's annual ceremony in Madrid on June 14, 2018.

Policy Incubator Receives Julio Castelo Matrán International Insurance Award

The Wharton Risk Center's Policy Incubator received the Julio Castelo Matrán International Insurance Award from Fundación MAPFRE, a Madrid-based non-profit foundation committed to human well-being and social progress. Presented biennially, the €30,000 award recognizes projects that foster economic stability and solidarity through insurance and/or social protection.

Fundación MAPFRE describes the Policy Incubator as "an innovative, powerful and differentiating project to put ideas into action and to address the need to alleviate the consequences of natural phenomena that weaken social cohesion."



Jeffrey Czajkowski (right) accepts the RMIR Award from ARIA president Richard Phillips of Georgia State University on behalf of the study team.

RMIR Award for Best Article by the American Risk and Insurance Association

Jeffrey Czajkowski, Kevin Simmons and James Done received the RMIR Award for Best Article by the American Risk and Insurance Association (ARIA), for their paper "Demonstrating the Intensive Benefit to the Local Implementation of a Statewide Building Code." See: <https://onlinelibrary.wiley.com/doi/abs/10.1111/rmir.1208.6>

This award is selected by a committee, chaired by Joan Schmit, which reviews all the articles published in the prior calendar year (2017) in ARIA's *Risk Management and Insurance Review*. Jeff and co-authors were recognized at the awards luncheon at the ARIA annual conference, August 5-8, 2018 in Chicago, IL.

Research Team and Partners



ACADEMIC CO-DIRECTORS



Professor Howard Kunreuther, kunreuth@wharton.upenn.edu

James G. Dinan Professor, Professor of Decision Sciences and Public Policy at the Wharton School, and co-founder and Co-Director of the Wharton Risk Center. Howard has a long-standing interest in ways that society can better manage extreme events. He is a Fellow of the American Association for the Advancement of Science, a Distinguished Fellow of the Society for Risk Analysis and recipient of the 2015 Shin Research Excellence Award from the Geneva Association and International Insurance Society (IIS) in recognition of his outstanding work on the role of public-private partnerships in mitigating and managing risks.



Professor Robert Meyer, meyerr@wharton.upenn.edu

Gayfryd Steinberg Professor of Marketing, and Co-Director of the Wharton Risk Management and Decision Processes Center. Bob's research has focused on a range of topics in decision making, for example, linking the much-publicized failures of preparation that contributed to the losses from catastrophic events such as Hurricane Sandy to a number of hard-wired biases in how people respond to risk.

CENTER DIRECTORS



Jeffrey Czajkowski, jczaj@wharton.upenn.edu

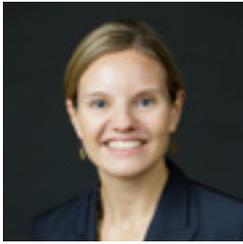
Managing Director. Jeff conducts research on economic and risk-related issues of natural hazards, and oversees grant-supported sponsored research and corporate sponsorships. He has served on two committees of the National Research Council of the National Academy of Sciences, the World Economic Forum's Academic Advisory board, and the Department of Homeland Security's Flood Apex research review board. He holds a B.S. from Carnegie Mellon University, a M.S. in environmental and urban systems from Florida International University, and a Ph.D. in economics from Florida International University.



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Director of the Policy Incubator. Carolyn is an expert on issues relating to natural disaster insurance markets, the National Flood Insurance Program, the incentive effects of disaster aid, and policy responses to potential changes in extreme events with climate change. She is the recipient of the 2013 Tartufari International Prize from the Accademia Nazionale dei Lincei. She has a B.S. in Earth Systems from Stanford University and a Ph.D. in Public Policy from Harvard University.

RESEARCH STAFF



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Strategic Advisor. Kathrine is an expert on climate change information, insurance research and outreach, and building mitigation. She was previously with the New York City Mayor's Office of Recovery and Resiliency, and the Hurricane Sandy Rebuilding Task Force under Secretary for Housing and Urban Development, Shaun Donovan. She has a MALD (Masters of Law and Diplomacy) from the Fletcher School of Law and Diplomacy, an MBA from Dartmouth's Tuck School of Business.



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Policy Analyst and Project Manager. Brett's work focuses on disaster risk financing and the role of public policy in hazard mitigation and disaster recovery. Brett has a B.A. in Politics from Pomona College and an M.A. in Environmental Policy from American University.

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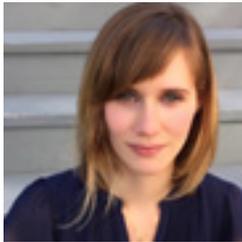
Reihane Boghrati earned her Ph.D. in Computer Science at the University of Southern California in 2018. Research interests: natural language processing, machine learning methods to investigate psychological phenomena expressed in written and spoken language.



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Shereen earned her Ph.D. in Behavioral Decision Research from Carnegie Mellon University. Research Interests: Social communication, thanking, apologizing, bragging, and blaming.



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Kelly completed her Ph.D. in Resource Economics at the University of Massachusetts Amherst. Research Interests: Market and behavioral responses to various risks, including natural and environmental hazards and air and water pollution.



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Elissa completed her Ph.D. in Communication from the University of Pennsylvania. Research Interests: relationship between media messages and risk behavior.



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SENIOR FELLOWS

The Risk Center collaborates with leading scholars from across the University of Pennsylvania as well as outside the University.



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Research Interests: Word of mouth, social influence, consumer behavior, and how products, ideas, and behaviors catch on.



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Research Interests: The study of the cognitive basis of human judgment and decision making with the use of mathematical and computational models.



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VU University Amsterdam, Institute for Environmental Studies.
Research Interests: Climate change economics with a particular focus on risk, natural disaster insurance, behavioral economics of decision making under risk, and natural disaster risk assessment and management.



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Research Interests: Bayesian computation, latent variable models, marketing research methods, missing data problems, analytics, psychometrics.

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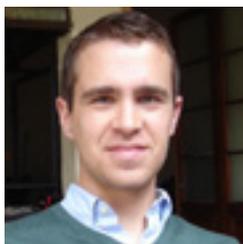
Senior Consultant, IHS, Inc. Research Interests: frameworks and methods for measuring intangibles such as resilience, economic effects of strategic decisions and economic impact of policies.



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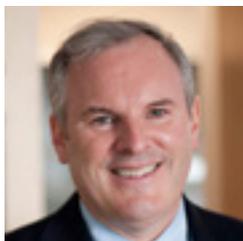
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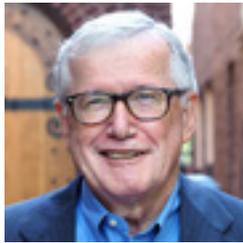


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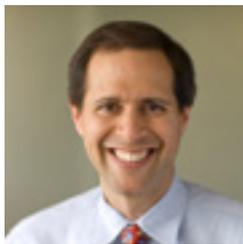
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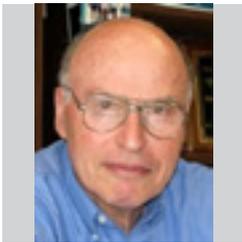
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CORPORATE PARTNERS

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

In addition to providing crucial financial support for the Risk Center's operations, our Corporate Associates offer insight into the direction of research projects while regularly interacting with Risk Center directors, faculty and fellows to discuss these projects. With a single or multi-year commitment, Strategic Research Partners provide funding for specific research initiatives and thereby play a key role that enables their organization to impact the future of their industry.

Corporate partners attend our workshops and conferences to actively participate in open dialogue and bring their expertise to the research topic at hand. These meetings also offer an opportunity to network with experts and policy makers from research institutions, industry and government agencies from the United States and abroad. Funders also benefit from visibility and customized relationships across the Wharton School through membership in the Wharton Partnership, the School's primary vehicle for fostering industry-academic collaboration. The Risk Center thanks our Corporate Associates and Strategic Research Partners for their support and involvement.

Managing and Financing Extreme Events Project

American Insurance Association
American International Group (AIG)
Credit Suisse
Liberty Mutual
Lloyd's
Marsh & McLennan
Property Casualty Insurers Association of America
State Farm Fire & Casualty Company
TransRe
Travelers Companies, Inc. (strategic partner)
WeatherPredict Consulting, Inc. (a division of Renaissance Re)
Willis Re (strategic partner)

Wharton Risk Center Policy Incubator

Pool Re
Risk Management Solutions (RMS)

We invite you to become a Corporate Associate or Strategic Research Sponsor of the Risk Management and Decision Processes Center. *Corporate Associate and Strategic Research Partner contributions are tax-deductible. For information please contact:*

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INTERNATIONAL PARTNERS

The Risk Center Partners with the World Economic Forum on Global Risks 2018

The Wharton Risk Center has been an academic partner of the World Economic Forum since 2005.

The Global Risks Report 2018 presents the results of the Global Risks Perception Survey, in which nearly 1,000 experts and decision-makers assess the likelihood and impact of 30 global risks over a 10-year horizon. Environmental risks have grown in prominence following recent years characterized by high-impact hurricanes, extreme temperatures and the first rise in CO2 emissions for four consecutive years. Biodiversity is being lost, agricultural systems are under strain and pollution has become an increasingly pressing threat to human health. A trend towards nation-state unilateralism may make it more difficult to sustain the long-term, multilateral responses that are required to counter global warming and the degradation of the global environment. See http://www3.weforum.org/docs/WEF_GRR18_Report.pdf



Zurich Flood Resilience Alliance

The Zurich Flood Resilience Alliance is an interdisciplinary effort convened by the Zurich Insurance Group to broaden the scope of current flood resilience research and to provide opportunities to advance global understanding of flood impact, risk reduction, financial protection, and community resilience. The Wharton Risk Center was one of two research partners in Phase I of the Alliance from 2013 to 2018.

Geneva Association

The Geneva Association project is a comparative analysis of flood risk management in Australia, Canada, Germany, Japan, the United Kingdom and the United States with focus on the interplay of preventive measures and risk transfer, societal resilience, role of the insurance industry and private-public partnerships.

RESEARCH FUNDING PARTNERS

Department of Homeland Security's Critical Infrastructure Resilience Institute (CIRI) - University of Illinois

Research is focused on identifying barriers and opportunities to improving infrastructure resilience, including an understanding of the role of insurance in providing financial protection against infrastructure damage from extreme weather events as well as identifying indicators for measuring and tracking organizational and physical resilience to extreme weather for transportation infrastructure.

Department of Homeland Security Science and Technology Directorate's (S&T) Flood Apex Program

Research is focused on providing an understanding of the ability of—and interest for—private sector expansion in the flood insurance market, the nature of the market today and how it is likely to evolve in the coming years.

Edison International

Research is focused on understanding who ultimately bears the cost burden of California's increasing wildfire risk and recommending policy changes to more optimally combine pre-event risk reduction and post-event disaster financing. This project also involves developing tools to visualize wildfire risk over time, including the potential impacts of climate change and increasing development in fire-prone areas.

Florida Division of Emergency Management

Research is focused on the economic effectiveness of mitigating single-family homes located in Escambia County, Fla., against storm surge risks (now and under future sea level rise scenarios). The project also assesses community-based approaches to flood risk mitigation that connect mitigation benefits of individual structures to that of communities.

Fannie Mae

Research undertaken jointly by the Wharton Risk Center and the Penn Institute for Urban Research is focused on flood risk in relation to the U.S. housing market. Topics include mortgage credit risk and housing-related issues related to flood hazard events, extent of flood insurance coverage, and implications for the U.S. housing market. Particular attention is given to issues of housing affordability and low-to-moderate income households, including renter households.

National Science Foundation Interdisciplinary Research in Hazards and Disasters (Hazards SEES)

Research undertaken by the Wharton Risk Center, Princeton University, MIT, and NOAA Geophysical Fluid Dynamic Laboratory is focused on hurricane and tropical cyclone risk assessment and a management framework to compare vulnerability and risk associated with these hazards, as well as existing and potential risk management strategies in coastal cities and communities in the United States.

National Science Foundation EaSM3 Integration of Decision-Making with Predictive Capacity for Decadal Climate Impacts

Research is focused on the role of decadal climate prediction in water resource and flood management. The Risk Center is conducting experiments to explore how the communication of prediction uncertainty affects decisions, and how this depends on the prediction timescale.

National Science Foundation Urban Water Innovation Network

Research is focused on the use of dynamic information acceleration to understand and forecast homeowner adoption of new technologies for sustainable water management.

National Science Foundation Water Sustainability and Climate Program

Research will develop and apply a conceptual framework based on a regional-scale hydro-economic model for making informed decisions about the short- and long-term allocation of water resources in coastal regions that are susceptible to increasing populations, sea level rise, and climate change. The study site is south Florida.

The Travelers Companies

The Travelers-Wharton Partnership for Risk Management and Leadership is supporting new research on how the public and private sectors can work together to incentivize individuals, communities and firms to build their resiliency to extreme events. The partnership with Travelers is allowing the Wharton Risk Center to push the frontier of knowledge and practice on multiple aspects of disaster risk management.

Willis Research Network

Research is focused on risk assessment of flooding in urban areas due to rainfall. These studies allowed for the first-of-its-kind locally-specific quantification of extensive insurance claims and damages.

The Wharton Risk Management and Decision Processes Center, established in 1985, has developed into one of the world's most recognized centers for the study of catastrophe risk management, based both on output and global network of partnerships in the public, private, non-profit and academic sectors.

By developing diverse governmental and independent partnerships, the Center has played an active role in informing the debate over how escalating risk should be managed. The mission of the Risk Center is to:

- Promote effective policies and programs for low-probability events with potentially catastrophic consequences.
- Link the science of risk assessment with risk perception and risk management.
- Conduct descriptive and prescriptive analyses of relevant risk management issues.



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