A Framework for Risk Management of Extreme Events: Evidence from Firms

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The Wharton School, University of Pennsylvania

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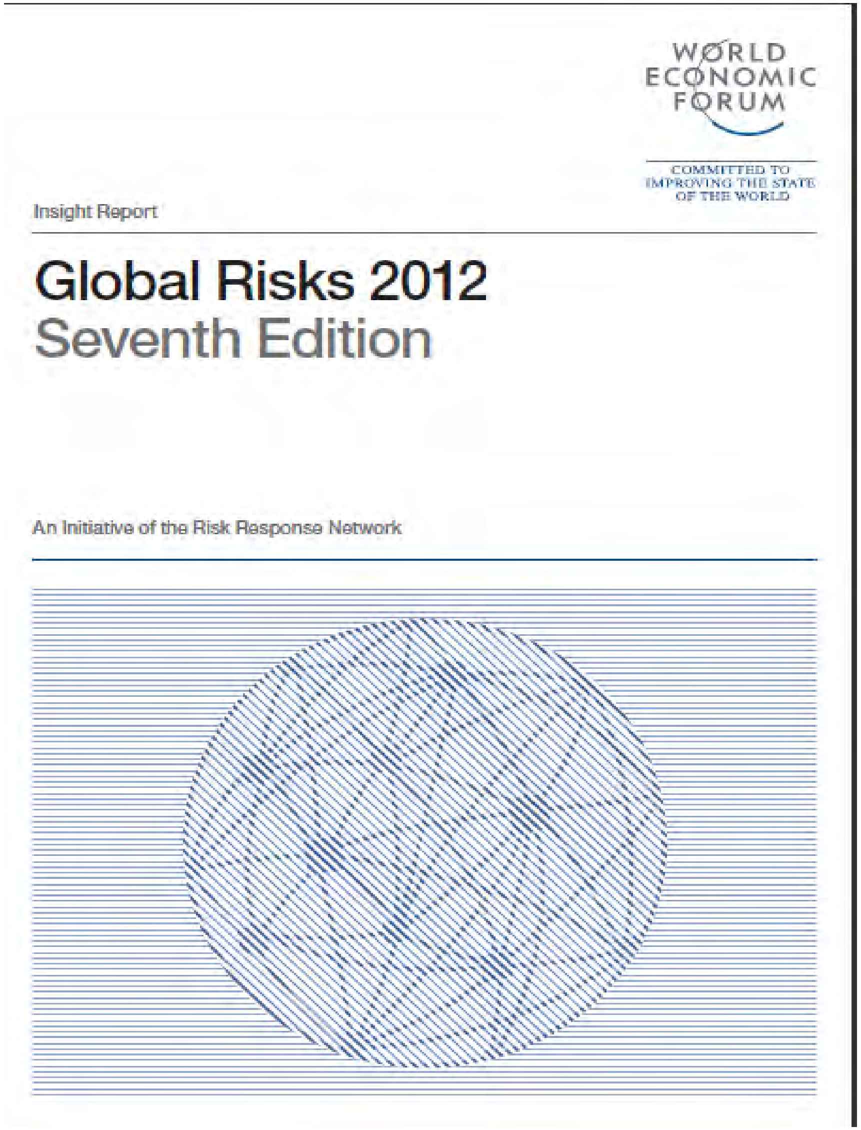
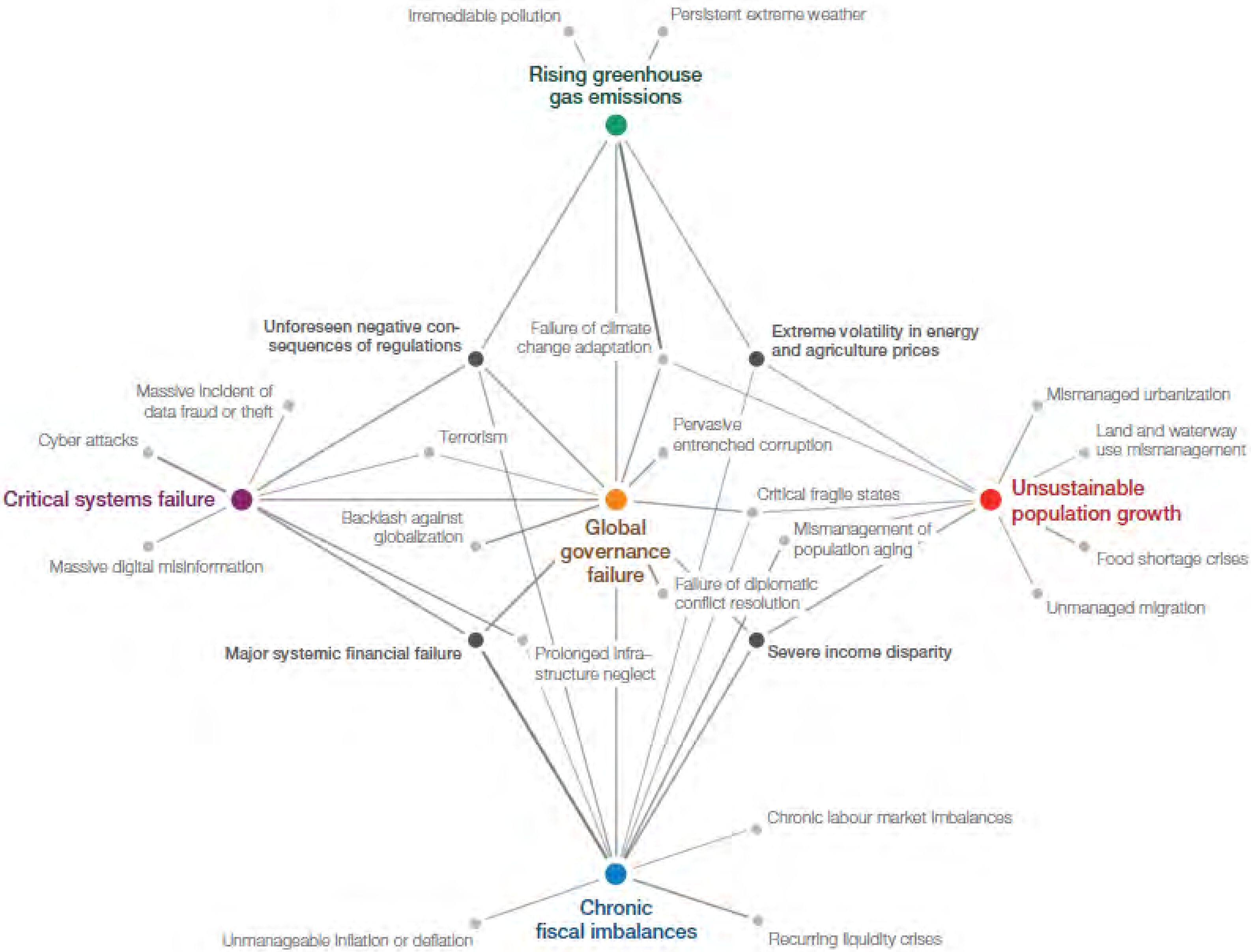
World Economic Forum – Global Risks 2012



Global Risks Map 2012



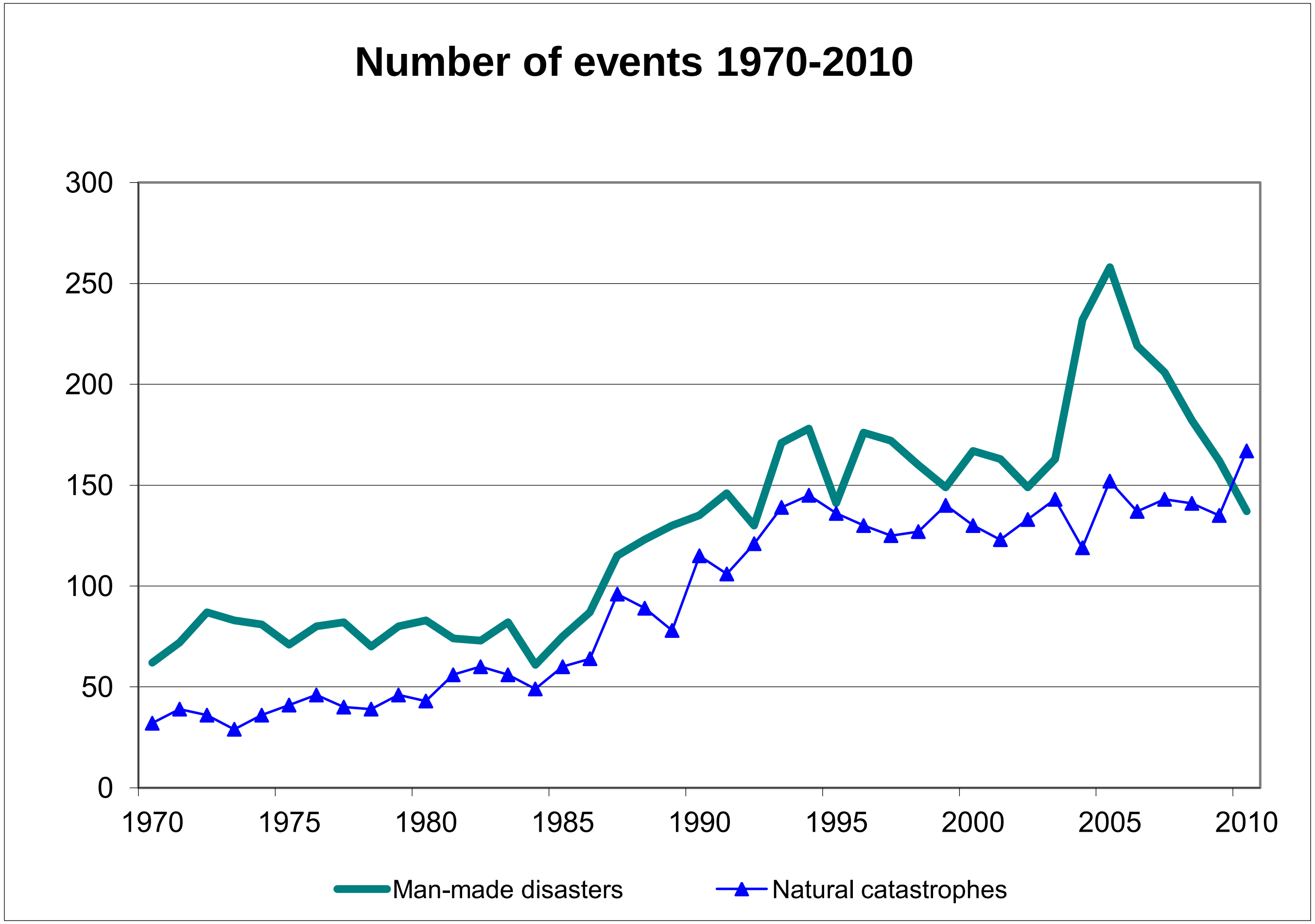
Source: World Economic Forum

Outline

- Catastrophic Risk Management (CRM) in a New Era of Catastrophes
- Framework for Analyzing Firm Behavior with Respect to Catastrophes
- CRM Project Design
- CRM Project: Applying Risk Analysis Framework
- Project Hypotheses and Illustrative Quotes from Interviews

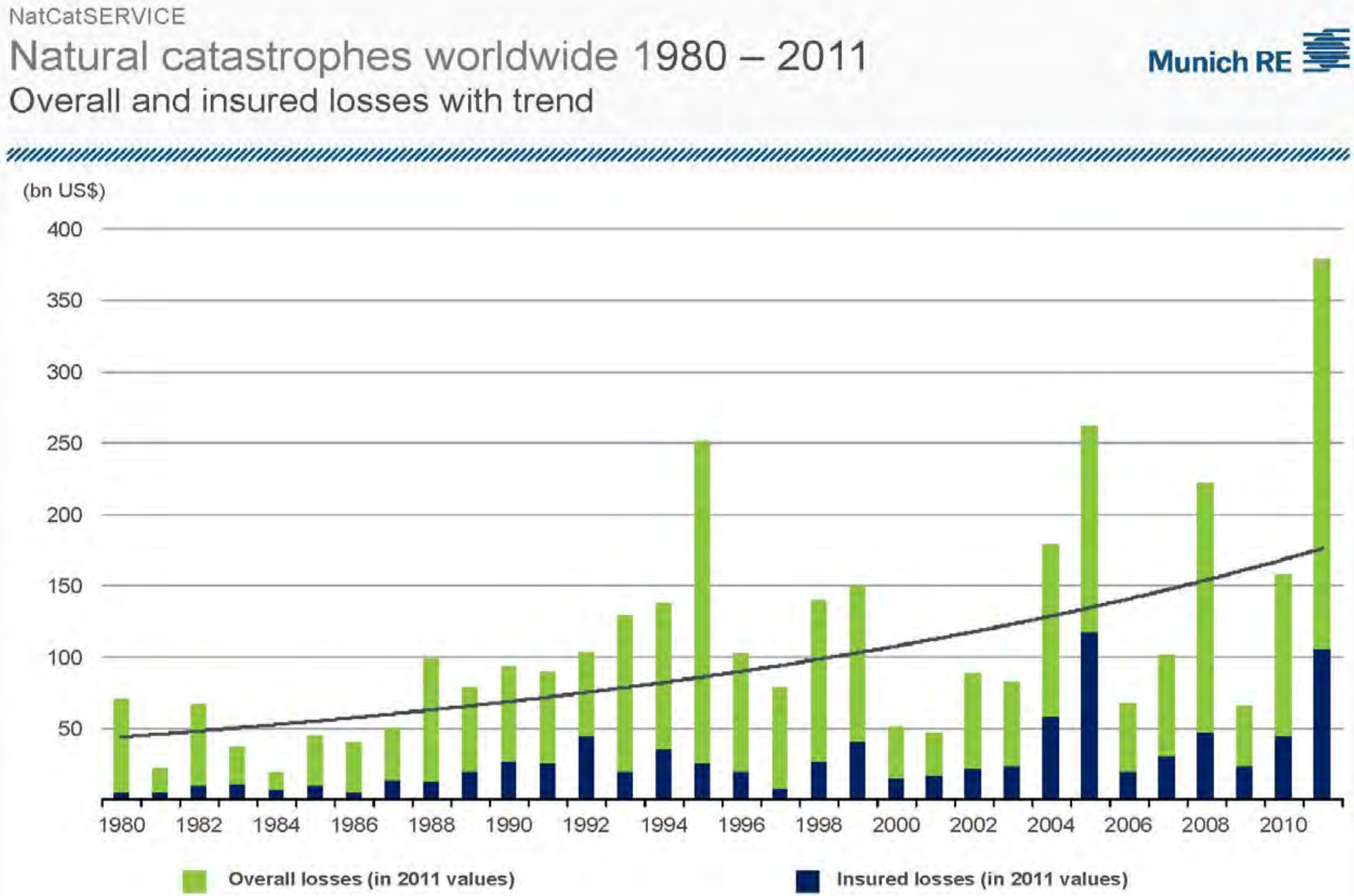
Catastrophic Risk Management (CRM) in a New Era of Catastrophes

Natural Catastrophes and Man-Made Disasters: Number of events 1970-2010



Source: Swiss Re sigma 1/2011: Natural catastrophes and man-made disasters in 2010: a year of devastating and costly events

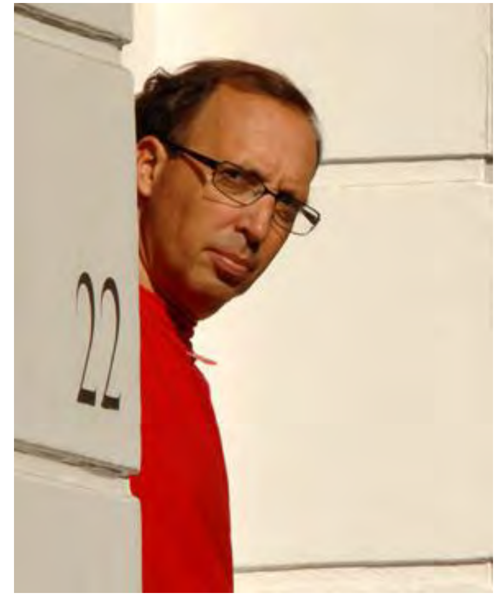
Worldwide Evolution of Catastrophes, 1980-2011



Catastrophic Risk Management (CRM) at AIG

Maurice R. Greenberg
CEO, 1968-2005

Martin J. Sullivan,
CEO, 2005-2008



Joseph Cassano, AIG Financial
Products, 1987-2008

2008: AIG employed 116,000, revenue of $110 billion, assets of $860 billion, in DJIA

AIGFP: Portfolio of $1.6 trillion in insured products, including CDOs

AIGFP: 0.4% of AIG employees, 17% of operating income

Cassano reported in 2007: "We believe this is a money-good portfolio"

AIG loses $5b billion in Q4, 2007, then $8b in Q1, 2008

Sept. 16: Credit agencies downgrade AIG from AAA to AA (day after Lehman fails)

Sept. 17: AIG draws $28b from U.S.

Q4, 2008: AIG loses $61b, $99 billion for the year

CRM at Morgan Stanley

Morgan Stanley's wrenching experience in 1993 helped prepare it to save itself in 2001; AIG's years of success ill-prepared it to save itself in 2008.

Morgan Stanley had 3,700 employees at work on 20 floors of South Tower of the World Trade Center on September 11, 2001.

Richard Rescorla

Richard Rescorla, Chief of Security urged CEO Philip Purcell to evacuate all employees. He had been drilling employees on evacuating the tower since the WTC truck bombing in 1993.

Just six staff members fail to exit before the South Tower collapsed at 9:59 am.

Morgan Stanley COO, chief operating officer Robert Scott later offered, "If you wait for a crisis to begin to lead, it's too late."

The Focus of Travelers-Wharton Initiative

Company executives should be preparing for catastrophic risk and practicing enterprise risk management.

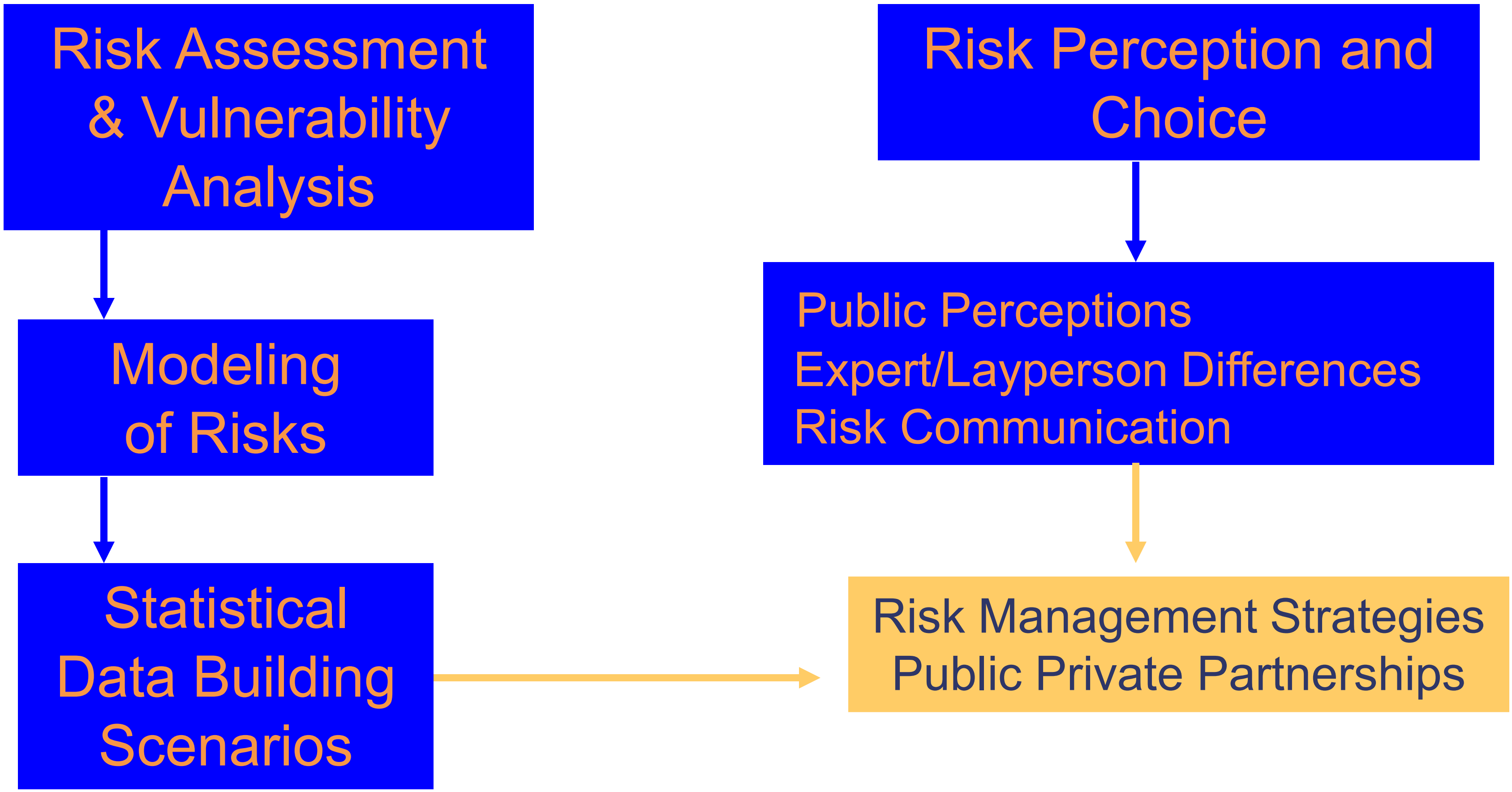
Companies should be asking:

- Are we doing enough?
- Could we do it differently?
- Can we do it more effectively?
- What is the role for the executives and directors?

But are they?

Framework for Analyzing Firm Behavior With Respect to Catastrophes

A Conceptual Framework for Studying Risk



A Conceptual Framework for Studying Risk

Risk Management Strategies: Public Private Partnerships

↓

- Information Provision
- Incentives
- Regulation
- Standards
- Compensation
- Insurance
- Liability

↓

Evaluation of Strategies

- Impact on Society
- Impact on Interested Parties

Risk Assessment & Vulnerability Analysis

Risk Assessment

- Encompasses estimates of both the chances of a specific set of events occurring and their potential consequences
- Experts differ in their estimates of the risk
- Find your favorite expert to support your position

Vulnerability Analysis

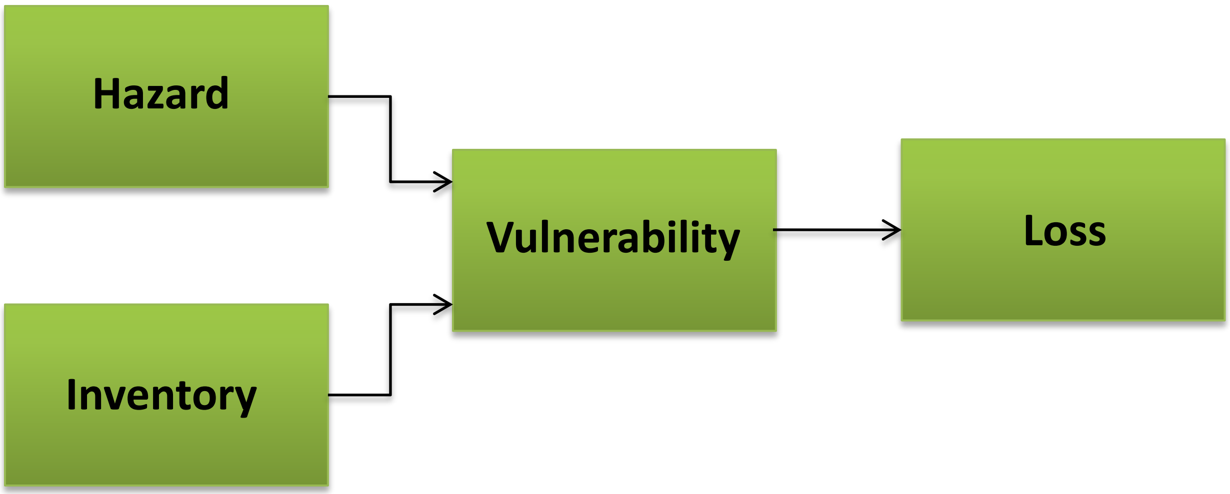
- Characterize forms of physical, social, political, economic, cultural, and psychological harms to which individuals and modern societies are susceptible
- Millions of dollars have already been spent to reduce our vulnerability

Constructing Scenarios

- What are the probabilities of specific events?
- What are the potential consequences?

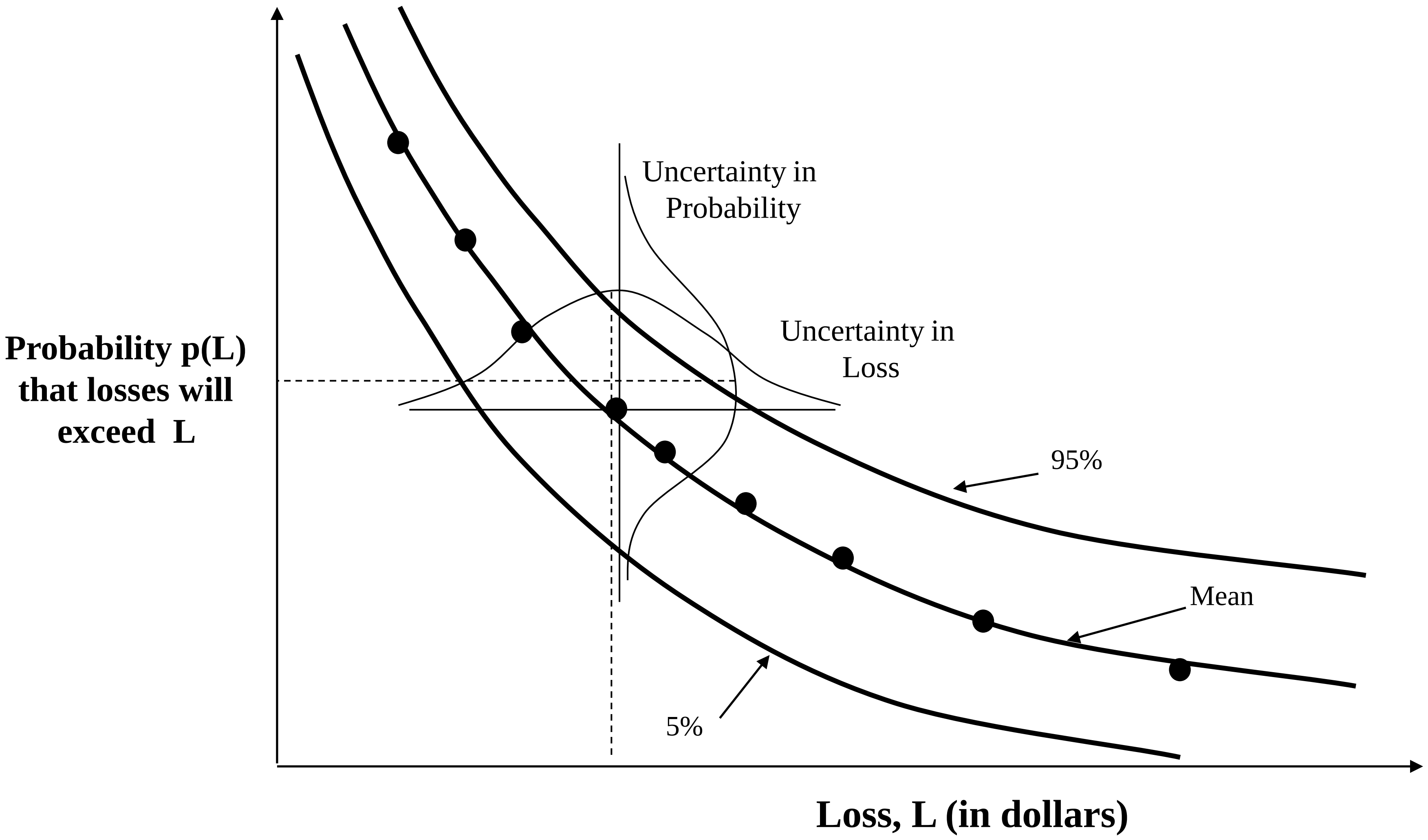
Risk Assessment Focuses on Objective Losses

There are four basic elements for assessing catastrophic risk.



*Risk assessment has become **more complex** with globalization, involving longer time periods (e.g., weeks, months) and more diverse measures (e.g., disrupted commercial flows).*

Using Exceedance Probability Curves to Depict Risk



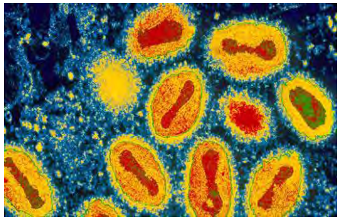
Risk Assessment Questions to Ponder

- What are the chances that New Orleans will have a Category 3 or higher hurricane in the next 5 years, and what would be the resulting damage and health impacts?

- What are the chances that there will be another severe oil spill in the U.S. in the next 5 years and what would be the health and environmental impacts?

- What are the chances of a swine flu pandemic in 2013 and how serious would the consequences be?

- What are the chances that there will be a smallpox epidemic in the United States in the next five years, and how many people would be affected?



Risk Assessment and Vulnerability Analysis
Open Issues and Questions

- How accurately can experts estimate the *likelihood and consequences* of disasters of different magnitudes and intensities?
- Can one characterize the types of *uncertainties* that currently exist in assessing risk and suggest ways to improve these estimates in the future?
- What are the expected *costs and benefits* of undertaking specific risk-reducing measures and can one rank them on the basis of cost effectiveness?
- What are the *interdependencies* in the system (e.g. infrastructure damage affecting supply of electricity, water, telephone/telecommunications, and other services to residences and businesses)?
- How do these interdependencies affect the direct and indirect losses that would result from a future disaster?

Risk Perception and Choice
Basic Concepts

Focuses on psychological and emotional factors that have been shown to have an enormous impact on behavior.

- Hazards where individuals have little knowledge and experience are highly dreaded and perceived as being very risky
- Disparity between experts and laypersons (e.g., nuclear power, storing radioactive waste)
- Ignoring public's perception of risk by scientific community if it differed significantly from their own estimates

Risk Perception and Choice
Basic Concepts

Individuals exhibit systematic biases in processing information and making choices

- Estimating likelihood of event is influenced by salience
- "It cannot happen to me" bias before a disaster
- "It will happen to me" bias after a disaster
- Framing of information may influence choice

Individuals have difficulties learning due to biases and information processing limitations

Risk Perception: People Don't Think Probabilistically

- It "will happen to me" or " it will not happen to me"
- Other factors influence protective decisions---worry; peace of mind
- Affect and emotion play a key role in decision-making
- Availability bias: likelihood of an event is estimated by the ease with which a person can visualize it.

Risk Perception:
Individuals and Firms Don't Think Probabilistically

Explain this behavior:

I bought my first set of battery cables only after my car would not start and I had to be towed. The towing charge was twice as much as the cost of the battery cables.

Most homeowners in California purchase earthquake insurance only after they experienced a quake. When asked whether the probability of a future event was more likely than before the disaster most people responded "Less likely."

Insurers did not charge a penny for terrorism insurance before 9/11. After Sept. 11th most insurers refused to provided coverage against damage or losses from terrorist attacks.

Insurance and Behavioral Economics: Improving Decisions in the Most Misunderstood Industry

Insurance and Behavioral Economics

Improving Decisions in the Most Misunderstood Industry

Save 20%!

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Stacey McMorrow
Urban Institute

About the Book

Insurance is an extraordinarily useful tool to manage risk. When it works as intended, it provides financial protection to individuals and a profitable business model for insurance firms and their investors. But it is broadly misunderstood by consumers, regulators, and insurance executives. At every level, confusion about insurance produces behavior that cannot be easily understood based on models of choice that assume individuals and firms are behaving sensibly. These incorrect choices often impact social welfare. With considerable sums of money at stake, both in consumer premiums and insurance company payouts, it is important to understand the reasons for anomalous behavior. The authors examine these anomalies through the lens of classical economics, and also through the lens of behavioral economics which takes into account our emotions, biases, and simplified decision rules, and offer recommendations that may help decision makers avoid irrational behavior when it comes to insurance.

Available from September 2012 | 244 pages
13 b/w illus. | 10 tables
Paperback | 978-0-521-60826-8
~~List Price: USD 34.99~~
Discounted Price: USD 27.99

Hardback | 978-0-521-84572-4
~~List Price: USD 100.00~~
Discounted Price: USD 80.00

Risk Perception and Choice
Open Issues and Questions

- What role do <u>perceived likelihoods and resulting consequences</u> play in how decision makers view a particular risk that they may face?
- How important are <u>emotional factors</u> such as fear, dread and anxiety in how people perceive these risks and learn over time?
- What role do <u>social networks and social norms</u> play in influencing risk perception, choice and learning with respect to low probability events?
- How can one best <u>communicate information</u> to those at risk so they are aware of what actions they can take prior to and after a disaster?
- What is the role of <u>past experience and the media</u> in influencing risk perception and choice?

Risk Management Strategies: Basic Concepts

Policy options for reducing losses and aiding recovery process

- Economic incentives
- Insurance
- Well enforced regulations and standards (e.g. building codes)
- Disaster assistance

Relevant roles of public and private sectors in implementing hazard management strategy

Criteria for evaluating alternative strategies

- **Efficiency**---allocating resources to maximize social welfare
- **Equity**---concern with fairness and distribution of resources

Risk Management Strategies for Reducing Losses

Risk managers must balance the competing forms of rationality (i.e., expert vs. public) in shaping better risk management strategies. Steps include:

1. **Risk forecasting**: improving the precision of risk forecasting.
2. **Communicating risk information**: expanding the time frame over which the likelihood of an extreme event is presented.
3. **Economic incentives**: framing positive and negative economic incentives in ways that motivate individuals to take protective action.
4. **Public-private partnerships**: creating public-private partnerships before they are needed.
5. **Reinsurance and other financial instruments**: expanding the availability of reinsurance.
6. **Resiliency and sustainability**: increasing businesses' ability to respond to continually changing risk environments.

Risk Management Strategies

Using Economic Incentives

- Premiums reductions on insurance policies for those who undertake loss reduction measures.

- Overcoming myopia---long-term loans on property coupled with insurance premium reductions

Risk Communication (Framing Information Makes a Difference)

- People are more willing to wear seatbelts if they are told they have a .33 chance of an accident over a 50-year lifetime of driving rather than a .00001 chance each trip.
- People are more willing to buy insurance if they are told that there is a 1 in 5 chance of a 100 year flood occurring in the next 25 years than a 1 in 100 chance of it occurring next year.

Risk Management Strategies
Open Issues and Questions

What type of economic incentives would encourage property owners to reduce their risks and purchase insurance prior to a disaster?

How does the prospect of federal aid affect protective decisions by individuals prior to a disaster?

What are the appropriate roles of standards and regulations in reducing losses from large scale disasters?

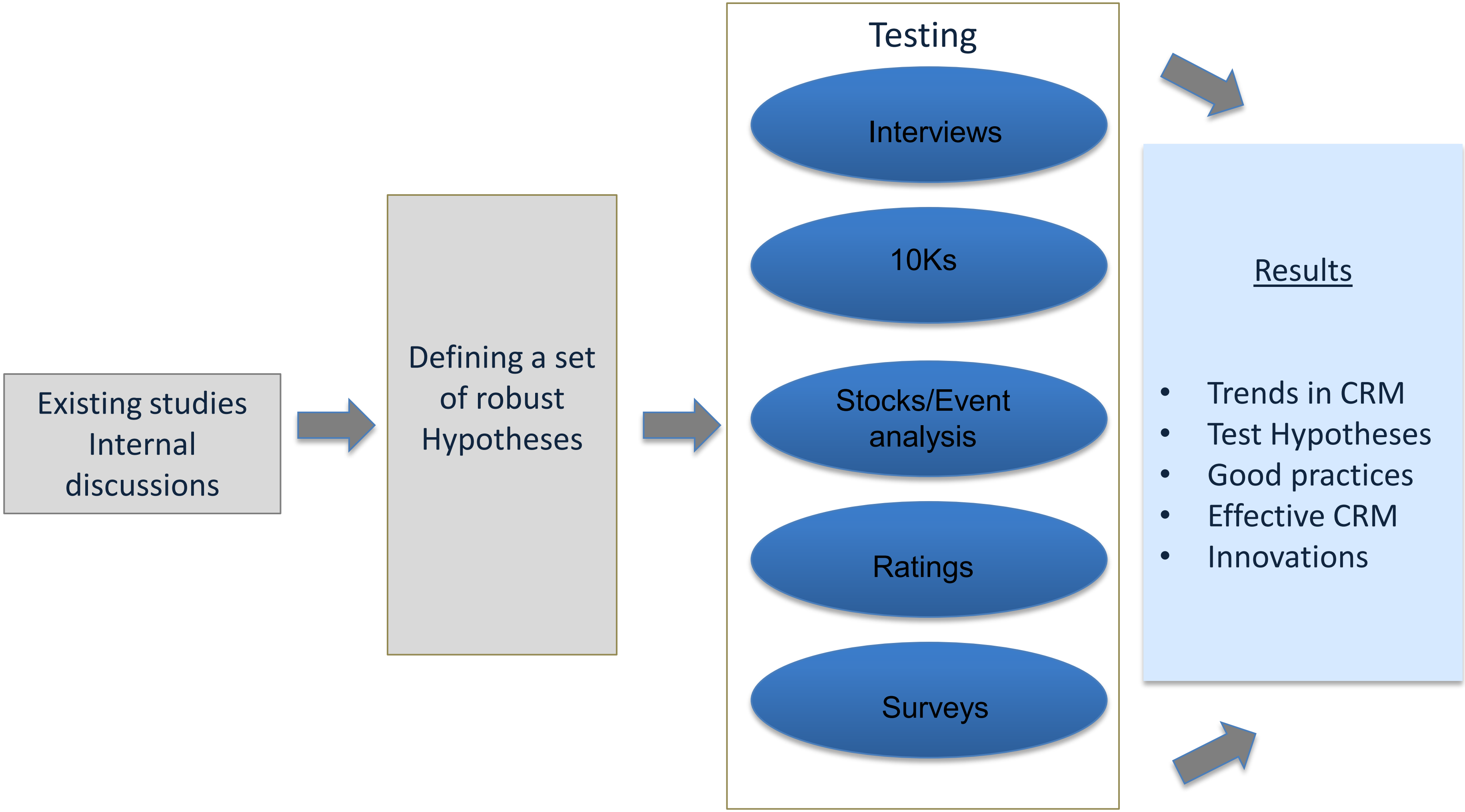
How can one link different policy tools to achieve the desired objectives of a hazard management strategy?

CRM Project Design

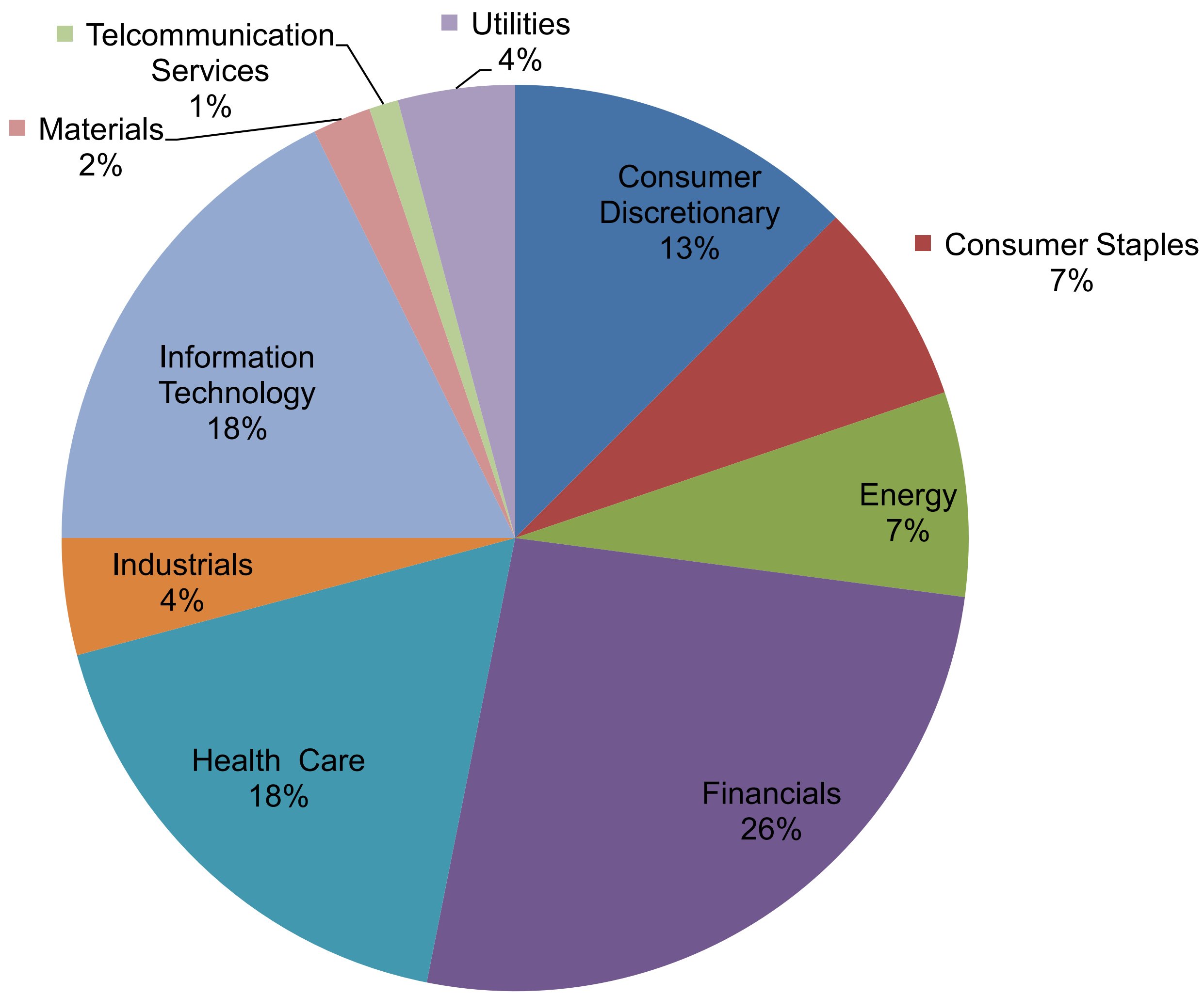
Catastrophic Risk Management Interview Objectives

- Joint project of Wharton Risk Center and Leadership Center
- To understand how S&P 500 companies make decisions about dealing with catastrophic risk
- To test a set of hypotheses regarding behavior with respect to catastrophes and enterprise risk management
- To develop best practices and policy recommendations for reducing future losses from catastrophes

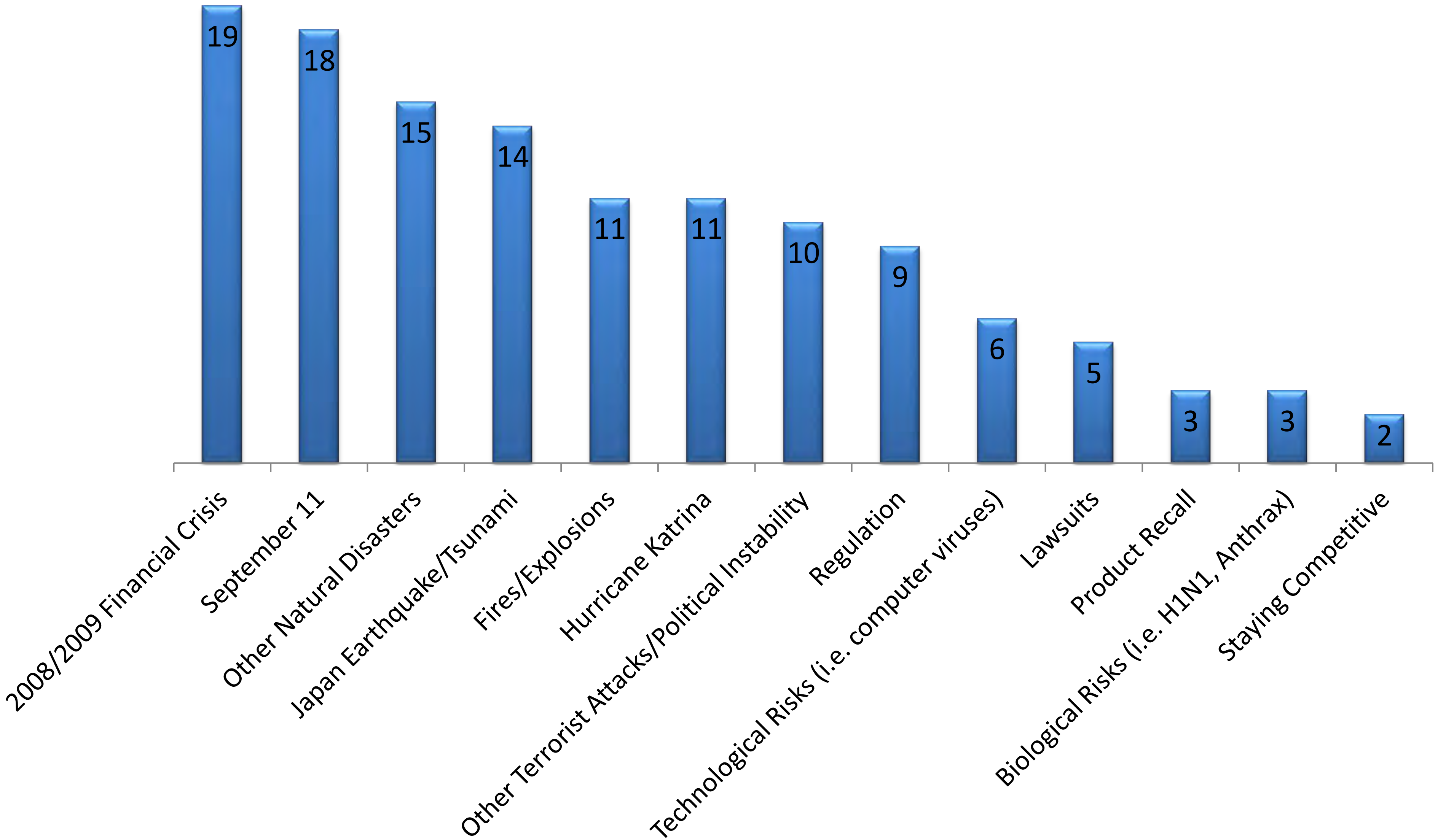
CRM Project Design



Industries Interviewed



Catastrophic Risks Companies Have Faced



CRM Project: Applying Risk Analysis Framework

The Challenge of Risk Assessment

The companies we interviewed identified several factors that complicate risk assessment. These include:

1 Managing a diverse supply chain	Supply chain risks are one of our major concerns. Sourcing materials from so many different companies it's **hard to know what they are all doing**. – Dir. of Risk Mgmt, Consumer Discretionary
2 Threat of cascading risks	The ability … for **contagion [to spread] across borders** and businesses is much higher than it used to be. The amount of time it takes for a crisis to spread is much faster than it used to be."- CRO, Financial Services Firm
3 Unforeseen inter-dependencies between risks	People **were looking at individual pieces** of those businesses and the risk associated with them, but **not necessarily the global risk.** – VP & CRO, Financial Sector

What Companies are Doing to Assess Risk

Firms engage in many quantitative activities to assess their risks. These include:

1	**Gathering data so risks can be assessed**	**Is anybody gathering the metrics** so that we even know how many safety violations we had nationwide? – General Counsel, Financial Sector
2	**Constructing more complex scenarios**	If we try to forecast the future, we can end up with an infinite combination of events. The better way is **to do reverse stress testing**…'What kind of event can cause a significant loss for our firm?' – CRO, Financial Sector
3	**Quantifying risks across the entire enterprise**	Each Business Unit (BU) takes the list of 105 risks, and comes up with the 50 most applicable to their BU. They then **score the risks** (based on impact, likelihood, mitigation effectiveness, and velocity), and assess the top 10. – VP Corp Strategy, Consumer Discretionary

What Companies are Doing to Improve Risk Perception

In order to improve risk perception, risk managers are taking several steps. These include:

1	**Translating complex risks for non-experts**	In the wake of the 2008 financial crisis, risk managers have to do a better job **communicating risks to a broader audience**, and the right subject matter for the right decision. – CRO, Financials
2	**Engaging the board in risk discussions**	Almost every monthly communication to the board involves some form of communication about risk. Now, it may be market risk. What are the trends in our utilization and what are the risks involved with that? – CRO, Materials Sector
3	**Hedging non-transparent risks**	Because of the surprise factor, the size of the operational risks (e.g. fraud, reputational and legal risks) have to be smaller than the market and credit risks. – CRO, Financial Sector

What Companies are Doing to Better Manage Risk

In the aftermath of the 2008 financial crisis, companies are intensifying their risk management efforts. New steps include:

1 Defining risk appetite & tolerance levels	Very few financial institutions had a **defined risk appetite**. And that's sort of like going sailing in the Atlantic Ocean without a rudder. **Unless you have a rudder to direct you**, you never know where you're going to wind up until it's too late. – CRO, Banks
2 Aligning strategy with risk mitigation efforts	We're identify all those risks that could get in the way of fulfilling the strategic plan and allowing the organization to work on **plans to mitigate those risks**. – VP Safety, Energy Sector
3 Diversifying suppliers	We're trying to make sure **that no one plant makes the majority of our glass**, so if you have a disruption, it's limited. – CRO, Consumer Staples

What Companies are Doing to Better Manage Risk

In the aftermath of the 2008 financial crisis, companies are intensifying their risk management efforts. New steps include:

4	**Ensuring vendor compliance to quality standards**	The quality standards we sets for our products were adequate, but the **adherence to that standard by an outside party** was the problem. In hindsight, we should have done more to increase the level of quality compliance. We increased adherence by vendors after the event. – CRM, Consumer Discretionary Co.
5	**Preparing for catastrophic events**	I think the one thing that we've learned over the years is those high-consequence, low-likelihood events will happen, and therefore **people absolutely have to plan for them**. – VP Safety & Environment, Energy Sector
6	**Risk leadership from the top of the firm**	**You've got to have ownership** at the top. You need to have the **business own your disaster recovery** or continuity planning. – CRO, Leisure Sector

Project Hypotheses and Illustrative Quotes from Interviews

Hypothesis 1: Prior to a catastrophic event, firms focus on the low-probability estimate of its occurrence.

Companies are learning, in hindsight, to take low-probability, high-risk events more seriously than they did before.

1 Learning to take black swans seriously

If you're thinking you only have **a 0.001%, not in your lifetime, chance** of gold markets spiking, or liquidity dissipating, you're doomed, because you know that's going to happen. – CRO, Financial Services Company

You can't just say, 'You know what? **That event's never going to happen**'. Look what's going on in Japan, the BP Macondo, and the two hurricanes in the Gulf Coast. – VP Health & Safety, Energy Company

The modeling that we use to anticipate these black swans and the resulting capital that we have to set aside for these anticipated risks **are taken far more seriously** than they were before. – Dir. Risk Management, Financial Services Company

Hypothesis 2: Firms in industries with an active dialogue about adverse events manage them better.

Firms are more proactive in managing risks in industries with an active dialogue among industry leaders and government officials.

2 Firms are more proactive in networked industry sectors

What we've tried to do in the last six months is to **reach outside the oil and gas industry** and look at how a few other people are managing risk. We've spent time with financial companies to understand how they view risk, and whether we have some blind spots. – VP Health & Safety, Energy Company

I get calls all the time from other security VPs who didn't know something was a potential risk. You can't develop a plan if you don't know where the threat vectors are, which means **having good liaisons** with the federal, state and local government, the fusion centers, and law enforcement. – VP Corporate and Information Security, Energy Company.

Hypothesis 3: Firms that have learned from near misses and catastrophic losses become better at managing adverse events.

Catastrophes and near misses prod many companies into strengthening their CRM or ERM efforts.

3 Firms can learn from near misses and adverse events

Prior to 2007, enterprise risk consisted of internal audit, standards compliance, etc. We had no dedicated risk management effort. Watching what happened at Enron, WorldCom, etc., the board decided to **look at enterprise risk management in a different way**. – VP Corporate Strategy, Auto Parts Supplier.

After the 2008 financial crisis, we created a clear process to define our risk appetite, and made changes in risk governance. Like many banks, we **carried out a risk management overhaul**. Deleveraging and recapitalization were key. – CRO, Investment Banking Firm

The mistakes we made with Hurricane Rita [in 2005] **helped us prepare** for Hurricane Ike [in 2008]. We inadvertently sent all of the repair crews to one area during Rita, resulting in a bottleneck, which made it look to the media **like we were doing nothing.** – Risk Control Manager, Energy Company.

Next Steps

- Completion of interviews
- Completion of the quantitative analysis
- Test hypotheses against results of qualitative and quantitative data
- Identify trends effective CRM practices

Summary

The value of past experience in managing catastrophic losses .

The power of proactive boards to review firm risk exposure and mitigation strategies on an ongoing basis

The importance of regular drills, tabletop exercises and simulations to prepare key personnel to act decisively in a crisis.

The role of catastrophic risk management (CRM) in helping firms eliminate outsized risks and focus on more effective allocation of financial and human capital.

The implementation of a CRM strategy requires at least a year of concerted effort by the C-Suite working together with the Board and line employees.

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Adverse events

What are one or two of the most adverse events that you have faced as a firm?
What steps did you take in the moment to respond to those events?
In hindsight, what would you have done differently?

"What ended up happening is that some of our products were found to have a higher than acceptable level of lead in the paint. Nothing that, in our view, could injure anybody, but higher than the standard limit… I think the standard was adequate. What was not adequate was the adherence to that standard by an outside party… So in hindsight, I think the company would have probably tried to do more to make sure the level of compliance was there."

"Well, we've had two buildings burn down to the ground. So we did tighten the policies on security."

Distribution of Responsibility

Taking the last adverse event, what roles did people play?
How is risk management structured in your organization? Who does what?
Probe on board, upper management, and staff.

“Clearly the national crisis ’07-’08 was the biggest crisis or catastrophe risk that we have faced….The governance process has been definitely enhanced, As the current CRO, I report to the CEO and I report to the board. “

“I think the establishment of the compliance and risk committee as a standing committee of the board has probably made the most impacts, followed by the natural outgrowth of that which is the creation of a role within our organization of the chief risk officer, who's accountable in this organization for an enterprise risk program.”

Advice

Based on your own personal experience, what advice for managing catastrophic risk would you give to the directors of other companies?

“I think the one thing that we’ve learned over the years is those high-consequence, low-likelihood events will happen, and therefore people absolutely have to plan for them…but you can’t just say, “You know what? That event’s never gonna happen,”

“You really do have to be disciplined about limiting the catastrophic events, chopping the tails. You really do have to worry about what the numbers tell you because if you’re thinking therefore that you only have a 0.001, i.e., not in your lifetime chance of gold markets spiking, or liquidity dissipating, or whatever it is, you’re doomed, right, because you know that’s going to happen”

“Well, prioritize, first of all. I mean find out – look to where you’re really vulnerable. Once that priority list is established make sure that everybody is involved and understands it and understands their role in controlling the risk.”

“We use something that I call the four foundations of business continuity. We have to have the right people to respond. We have to have the right processes in place. We have to have the right infrastructure, And, lastly, we have to have the right training. If you focus on those four buckets: people, processes, infrastructure and training, that you can make your program successful.”