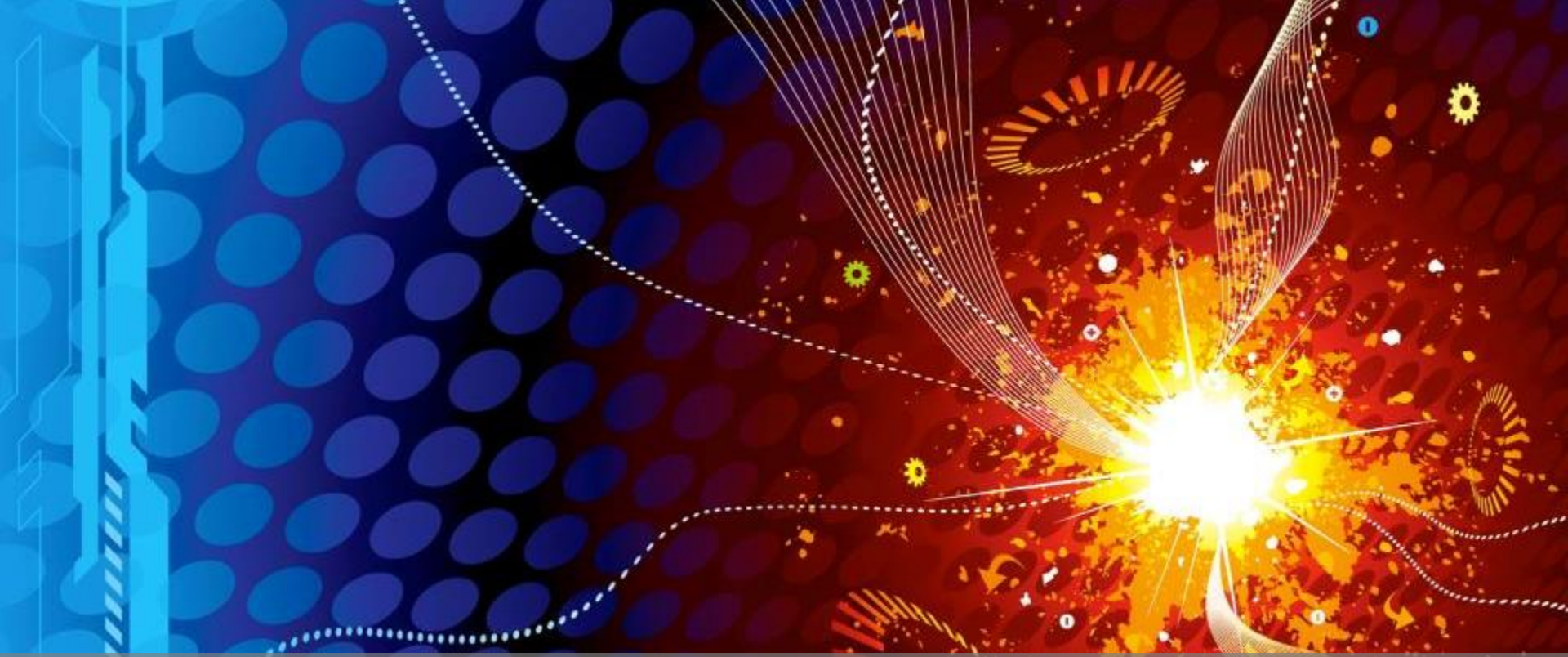

24 January 2017

Cambridge Centre for Risk Studies Research Showcase

Towards the Resilient Enterprise: Corporate Risk Profiling

Centre for Risk Studies

UNIVERSITY OF CAMBRIDGE
Judge Business School

Dr Michelle Tuveson

Executive Director

Centre for Risk Studies

Complex Footprints of Global Corporations

- Perform large range of business activities
  - Discovery and Innovations/R&D
  - Product Manufacturing
  - Supply and commercialisation
  - Sales
- Multiple stakeholder communities
- External threats
- Geographically dispersed functions and staff
- Legal and regulatory jurisdictions
- Counterparties and secondary supply chains

Where might risks lie in a corporation? What is an effective way to report risks?

Interview Results: Problem Definition

- **External threats:** Corporations do not have a consistent or comprehensive model for identifying and evaluating risks to the corporation from external threats.
- **Geography:** Do not have a consistent and comprehensive model for evaluating risks to the corporation in relation to geography.
  - e.g. Assets, counterparties, secondary supply chains, legal and regulatory jurisdictions
- **Stress testing:** Do not have a consistent and comprehensive approach to stress testing the state of their corporation
- **Reporting:** How to complement existing reporting requirements with meaningful enterprise risk insights and address multiple stakeholder communities
- **Methods and Metrics**: Methods are consistent approaches; metrics allow normalization across other costs

Gaining Greater Accuracy in Corporate Risk Profiling

Internal Risk Register

Company-specific identification of threats

External Risk Register

Taxonomy of global threats to business and economic activity

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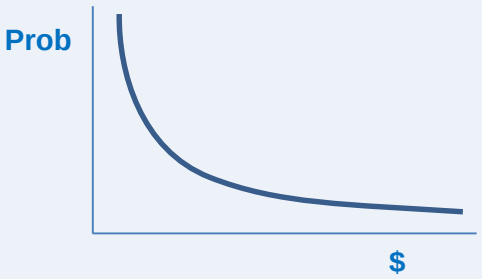
Company-Specific Inputs

- Business Network
  - Locations and revenue sources
- Activity Matrix
- Scenarios from internal risk register

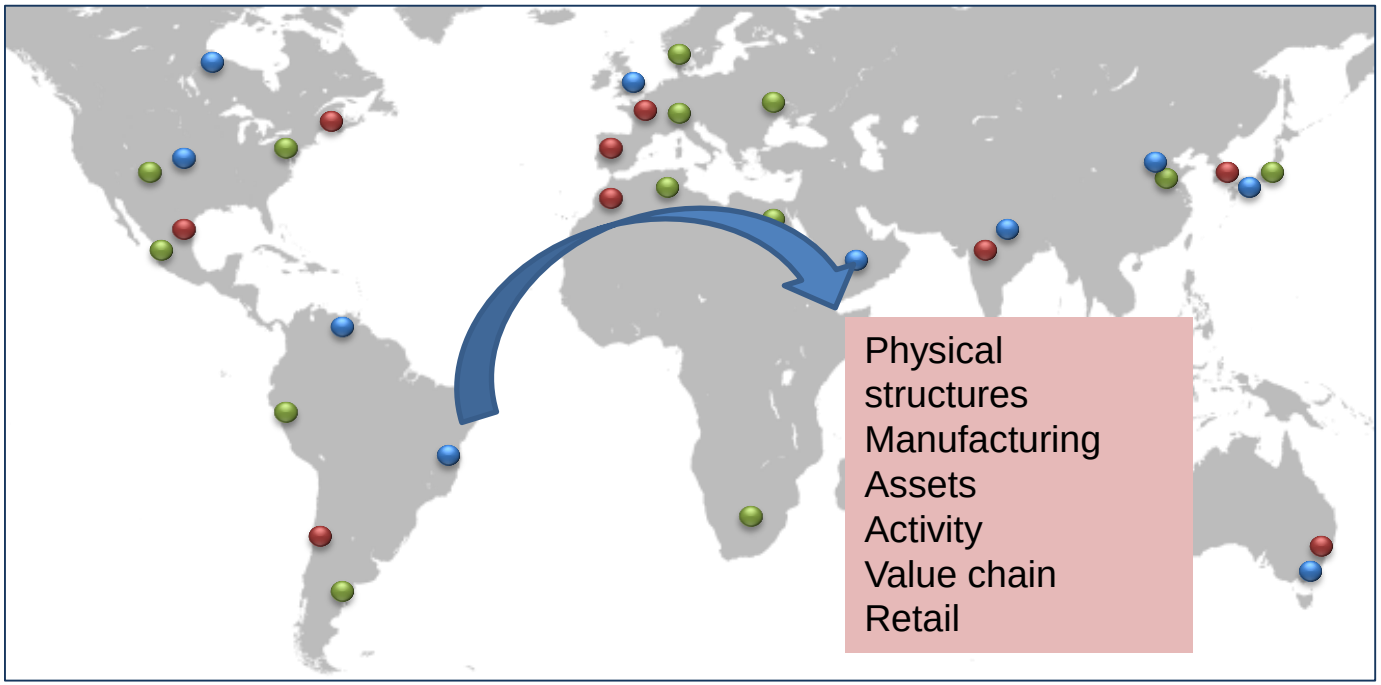
Integrated Risk Profile



Outputs and Applications

- Annual report risk declarations
  - 10K and other reporting
- Regulatory risk reporting
  - Long term viability statements
- Insurance purchasing strategy
- Crisis and continuity management
  - Management stress tests
- Emerging risk monitoring and stress test design
- Monitoring of risk metrics for business units

CRS View of Corporate Risk Profiling

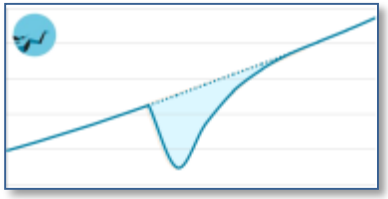


- Overlay corporate value chain onto view of world
  - Physical structure, asset, activity, value chain mapping provided
  - Manufacturing, Local operating company, Localized mapping to markets, Retail
  - Geographical mapping of corporate operations with overlay to threats.
  - Data standard needed. V0.1, V0.2

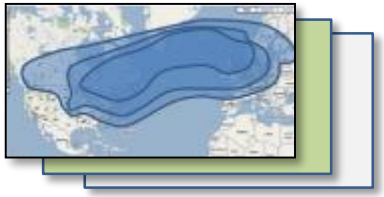
Corporate Risk Profiling
Using CRS Research Outputs in Managing Business Risks

Threat Maps

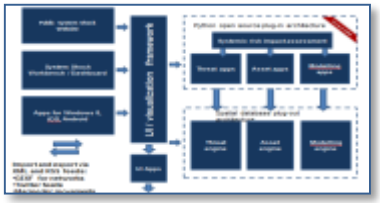
Risk Models



Scenarios

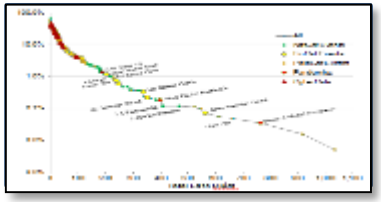


Software Platform



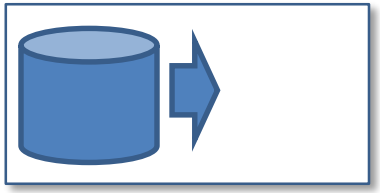
Exposure Data

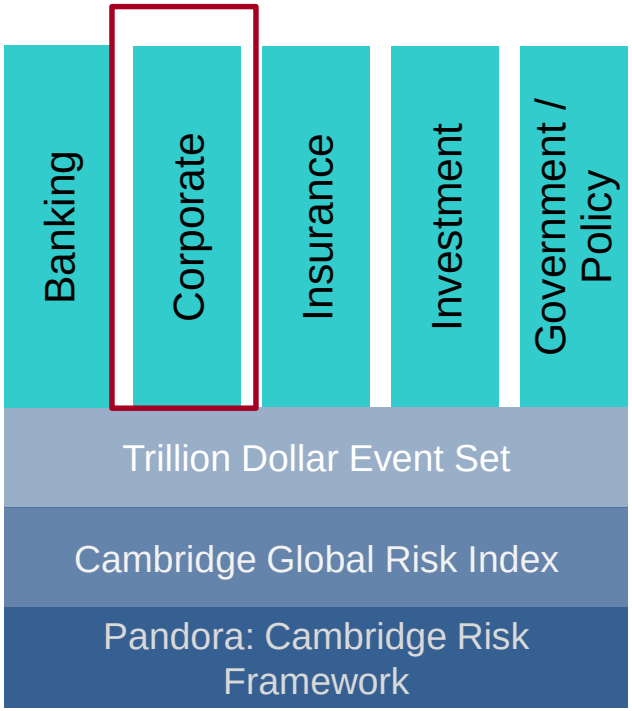
Use Cases



Network Models

Private Portals



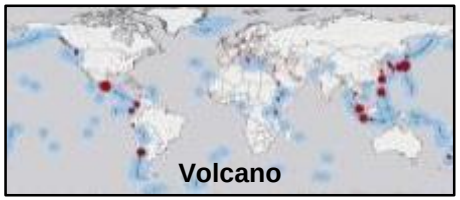


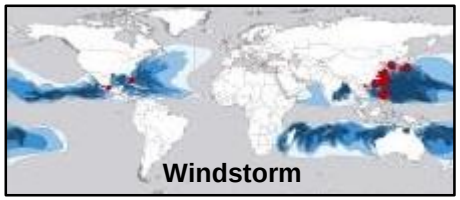
- Use cases envisioned by CRS partners
- Reflective of the stages of research at CRS
  - Scenarios
  - Taxonomy of global threats
  - Severity and likelihoods

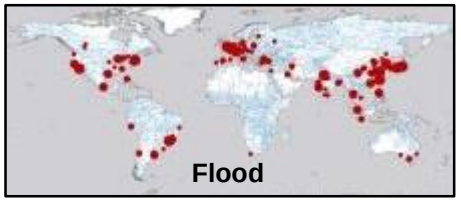
Developing Business-Ready Tools: “Use Cases”

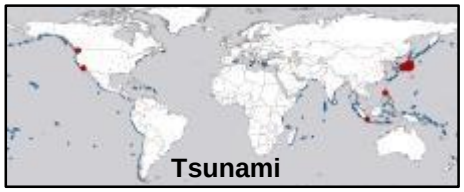
- A major innovation of Centre for Risk Studies has been to standardise shock assessment
  - Express costs & benefits of resilience via financial metrics for risk, like GDP@Risk
- Corporate Risk Profiling for quantifying balance sheet risk
  - **Assets@Risk** for manufacturing and finance
  - **Revenue@Risk** for disruption of markets
- Insurance & Finance
  - **Insurance@Risk** for probable maximal loss
  - **Underwriting@Risk** for (new) insurance products
  - **Investments@Risk** for financial portfolios
- Government policy
  - **Infrastructure@Risk**
  - **Security@Risk**
- International capital markets
  - Accounting standards for expected losses from shocks

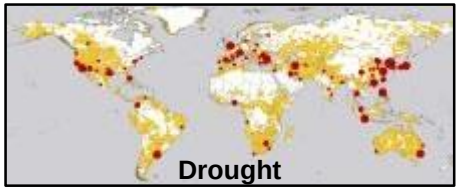
Geographical Mapping of All the Threats

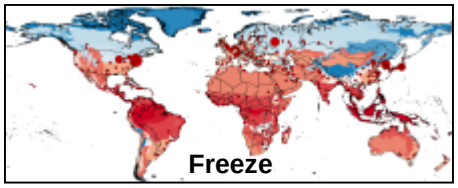


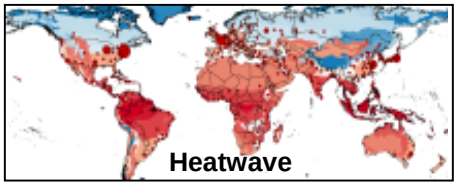


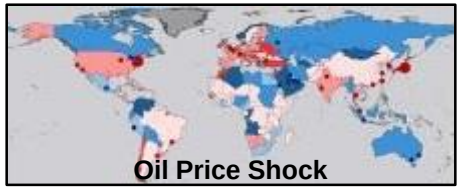


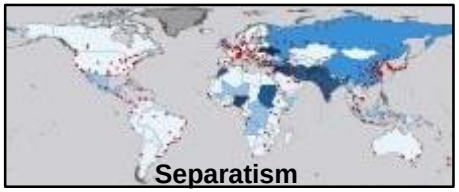


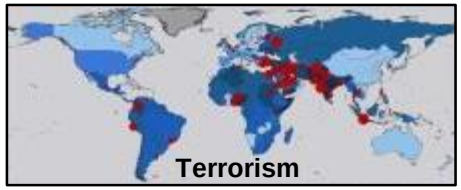


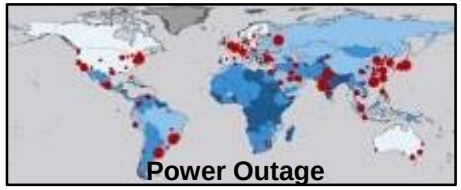


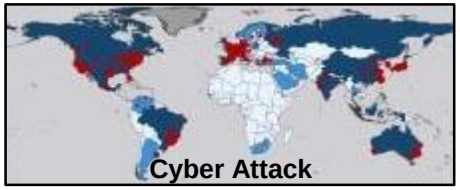


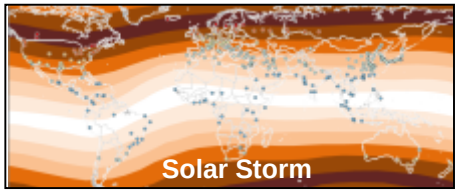


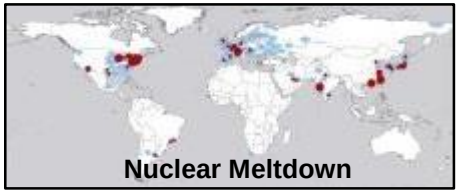


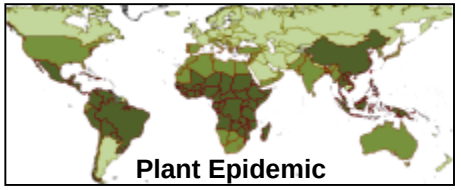






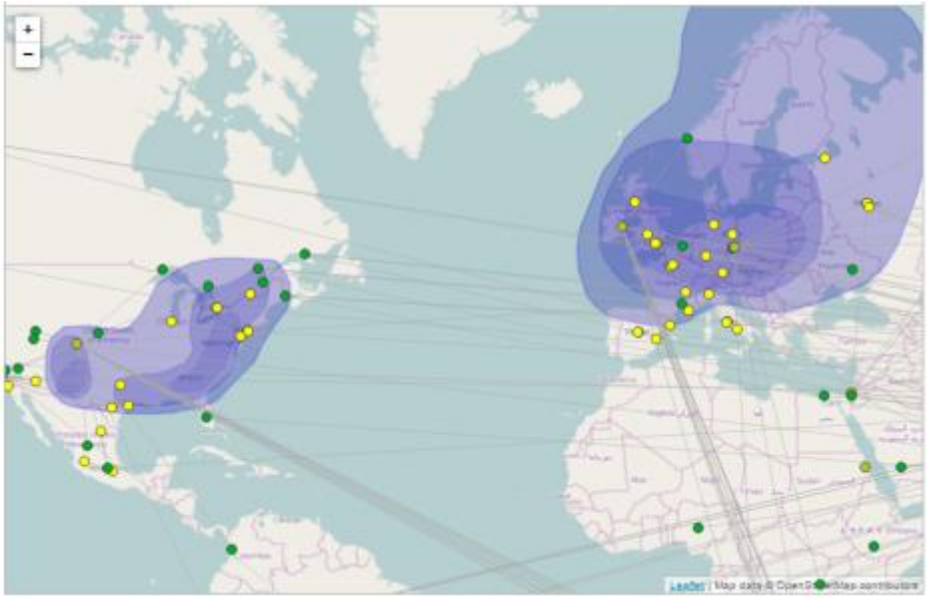






Events Defined as Footprints

- Scenarios will be re-defined as geographical footprints that can impact multiple cities
- Create a plausible ‘event set’ of representative scenarios
- Scenarios will be super-sets of current individual city scenarios



City Interconnectivity

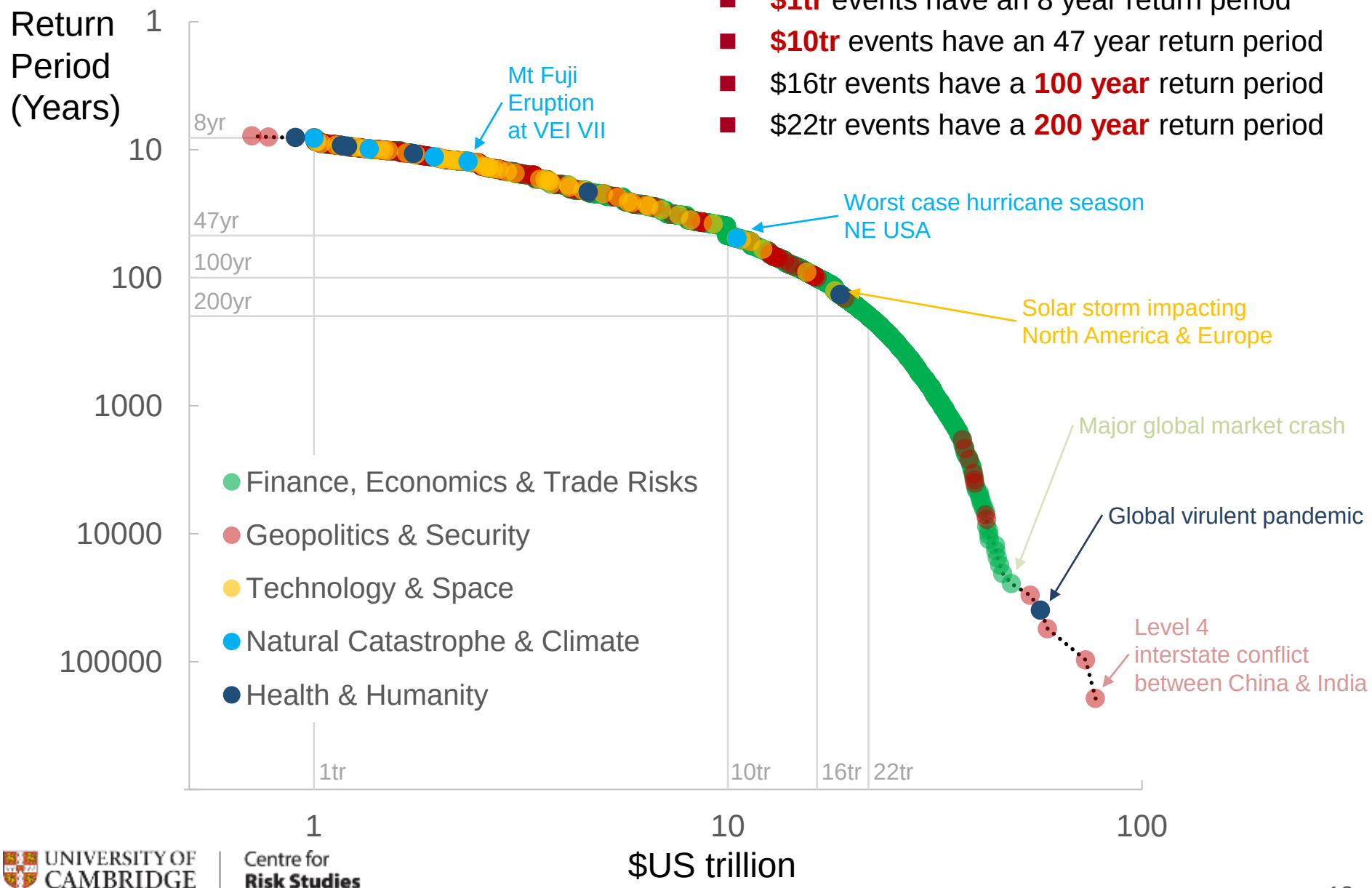
- How cities are related economically
- How a catastrophe for one city will also affect its primary trading partners
- Propose to develop an economic interdependancy matrix between the cities
- Catastronomics modelling will quantify the expected impacts of consequential economic shocks on city trading partners

Meaningful Metrics for Corporations?

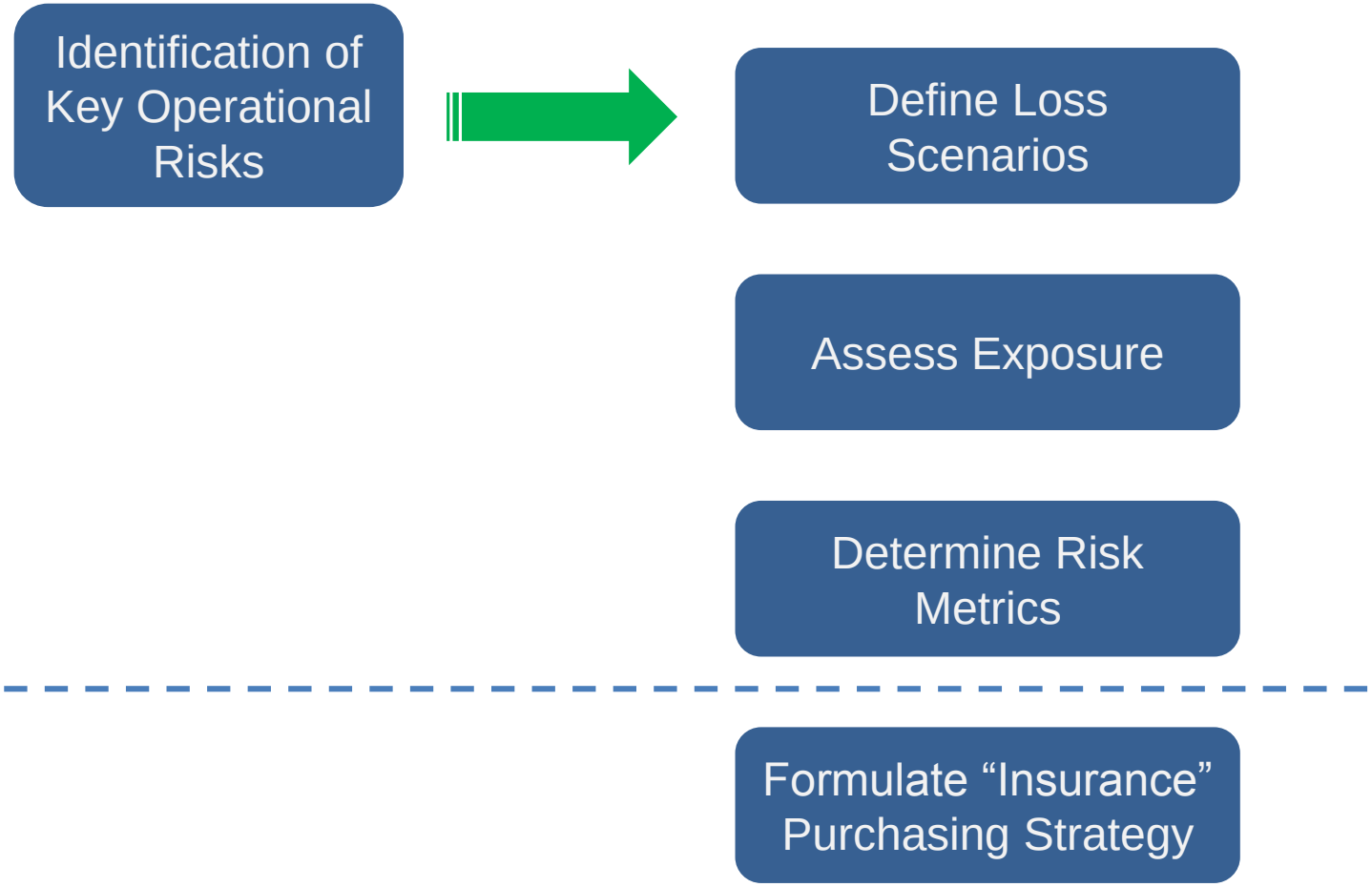
Top 5 Scenarios Impacts	Revenue 100	EBIT 100	EBITDA 100
1. Finance, Economics & Trade	80	90	95
2. Geopolitics & Security	110	70	80
3. Technology & space	80	85	95
4. Natural Catastrophe & Climate	80	90	130
5. Health & Humanity	120	120	130

Global Catastrophe Exceedance Probability Curve

- **$1tr** events have an 8 year return period
- **$10tr** events have an 47 year return period
- $16tr events have a **100 year** return period
- $22tr events have a **200 year** return period



Defining a Risk Strategy Aligned to Corporate Objectives



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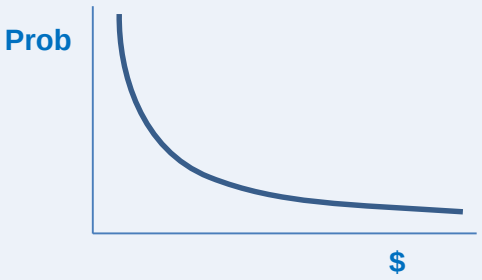

Outputs and Applications

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Corporate Risk Disclosure Requirements

Since 2005, the SEC has required all public companies in USA to disclose "the most significant factors that make the company speculative or risky" (Regulation S-K, Item 503(c), SEC 2005)

Where appropriate, provide under the caption “Risk Factors” a discussion of the most significant factors that make the offering speculative or risky. This discussion must be concise and organized logically. Do not present risks that could apply to any issuer or any offering ...
The risk factors may include, among other things, the following:

1. *Your lack of an operating history;*
2. *Your lack of profitable operations in recent periods;*
3. *Your financial position;*
4. *Your business or proposed business; or*
5. *The lack of a market for your common equity securities or securities convertible into or exercisable for common equity securities*

See https://www.sec.gov/about/forms/form10-k.pdf.

Sample 10-K 1A Risk Factors:
2016 Aerospace Corporation

- Heavy dependence on US Government for business
- Business and reputation risk for failure to comply with procurement laws and regulation
- Profitability and cash flow dependent on US government procurement policies
- Financial performance could be impacted by increased competition and bid protests
- Dependent on subcontractor, supplier, and partner performance
- Uncertainty of international markets
- Cyber, security or other disruptions
- Failure to manage acquisitions, divestitures, investments
- Uncertainty about profitability and cost estimations regarding recent acquisitions
- Business risks outside of indemnity or insurance
- Meeting employee pension fund obligations
- Future costs associated with environmental protection and remediation imposed by regulations
- Outcome of legal proceedings and litigations
- Maintaining qualified workforce
- Accuracy of financial estimates and projections

Sample 10-K 1A Risk Factors: 2016 Insurance Sector

- Market conditions
- Investment portfolio, concentration of investments, insurance and other exposures
- Reserves and exposures
- Liquidity, capital and credit
- Business and operations
- Regulation
- Competition and employees
- Estimates and assumptions

Summary of 10-K Risk Disclosures

- Risk factor disclosures coverage sizeable in 10-K
  - Risk factors 7% average length of 10-K; 1% - 30% range
  - Highest coverage by Technology, Telecommunications, and Utilities sectors
- Wide variation in the number of risk factors reported
  - Average risk factors across all firms (22)
  - Most risk factors reported by Healthcare, Telecommunications, Utilities

Source: The Corporate Risk Factor Disclosure Landscape, IRRC Institute, Jan 2016
Review used baselined data from Jan 2015. The study normalised all reported risks to 17 different categories and binned the risk section of 50 companies (5 largest in 10 sectors) into those bins.

Summary of 10-K Risk Disclosures (cont)

- Generic risks reported – 70% or more of companies report common risks

Percent Reported	Common Risk Disclosures
92%	Corporate finance and operations
90%	Capital markets and economic conditions
90%	Government and regulation
78%	Cyber, physical assets and data security
76%	Corporate growth strategy
74%	Competitive landscape
72%	Litigation and legal liabilities

- Lack of common language for risk disclosures

Source: The Corporate Risk Factor Disclosure Landscape, IRRC Institute, Jan 2016
Review used baselined data from Jan 2015. The study normalised all reported risks to 17 different categories and binned the risk section of 50 companies (5 largest in 10 sectors) into those bins.

Summary of 10-K Risk Disclosures (cont)

- Disclosure of risk management efforts
  - Investing in R&D, Purchasing insurance coverage, using hedging tools, implementing greater compliance controls, managing counterparty risk of suppliers and distributors
- Disclosure of risk factor trends
  - Increased likelihood of cyber attacks
  - Increasing challenging regulatory environment (Dodd-Frank, Consumer Protection Act, Patient Protection, Affordable Care Act, Greenhouse gas emissions)

Source: The Corporate Risk Factor Disclosure Landscape, IRRC Institute, Jan 2016
Review used baselined data from Jan 2015. The study normalised all reported risks to 17 different categories and binned the risk section of 50 companies (5 largest in 10 sectors) into those bins.

Questions Regarding Risk Disclosures

- How informational are risk disclosures? Do they accurately represent the risks posed to company?
  - Limitations of "materiality" threshold
- Do risk disclosures hold any predictive capability on company performance?
- How to include Likelihood and Impact into risk disclosures?
- Relationship of risk disclosure and insurance coverages

1-in-100 risk requirements?

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Summary of 10-K Risk Disclosures (cont)

- Less common risks reported – 30% or less of companies report

Percent Reported	Common Risk Disclosures
28%	Key personnel
22%	Power and communications infrastructure
18%	Company reputation
16%	Governance matters

- Key personnel risk factor present in all sectors except Health Care and Industrials.
  - Importance of certain executives to the company's growth strategy, operations, culture, company success

Source: The Corporate Risk Factor Disclosure Landscape, IRRC Institute, Jan 2016
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Risk Factor Categories of 10-K Risk Disclosures (cont)

Capital markets and economic conditions — Currency fluctuation and devaluation, debt and equity markets, credit risks, interest rate risk, macro and regional economy (including housing markets), inflation, employment and consumer spending, effects of monetary and fiscal policies
Company reputation — Public perception of company, questions over ethical nature of company business or actions, controversies which may tarnish company image, such as headline-making news on supply chain
Competitive landscape — Competitors (traditional and new/emerging) and competing products and services, including from counterfeiters
Consumer power — Consumer preferences, demographics, regulatory changes and other drivers affecting customer demands, such as health and safety considerations, customer concentration level and related company vulnerabilities
Corporate finance and operations — Revenue forecasts and other estimates and assumptions, short- and long-term investments, hedging, profit margins, performance and operating and financial results, goodwill, impairments, working capital management, internal controls, pension and health care costs, product and service quality, contracts and counterparty risk, insurance, inventory, property, plant and equipment
Corporate growth strategies — Strategies such as global expansion efforts, merger and acquisition and divestiture activity, joint ventures and strategic alliances
Cyber, physical assets and data security — Physical or electronic break-ins, data breaches, misappropriation of sensitive information, related human error and malfeasance, electronic fraud
Energy and natural resources — Pricing of fuel, energy and commodities, access to water and other natural resources
Governance matters — Dual-class stock structure, anti-takeover mechanisms
Government and regulation — Taxes and import/export duties, legislation and regulatory requirements, compliance requirements, financial reporting, accounting rules, political instability, nationalization of companies/industries
Human capital — Access to qualified labor, satisfactory relations with labor unions, retention, worker health and safety
Innovation and competitiveness — Research and development, intellectual property rights and protections, transition process for new products and services and related technology, adjustments to effects of technological change on company business model, product and service offerings and the scale of investment needed to maintain competitiveness
Key personnel — Continued service and availability of key individuals shaping company strategy, succession planning
Litigation and legal liabilities — Litigation, including potential and ongoing claims, legal compliance matters, related liabilities
Natural and human disruptions — Natural disasters, severe weather events, climate change, earthquakes, fires, war, terrorism, health pandemics and other public health crises, pollution
Power and communications infrastructure — System failures, network disruptions, communications lines and capacity, power shortages
Supply chain and third party — Sourcing, production, distribution and related logistical services, performance of vendors and distributors, access to and availability of third-party intellectual property, content and support

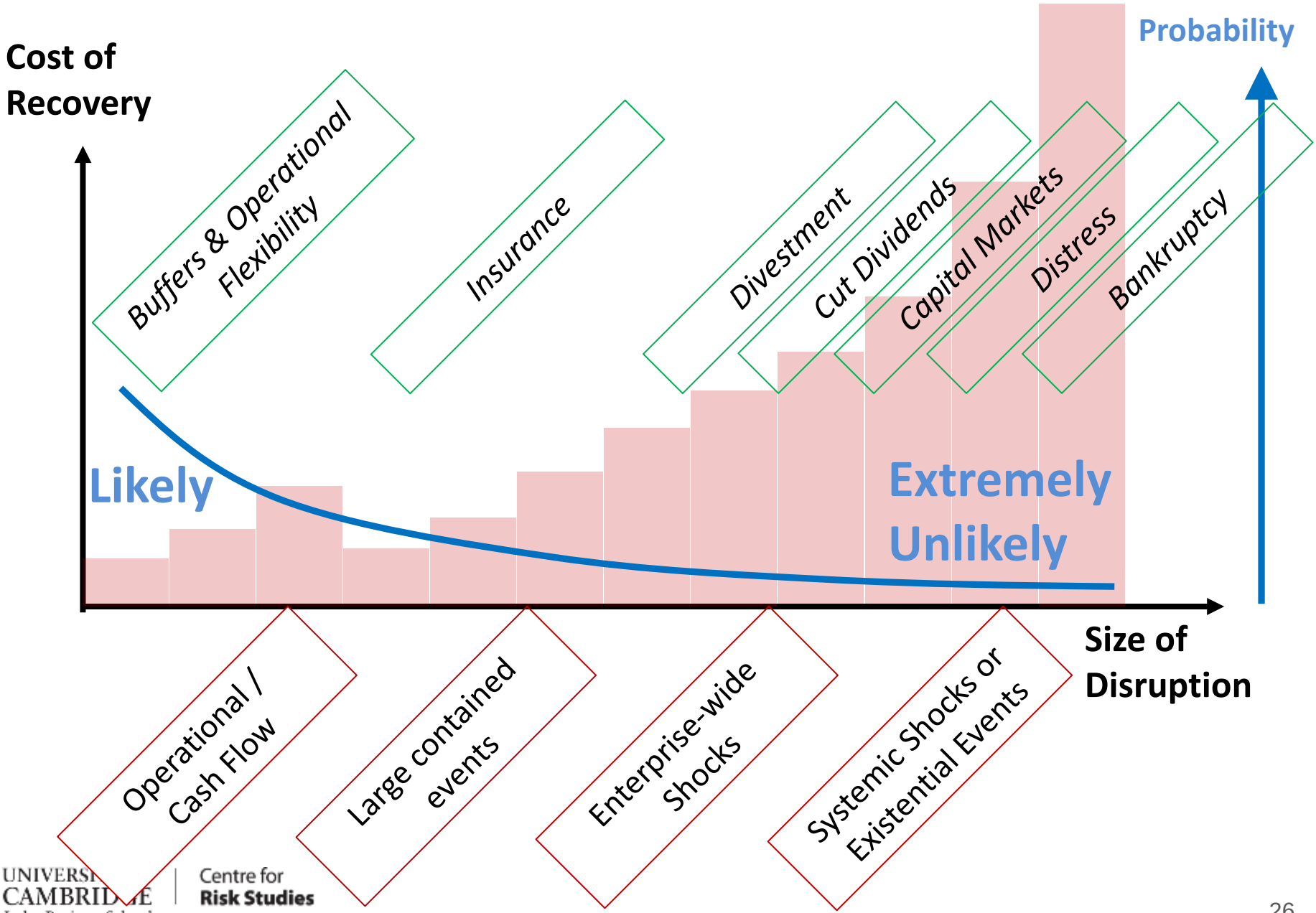
- Disclosure language is vague
- Sectors providing more specificity in risk factor disclosures
  - Consumer Staples
  - Financial Services
  - Health Care
  - Technology

Source: The Corporate Risk Factor Disclosure Landscape, IRRC Institute, Jan 2016

Potential ‘Use Cases’ for Pandora

- Scenario Identification Framework
  - Overlay AIG insurance portfolio and prioritize the scenarios that are most impactful
  - Track ‘Emerging Risks’ over time: index the changing prioritization of scenarios
- ‘Clash’ modeling
  - identify the scenarios of greatest threats to ALM and Underwriting
- Evaluation of Insurance Opportunities
  - identification of under-insured markets and perils that could represent future expansion opportunities
  - Develop 5-10 year insurance market projections
- Corporate risk profiling
  - Overlay the geographical offices of a company and derive the threats to the revenues and operations of the enterprise
  - Quantify balance sheet risk and supply chain disruption potential

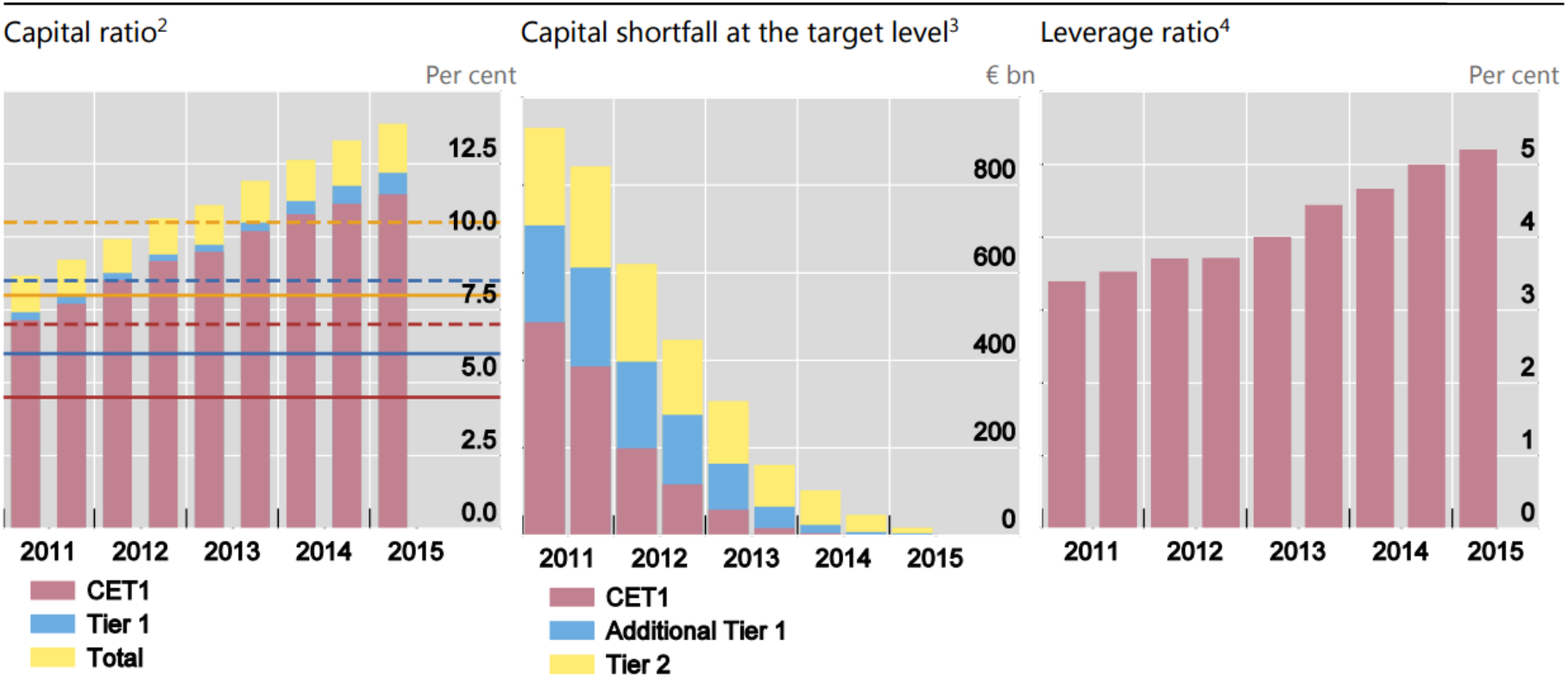
Tail Risks and Top Risks



The Improving Resilience of Banks

Average Basel III capital ratios, capital shortfall and leverage ratios

Fully phased-in Basel III, samples of large internationally active banks[1]



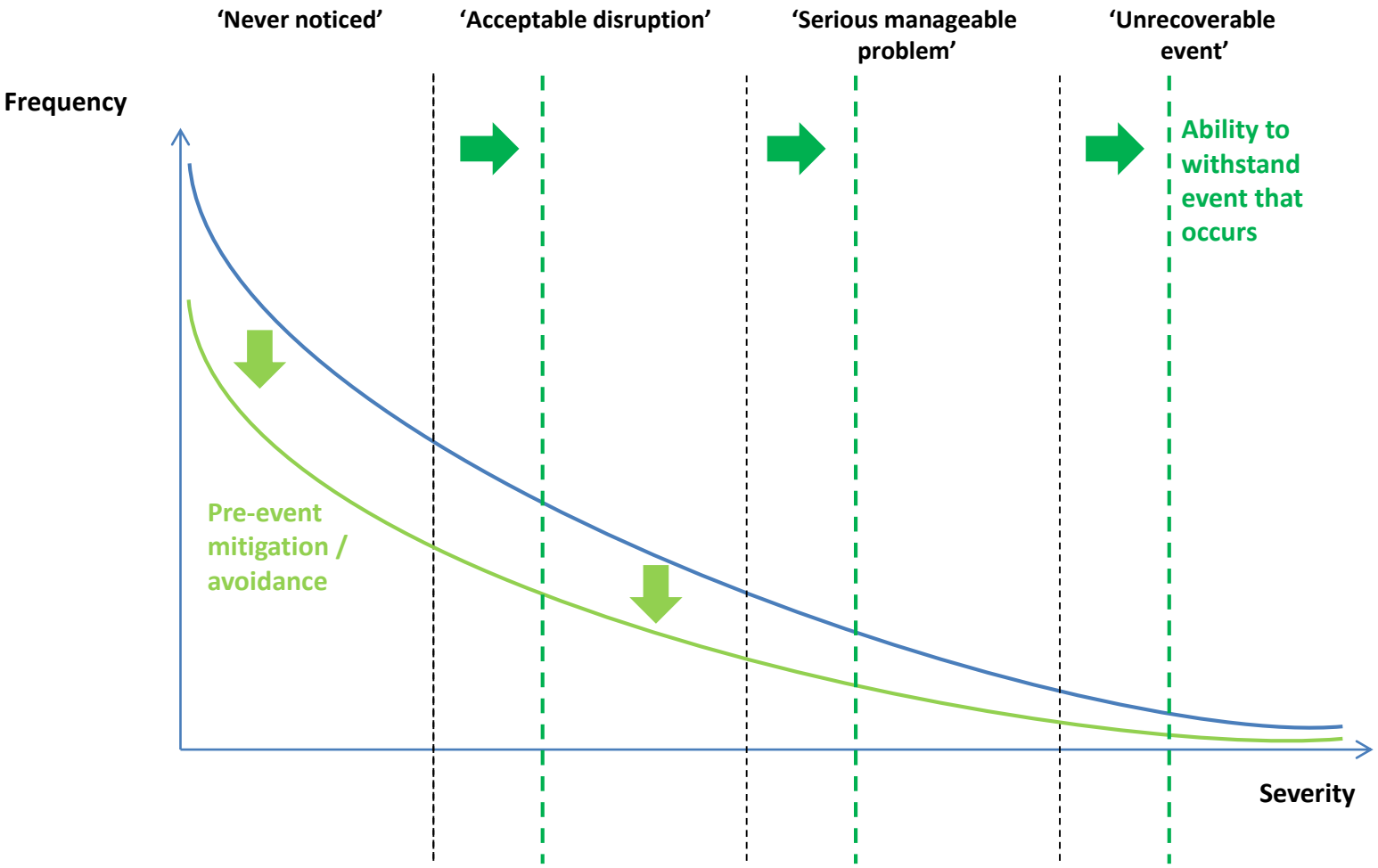
- TLAC (Total Loss Absorbing Capacity) of G-SIBs is near completion
- But eight large US banks downgraded by S&P Dec 2015 because now less likely that Federal Reserve will bail them out if they get into difficulties

Overview

- What do we mean by resilience?
- Insurance industry approaches to resilience
- Some challenges of today's approaches
- We could improve the world if… - opportunities to improve resilience to consider

What Do We Mean by Resilience?

Reaction to events, based on purely arbitrary distinctions for illustrative purposes



Insurance Industry Approaches to Resilience

Illustrative examples of how insurance companies improve resilience today

	Pre-event mitigation / avoidance	Increased ability to withstand event
Insured-oriented	• Provide external perspective / signal to insured as to risk level through pricing and risk selection • Incentivize insureds to reduce expected loss by rewarding risk mitigation / avoidance investments (e.g. training, technology deployment, inbuilt redundancy)	• Pay indemnity to 'make good' loss • Provide post-loss services to increase effectiveness and speed of recovery
Insurer-oriented	• Use human experience of many clients to inform judgements • Leverage technology to improve risk selection and pricing models • Invest in technology / research to reduce insureds' expected loss	• Hold sufficient capital to withstand even low frequency events • Diversify risk through reinsurance / other capital transactions • Assume more risk to achieve diversification benefits against larger earned premium received

Some Challenges of Today's Approaches

Selected points for reflection

1. 1-year insurance contracts limit effectiveness of insurer-insured interaction

2. Limited ability to see across insurer results, coupled with very different ingoing insurer objectives and beliefs, make deriving a market signal difficult

3. Low data volumes / limited pool of comparable clients in some spaces mean high pricing model uncertainty for individual risks and some portfolios

4. Computational and statistical techniques exist that can reduce model uncertainty; but are typically black box and difficult to combine with human judgement

5. Understanding more potentially catastrophic events than peers is a competitive advantage in resilience for insurers; but potentially a disadvantage in winning business

We Could Improve Resilience If…

Possible opportunities to improve resilience to consider

…we had longer term insurer–insured relationships, aligning interests more tightly and enabling co-investment

…we could tell more readily how insurer results compared to those of peers, so we had a better idea of what the market was telling us

…insurers could aggregate much more data from insureds, to derive signals from data that never seemed relevant before

…insurers selectively and anonymously pooled data with the backing of insureds, insurers, regulators and Government, to create sufficient data sets to truly improve resilience

…we could move the debate from ‘who has the data’ to ‘who can use the data most insightfully’

…we invested in talent and their understanding of advanced models, so they can effectively combine human judgement and cutting edge data science

…insurers took into account a similar set of risk scenarios, to reward insurers who invest in understanding more, not those who avoid discovering threats to resilience