Gap Approach in Mitigating Risk
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Agenda

• Challenges in quantifying and mitigating risk
• Outlook to operational risk in NatCat
  • Overview of NatCat risks
  • Differences and equalities in NatCat risks
  • Decisive and substantial data base
• Example of the latest risk type with cyber – Technological Risks
  • Quantifying cyber security risk
  • Mitigate cyber security risk
• Example of a state-of-art dataset with Pandemic risks – Societal Risks
  • Infectious disease outbreak data are messy
  • Market-validate approach
• Outlook
  • Preparedness
  • Future processes of operational risk measurements
Today’s challenges

• Risk Management exists for a very long time
• The challenge lies in the preparedness of the risk-profit profile

- Book of Hammurabi (1800 BC)
  - Risk
  - Harvest fail
  - Lack of water resulting in no grain
  - Settlement
  - No grain for creditor
  - No payments for rent

- 17th Century (in Amsterdam)
  - Call and Put options

- 19th Century
  - Systematic development of statistics

- 20th Century
  - Mathematical modeling in Finance and Insurance
  - Mostly developed during the last 30-40 years

- Before 1960
  - Cash
  - Stocks
  - Loans
  - Mortgage
  - Bonds

- After 1970
  - Futures
  - Options
  - Swaps
  - Asset-backed securities
  - Mortgage-backed Securities
  - Credit derivatives

- 2000
  - Financial institutions and regulators
  - Market risk
  - Credit risk
  - Operational risk
  - Liquidity risk
  - Model risk
  - Parameter risk
Reduction of adverse effects

**Risk acceptance**
- Cost and expenses are the drivers
- Avoiding to spend money and therefore accept the risk
- No reduction of any effects

**Risk avoidance**
- No risk takings are the drivers
- Avoid any exposure to the risk
- Most expensive of all risk mitigation options

**Risk mitigation**
- Backup solutions are the drivers
- Most common risk management strategy used by businesses
- Mixture of risk acceptance along with risk avoidance

**Risk transfer**
- Focus on core competencies are the drivers
- Involvement of transferring risk to third parties
- Outsource operations with risk bearing
Risk Acceptance

- Many of the project risks are viewed as acceptable
- Once the risk occurs, it will be fixed to move on
- Reactive behaviour
- Severity of the risk is lower than our risk tolerance level
- The costs for the claims are lower than the protection of the risks

**Active acceptance criteria**
- Existing plan when the risk occurs
- Follow the plan once the risk had taken place
- Avoidance of wrong things to do

**Examples**
- Recall plan on risks for automotive, food, technology, etc
- Market entrance for products where a delay can be within reasons
- Delay on flights and travel where solutions are to secure a stop-over
- etc

**Passive acceptance criteria**
- No back-up plan for occurrence of the risk
- Cost of development of a plan can be higher than the cost to deal with the risk without preparation
- Usually the risks are very small

**Examples**
- Defective CD of an off-the-shelf software for a single user
- Delivery failure for non-critical small purchased items
- Failures on projects outside of critical steps where a work-around can be done
- etc
Risk Avoidance

• Eliminating any exposure of risk that poses a potential loss
• Not performing any activity that may carry risk
• Choosing to avoid actions that trigger the risk

Example:
• Investment in oil stocks
• Risks are political risks for the country with the production of oil and unsystematic risks on stocks
• Reduction of risk can be by diversifying the portfolio by buying stocks in other industries such as retail or airlines

Example:
• Suppliers outsource their production of a software development into a different country
• Risks can be increased due the unsecure handling of data and modules which the country changed from a secure to an unsecure status
• Reduction of risk can be to stop working with suppliers in dangerous areas or third world countries

Example:
• Large construction project such as skyscrapers, or airports within the buildings, infrastructure and industrial industry
• Risks are material defects, lack of expertise on the constructions site
• Reduction of risk on failures of the construction site is to shut down the operation in bad weather to avoid the risk of someone to get hurt
Risk Mitigation = Risk Reduction

• Reducing the likelihood and severity of a possible loss
• Mitigating potential losses
• Systematic reduction in the extent of exposure to a risk and/or the likelihood of its occurrence
• Management of the exposure – limitation of exposure
• Protection of the business
• Avoidance of business going bankrupt
• Responding to the level of uncertainty
• Risk response and mitigation tools
• Monitoring
Risk Transfer

- Risk Transfer Chain for Reinsurance and Insurance industry
- Covering an insurer’s portfolio of risks
- The absolute level of exposure for an insurance company is the capital it has on its balance sheet
- Risk to be transferred to third parties
  - Traditional reinsurance market
  - Capital market
- Methods of risk transfer
  - Insurance
  - Captives / Self-insurance
  - Treaty Reinsurance (contracts for a specified portion of a category)
  - Facultative Reinsurance (negotiated for each insurance contract)
  - Insurance Linked Securities
Definition of NatCat events

The term „natural catastrophe“ refers to an **event caused by natural forces**. Such an event generally results in a large number of individual losses involving many insurance policies. The scale of the losses resulting from a catastrophe depends not only on the severity of the natural forces concerned, but also on man-made factors, such as building design or the efficiency of disaster control in the affected region. Natural catastrophes are subdivided into the following categories: floods, storms, earthquakes, droughts/forest fires/heat waves, cold waves/frost, hail, tsunami and others natural catastrophes.

A big **natural catastrophe** is defined as one where the affected region is “distinctly overtaxed, making interregional or international assistance necessary. This is usually the case when thousands of people are killed, hundreds of thousands are made homeless, or when a country suffers substantial economic losses, depending on the economic circumstances generally prevailing in that country”.

*Swiss Re – Definition of NatCat events*
NatCat modeling Approaches

- **Physical NatCat models (exposure based, synthetic event catalogue)** – High time/space required for computing
  - Scientific view on vulnerability from many perspectives
  - Modeling insights: Black Box Character

- **Stochastic NatCat models (historical experience based)** – Only possible having long time observations
  - Usually not sufficient data available (low/no data for earthquake) – High transparency

- **Zonal Systems**
  - Distribution of the risks into different vulnerability zones – Used in pricing/rating
  - What is the size of Probable Maximum Loss (PML)?

- **Scenario-based approach** – QIS5
Outlook to operational risk in NatCat

**Cyber Risk**

“GIVEN THE WORLDWIDE NATURE OF OUR CYBER EXPOSURE, WE TAKE INTO ACCOUNT FACTORS SUCH AS SECTOR OF THE INSURED, SYSTEMS THEY USE THAT MAY BE A TARGET, VENDORS THEY USE THAT MAY POSE AN AGGREGATION RISK AND THE POTENTIAL OF VIRUS OR MALWARE TO AFFECT MULTIPLE COMPANIES.”

*Geoff White, Underwriting Manager, Cyber, Technology and Media at Barbri*

**Nuclear Accident**

“BLACKOUTS HAVE THE POTENTIAL TO CREATE LOSSES FOR BUSINESSES, PROVIDING BOTH RISK AND OPPORTUNITY FOR INSURERS. MODELLING TOOLS CAN NOW QUANTIFY LOCAL AND PORTFOLIO RISKS FOR BOTH INSURERS AND THEIR CUSTOMERS, ALLOWING THEM TO MANAGE, MITIGATE AND RESPOND TO THESE RISKS.”

*Kyle Beatty, President, Verisk Climate*

**Power Outage**

“INSURERS COULD DO MORE. WE COULD PROVIDE COST EFFECTIVE, MATERIALLY HIGHER FINANCIAL SUPPORT FOR THE NUCLEAR INDUSTRY, REDUCING THE BURDEN OF ACCIDENT COSTS THAT CURRENTLY FALLS TO GOVERNMENTS AND TAXPAYERS.”

*Mark Tetley, Managing Director, Price Forbes*

**Earthquake**

“IN CALIFORNIA, TAKE UP OF EARTHQUAKE INSURANCE IS ONLY ABOUT 12%. IN LIEU OF THESE COVERS BEING MADE COMPULSORY, THE INDUSTRY NEEDS TO WORK HARDER AT PROMOTING THE VALUE OF AND DRIVING THE TAKE UP OF THESE PRODUCTS, SO THAT DISASTER RISK FINANCING IS IN PLACE WHEN THE ‘BIG ONE’ HAPPENS.”

*Jeremy Hindle, Head of Enterprise Risk Aggregation, XL Group*

**Flood**

“THE FLOODS WERE A WAKE-UP CALL FOR THE INSURANCE INDUSTRY, WHICH SINCE THE EVENT HAS BEEN MAKING A STRONG EFFORT TO PRICE AND MODEL FLOOD RISK MORE ACCURATELY.”

*Karl Jones, Head of Catastrophe Management, Willis Reinsurance; Australia, New Zealand and Asia-Pacific*

**Drought**

“DROUGHTS AND OTHER CLIMACTIC ISSUES ARE ONGOING AND WILL BECOME AN EVEN BIGGER ISSUE IN FUTURE. IT IS CLEAR THAT MORE INVESTMENT IN MODELLING AND THE DESIGN OF INNOVATIVE PRODUCTS - SUCH AS PARAMETRIC CROP INSURANCE COVERS - ARE NEEDED TO REDUCE THE IMPACT ON POPULATIONS AND ECONOMIES.”

*David Flandro, Global Head of Strategic Advisory, JLT Re*
Global Risks – NatCat and Man-Made Risks

**Economic Risks**
- Food price volatility
- Oil price spikes
- Major fall in the US $
- Slowing Chinese economy (<6%)
- Fiscal crises
- Asset price collapse
- Retrenchment from globalization (developed)
- Retrenchment from globalization (emerging)
- Burden of regulation
- Underinvestment in infrastructure

**Environmental Risks**
- Extreme weather
- Droughts and desertification
- Water scarcity
- Natcat: cyclone
- Natcat: earthquake
- Natcat: inland flooding
- Natcat: coastal flooding
- Air pollution
- Biodiversity loss

**Geopolitical Risks**
- International terrorism
- Nuclear proliferation
- Iran
- North Korea
- Afghanistan instability
- Transnational crime and corruption
- Israel-Palestine
- Iraq
- Global governance gaps

**Societal Risks**
- Pandemic
- Infectious diseases
- Chronic diseases
- Liability regimes
- Migration

**Technological Risks**
- Critical information infrastructure (CII) breakdown
- Nanoparticle toxicity
- Data fraud/loss

Source: World Economic Forum
Global Risks – NatCat and Man-Made Risks

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Source: World Economic Forum
Global Risk 2015 Interconnections Map

The Global Risks 2015 Interconnections Map

Global Risks 2015 Report
Data explorer

View
Global Risks Interconnections Map
Risks-Trends Interconnections Map
Global Risks Landscape

Source: World Economic Forum
Risk Trends 2015 Interconnections Map

The Risks-Trends 2015 Interconnections Map

Source: World Economic Forum
Global Risks Landscape 2015

The Global Risks Landscape 2015
What is the impact and likelihood of global risks?

Global Risks 2015 Report
Data explorer

View
Global Risks Interconnections Map
Risks–Trends Interconnections Map
Global Risks Landscape

Compare
Business to others
Male to female
Aged below 30 to older
Expert to non-expert

Filter
Economic
Environmental
Geopolitical
Societal
Technological

Source: World Economic Forum
Decisive and substantial data base

• Munich Re
  – NatCatSERVICE
  – 37,000 datasets
  – Worldwide the largest dataset for NatCat risks
  – 1,000 events per year

• Metabiota
  – Worldwide largest data for Pandemic and Human Infectious disease
  – More than 1,000 outbreaks
  – Pathogens, data sources, countries and territories
  – Subnational and Time Series quantitative case data

• Swiss Re
  – Sigma Service
  – Largest insurance research for all lines of business

• Air Worldwide
  – Exposure data for effective catastrophe risk management
  – Majority of NatCat risks incl Cyber

• And others for specialised risks
Technological Risks: Back to the Future

- Risk of large-scale cyber attacks is above average on impact and likelihood
- Reflecting the growing sophistication of cyber attacks and the rise of hyperconnectivity
- Sensitive personal data on the Internet – the Internet of Things (IoT)
- USA: cyber crime already costs an estimated $100 billion each year

Source: World Economic Forum
Cyber Attacks mainly in wealth countries

Source: World Economic Forum
Risks connected to digital technologies, media and technical devices are arising in ways and to a degree we have never dreamed of.

It was once thought that such risks arose solely in the ranks of technology providers, defense contractors, financial services companies, or "big names".

The evolution of this high risk means every type of organization is in danger.

It is now a concern for all.

It is now essential for such risks to be measured, analysed and insured.

High risks occur in particular if the attack is in the so-called "cyber risk" category.
Mitigate cyber security risk

• Without historical data, actuaries cannot predict what might happen
• All financial data is sensitive data and should be carefully managed
• All business data has value
• The value of data increases the more it is used
  • This differs from all other protection
  • For traditional coverages, the value of an insured object or an asset decreases over time

Are cyberattacks the biggest risk that global businesses are unprepared for?
Mitigate risk before a cyber event

**Investment**
- Additional capital to prepare before the event occurs
- Investment in incident and response plans
- Update security protection and user authentication
- Monitor traffics, trans and activities on any platforms or clouds

**Insurance**
- Plays a key role in enhancing risk mitigation and improving economic resilience to catastrophes; this will be ongoing
- Improves the sustainability of an economy and leads to greater rates of growth
- Reduces the risks of governments, business and communities
- Takes the financial burden of recovery off the taxpayer and boosts economic growth

**Data base and models**
- Build historical data bases
- Develop model methodologies
- Develop business progress with big data analytics, cloud computing and relationship models
Global Influenza Spark Site Risk Map

- Probability of where the next influenza pandemic is likely to start
- Expand focus from typical historical outbreak locations to more diversified risky locations
Global Mobility and Epidemic Spread

- Individual based large-scale computation models for infectious disease spreading
- Collection of sub-populations coupled by traveling individuals
- Full airline transportation data (iata/oag) + short-scale mobility modeling between adjacent subpopulations
Modeling Approach

- **Stochastic Event Design & Generation**
  - Metabiota Expertise
  - MOBS Modeling Framework and Engine

- **Pricing**
  - Stochastic Outbreak Event Catalogue

- **Trigger Design and Development**
  - Exposure Data

- **Metabiota Analytics**
  - Event Filtering and Categorization
  - Event Rates
  - Country & Disease-Specific Costing Data
  - Costing Models

- **Financial Loss Expectations**
  - Pricing Payout

Proprietary and confidential information. Please do not distribute.
State-of-art dataset - Pandemic risks

Metabiota added value steps

- Data Format Optimization
- Model Output Validation
- Model Output Visualization
- Parameter distribution fitting
- Event Likelihood Estimation
- Event Sampling and Selection
- Age and gender-specific Attack Rates
- Age and gender-specific CHR*
- Age and gender-specific CFR*

One-of-a-kind database
- 98 years of infectious disease outbreaks
- More than thousand events
- 120 data sources in multiple countries
- Time series and sub-national case data
Data Exploration

Zika Virus Starting In Brazil In 2015

OUTBREAK MAP

Zika (Zika virus)
Location: State of Paraíba, Brazil
Onset: 06/28/2015

Cases & Deaths
3.9K Reported Cases
No Data Reported Deaths

12 Confirmed

GLOBAL EVENT DATA
First Reported Case: 01/04/2015
Last Reported Case: 09/09/2016

Cases & Deaths
616.1K Reported Cases
30 Reported Deaths

119.8K Confirmed

Case Fatality Ratio
0.0%

DISEASE & PATHOGEN PROFILE

Pathogen
Zika virus

Prophylactic Options
Incubation Period
2-7 days following mosquito bite.
Increased Frequency

Mobility

Population Growth

Urbanization
A Problem With Boundless Costs

Microbial Risks are massive

- UK - Foot & Mouth 2001: $11B
- Germany - E. Coli 2011: $2.8B
- Korea - MERS 2015: $23B
- West Africa - Ebola 2015: $11B
- Midwest - Avian Influenza 2015: $3.3B
- Stores Closed by E. Coli 2015: 43
- Annual US Cost of Foodborne Illnesses: $77B
- Annual US Cost from Salmonella: $4B
- Annual US Cost from Sick Animals: $5B
- Loss of Hogs from PEDV - US 2014: 6%
- Salmonella Outbreak 2014: $100M
- Listeria Recall 2015: $18M
- Midwest - Avian Influenza 2015: $3.3B
- Southern Africa - HIV 4.3% of GDP Annually
- Loss of Hogs from PEDV - US 2014: 6%
- Global Cost of SARS - 2003: $5.4B

Source: Naturally occurring infectious disease elevated to US national security concern in 2015
Differences or Preparedness at regional levels

Figure 1.7: For Which Global Risks Is Your Region Least Prepared?

Note: Respondents were asked to select three global risks that they believe their region is least prepared for. For legibility reasons, the names of the global risks are abbreviated. Please see Appendix A for the full name and description. Oceania is not displayed because of the low number of respondents.

Source: World Economic Forum
... and where are they least prepared

**Europe**
- Un- and underemployment
- Large-scale involuntary migration
- Profound social instability

**North America**
- Critical infrastructure
- Large-scale cyber attacks
- Failure of climate-change adaptation

**Middle East and North Africa**
- Profound social instability

**Sub-Saharan Africa**
- Infectious disease
- Unemployment
- Strong population growth

**Latin America, Caribbean and South Africa**
- Urbanization
- Failure of urban planning
- Social unrest
- Pandemic outbreaks

**East Asia and the Pacific**
- Interstate conflict
- Failure of urban planning
- Man-made environmental catastrophes

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**Source:** Global Risks Perception Survey 2014, World Economic Forum.

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Outlook to future processes of operational risk measurements

Risk Map

– The first step in the process of monitoring operational risk is to establish a risk map. This map is based on an analysis of business processes, which we cross with the typology of operational risks.

Loss data collection

– Data collection of loss events relies on the previously established map to register and reference incidents. It also allows, by a retroactive effect, to tune the map.

Measurement of operational risk

– Use of statistical approaches, scenario analysis and scorecard methods which relies on risk indicators

Operational risk control

– Determine an acceptable level of risk to be able to identify the required actions from existing risk to preventing measures
THANK YOU