Session 99 PD, Risk Identification, Emerging Risk Perspectives and Complexity Science Application

Moderator:
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Presenters:
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Primary Competency
Results-Oriented Solutions
SESSION 99: RISK IDENTIFICATION, EMERGING RISK PERSPECTIVES AND COMPLEXITY SCIENCE APPLICATION

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MODERATOR: SHIRAZ JETHA FSA, CERA

Primary Competency: Results-Oriented Solutions

EMERGING RISKS & FUTURISM TECHNIQUES

- Emerging Risk: Developing or already known risks which are subject to uncertainty and ambiguity and are therefore difficult to quantify using traditional risk assessment techniques (IAA Note on ERM for Capital and Solvency Purposes in the Insurance Industry – Sec 5.2)

- Futurism: a discipline that systematically explores what we can know about the future of human systems.......

(Future Techniques: The Applied Futurism note lists 12 Futurism techniques. “Big Data” mining?

http://www.slideshare.net/bigdatalandscape/big-data-trends)
EMERGING RISKS & FUTURISM TECHNIQUES

Why is emerging risk identification and evaluation important?

- Shorter response time in a fast-changing environment; financial impact can be swift and severe
- Company strategy can address risk issues
- Can identify new opportunities
- Increased interest from regulators

Emerging Risk Identification

- Outward looking methods - Environmental Scanning, Trend Identification & Monitoring, Complexity Science, others
- Reverse stress testing - Scenarios, Delphi Study, others

[Reverse stress-tests are stress tests that require a firm to assess scenarios and circumstances that would render its business model unviable, thereby identifying potential business vulnerabilities. Reverse stress-testing starts from an outcome of business failure and identifies circumstances where this might occur. This is different to general stress and scenario testing which tests for outcomes arising from changes in circumstances.]

http://www.fsa.gov.uk/pages/about/what/international/stress_testing/firm_s/reverse_stress_testing/index.shtml

- Check for impact from combination of trends or scenarios.
EMERGING RISKS & FUTURISM TECHNIQUES

- Emerging Risk Progression
  - Early - Germ of a Risk
  - Formative - Lots of Grey
  - Stabilized - New Normal
  "New" does not mean permanent
- Questions in early/formative stages:
  - Are the phenomena isolated or indicative of trend?
  - Stakeholder agenda?
- Multi-disciplinary setting better suited to ER analysis.
- Road to the New Normal could be bumpy and possibly a dead end.

Illustrative risky events, evolutionary stage and possible techniques (*not* meant to suggest specific situations of concern)

1. Life Insurance
   Evolution in traditional employer/employee relationships
2. Property & Casualty
   Auto Insurers: Sophisticated accident avoidance technologies/Driverless cars
3. Health Insurance
   Healthcare Reform: ACA enacted 2010
## 1. Life Insurance

Evolution in traditional employer/employee relationships

WORKERS BEARING MORE COSTS OF BENEFITS. Todd Wallace. The Boston Globe. 09/10/2012. Industry studies show that increasingly employers are requiring their workers and retirees to pay more of the cost of such benefits as life, disability and accidental death insurance, which were once seen as part of their compensation. A 2011 survey by Limra, a life insurance trade group, found that almost 1 in 10 employers in the U.S. said they might replace some benefits that were partly or fully subsidized by companies with voluntary benefits paid for entirely by employees. Another Limra survey reported that 40 percent of US employers asked workers to pay for the full cost of accidental death and dismemberment insurance in 2009, compared with 28 percent in 2002. In 2011 the consulting firm Mercer reported that 76 percent of large employers were offering vision insurance that was partly or fully paid by for workers, compared 70 percent two years earlier.

Concern: Impact of New Normal for employee benefits

Time Horizon: 2020?

## 2. Property & Casualty

Auto Insurers: Sophisticated accident avoidance technologies/Driverless cars

http://www.propertycasualty360.com/2012/05/22/a-world-without-personal-auto-insurance

Concern: Impact of New Normal for Auto Insurance

Time Horizon: 2020?

## 3. Health Insurance

Healthcare Reform: ACA enacted 2010

Concern: Impact of New Normal for healthcare delivery and financing.

Time Horizon: 2017? 2025?
EMERGING RISKS & FUTURISM TECHNIQUES

Event & Risk Evaluation Techniques

- Event: Health Care Reform
  Techniques: modeling, traditional analytical, complexity science

- Events: Sophisticated accident avoidance technology and driverless cars
  Techniques: combining both traditional and futurism

- Event: Employer/employee relationship
  Techniques: Delphi, scenarios, environmental scanning, others?

MAX J. RUDOLPH FSA, CFA, CERA, MAAA

Rudolph Financial Consulting, LLC
- Make better decisions using risk/return, common sense and skepticism
- Peer review ERM and ALM practices
- Research: ERM, Investing, Emerging Risks
- Continuing education: modules, courseware, seminars
- Facilitate board level ERM sessions
- Newsletter, financial predictions

Professionalism
- Frequent presenter and author
- Board of Governors
- Investment Section Chair
- ERM Task Force of ASB
- SOA President’s Award

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Milliman, Inc,
- Principal
- Global leader of CRisALIS™, a cutting edge complexity science based approach to ERM thinking and implementation
- Strategy
- Product development

Professionalism
- Frequent presenter and author
- ERM Thought Leadership & Research
- ILAG Risk Management Practitioners’ Group
- Institute of Directors
- Research for Actuarial Profession

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RISK IDENTIFICATION, EMERGING RISK PERSPECTIVES AND COMPLEXITY SCIENCE APPLICATION

Presenter: Max J. Rudolph, FSA CFA CERA
October 16, 2012 2-3:15 pm
Session 99PD

WHAT ARE EMERGING RISKS

- Evolving risks (creeping, mean reverting)
  - Public pension guarantees
  - Home mortgage market
- Tail risk (recently unseen)
  - Earthquake/asteroid/black plague
- Correlations of risks
- Rumsfeld’s Knowns and Unknowns
EMERGING RISKS

- May be internally or externally generated
  - Higher order impact (e.g., oil spill/tourism)
  - May be positive event (e.g., nanotechnology)
- Next big risk is likely to be something new

AVOIDING THE “PERFECT STORM”

- Environmental scanning
- Mean reversion (Perfect Sunrise)
- Gaussian copout
  - Once per century events don’t happen 4 days in a row
- Is New Madrid fault frequency really independent from severity?
**SURVEY**

- Emerging risks originally developed by World Economic Forum (23)
- Top 5 emerging risks (including #1)
- Leading indicators
- Combinations of risks
- Current topics

**EMERGING RISKS**

<table>
<thead>
<tr>
<th>Economic</th>
<th>Environmental</th>
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<tbody>
<tr>
<td>• Oil price shock</td>
<td>• Climate change</td>
</tr>
<tr>
<td>• Fall in value of US $</td>
<td>• Freshwater loss</td>
</tr>
<tr>
<td>• Chinese economic hard landing</td>
<td>• Tropical storms</td>
</tr>
<tr>
<td>• Financial volatility</td>
<td>• Earthquakes</td>
</tr>
<tr>
<td>• Blow up in asset prices</td>
<td>• Inland flooding</td>
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</table>
### EMERGING RISKS

- **Geopolitical**
  - International terrorism
  - Weapons of mass destruction
  - Interstate/civil wars
  - Failed and failing states
  - Transnational crime
  - Globalization fallback
  - Regional instability

- **Societal**
  - Pandemics / Infectious diseases
  - Chronic diseases
  - Demographic shift
  - Liability regimes

- **Technological**
  - Cyber security / Interconnectedness of critical infrastructure
  - Technology / Space weather

### CURRENT ENVIRONMENT MATTERS

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<tr>
<th>April 2008</th>
<th>October 2011</th>
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<tr>
<td>Oil price $114</td>
<td>Oil price $79</td>
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<tr>
<td>S&amp;P 500 1,386</td>
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<tr>
<td>Currency 1.56 $/Euro</td>
<td>Currency 1.34 $/Euro</td>
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<table>
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<tr>
<th>November 2008</th>
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<td>Oil price $68</td>
<td>Oil price $95-100</td>
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<td>S&amp;P 500 969</td>
<td>S&amp;P 500 1,400-1,500</td>
</tr>
<tr>
<td>Currency 1.27 $/Euro</td>
<td>Currency 1.31 $/Euro</td>
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</table>
**ANCHORING – BEHAVIORAL FINANCE**

- **April 2008**
  - 57% Oil price shock
  - 40% Climate change
  - 40% Blow up in asset prices

- **October 2011**
  - 68% Financial volatility
  - 42% Failed and failing states
  - 38% Cyber security/Interconnectedness of infrastructure
  - 32% Chinese economic hard landing
  - 32% Oil price shock
  - 32% Regional instability

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**TOP EMERGING RISKS**

![Emerging Risks by Category](chart.png)

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<th>Category</th>
<th>2011</th>
<th>2010</th>
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<td>9%</td>
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<td>14%</td>
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<td>Social</td>
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TOP CATEGORY

LEADING INDICATORS

• Over 50% identify leading indicators
  • sea surface temperatures
  • WHO pandemic alert level
  • CO₂
  • CPI, GDP, value of the dollar, gold price, oil price, US deficit, US debt, CDS rates, unemployment, interest rates
  • solar activity
  • water supplies

• “mostly by the seat of our pants”
PREPARING FOR ORSA

Modeling practice improvements

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<tr>
<td>Decreased risk to market</td>
<td>3%</td>
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DOING MORE WITH LESS?

2012 Anticipated ERM Levels

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<thead>
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<th>50%</th>
<th>75%</th>
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<tr>
<td>Activity</td>
<td>41%</td>
<td>39%</td>
<td>59%</td>
<td>59%</td>
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<tr>
<td>Funding</td>
<td>0%</td>
<td>3%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Decrease</td>
<td>3%</td>
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<td>3%</td>
</tr>
<tr>
<td>Same</td>
<td>41%</td>
<td>39%</td>
<td>59%</td>
<td>59%</td>
</tr>
</tbody>
</table>
PREDICTING THE FUTURE

- Predicting potential outcomes
- Not predicting actual future events
- “to be prepared to react is the goal”
  - Flexibility
  - Common sense

INTERESTING REVELATIONS

- Geopolitical risk evolving from terrorism to failing states and regional instability
- Financial volatility dominance (40% pick #1)
- Worried about China
- Cyber security becoming a concern but not space weather
- Climate change trending down
TO ACCESS PRIOR SURVEYS


• Article in August 2010 issue of The Actuary: Challenging the Herd


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THANK YOU!
MAX J. RUDOLPH FSA, CFA, CERA, MAAA

- Rudolph Financial Consulting, LLC
  - Design/peer review ERM and ALM strategies
  - Leverage ORSA and Risk Focused Exams
  - Continuing education and research: modules, seminars, newsletter, predictions
  - Facilitate board level ERM sessions
- Professionalism
  - SOA Board of Governors
  - Investment Section Chair
  - Actuarial Standards Board, ERM Task Force
  - SOA President’s Award

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Session 99 – Emerging Risk

Neil Cantle, MA FIA ASA CERA

Agenda

Emerging Risk
- What is emerging risk?
- What is the problem in spotting it?
- How do you spot it?
- (and manage it)
What is emerging risk?

- Some definitions
  - "an issue that is perceived to be potentially significant but which may not be fully understood or allowed for in insurance terms and conditions, pricing, reserving or capital setting"
  - "new or already known risks which are difficult to assess and which may have a major impact on an organisation"
  - "developing or already known risks which are subject to uncertainty and ambiguity and are therefore difficult to quantify using traditional risk assessment techniques"

- Common themes
  - Something you don't fully understand
  - Uncertain impact and/or timing
  - Impact may be significant

- Key Points
  - May not be sure that impact is significant at the point of study
  - An emerging risk does not need to be unknown
  - The risk may not be emerging (uncertain) for everyone
What is the problem in spotting it?

- You don’t know where to look
  - A universe of possibilities…
  - Study every science journal…
  - Scrutinize every news story…
  - Employ futurists…
- Too much data and not enough information
- Hard to engage people if scenarios unrealistic or fanciful

Why is it hard to spot emerging risk?

- You can’t make sense of what you see
  - Which trends will lead to risk for us…
  - What scale is the risk operating at…
  - Observed trends may be important but not yet combining sufficiently for sight of the risk to emerge…
  - Cognitive biases…
  - Insufficient resource…
  - Relevance to us…
The Right Perspective

Symptoms
Causes
Sense-making
Understanding

Complex Adaptive Systems

- Relevant properties…
  - Outputs result from multiple non-linear interactions
  - Self-organising
  - Emergence
  - Critical complexity/tipping point
  - Cause and symptom separated in time/space

- These offer clues about how to spot emerging risk

Milliman
How To Spot Emerging Risk

- Know what matters
- Look in the right place
- Look with the right lenses
- Know how to assess it

Then...
- Know how to manage it

Knowing What Matters

- Look at strategic scale first
  - What does strategy rely upon?
  - How do these things interact?
  - Exogenous as well as endogenous factors
- Trends must impact this scale to matter to you a lot

- Create scenarios at scale of operations to test how they might play out and plan your actions pre/during/post onset
Understanding The System

Key Nodes

Key Drivers

Gaps

You "know" more about how your company works than you might realise!

Example – Trade War
Knowing Where To Look

- Risks can emerge at multiple scales

Reaching a tipping point at one scale will cascade to others.

Responses must act at an appropriate scale to the emerging issue.

Tipping Points

- Adaptive cycle

Proximity to a tipping point is relative to sensitivity to particular condition as well as presence of the conditions.

Source: From Gunderson and Holling (2002)
Assessing Emerging Risk

**Sensitivities**
- What matters

**Triggers**
- Assessment processes to bound estimates of timing and impact
- Feed into regular risk management

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**Using the right lenses**

- Identify indicators signalling onset
- May not be “obvious”
- Non-linear relationships
- Adaptation

- Need tools to spot patterns
- No guessing in advance
Non-linear dependence

Variables of system performance

Variables sharing significant information

Information, $I(X) = -\log p(x)$

Looking beneath the surface

“Same” outcome but different drivers
Predictive Analytics

- Machine learning can determine predictive models for non-linear factors, providing real-time segmentation and performance data.
- Significantly more powerful than GLM.

Source: Milliman/EagleEye Analytics

Evolution of Risk

- Typical risk factors include:
  1. Loss expectancy
  2. Loss severity
  3. Policy limits
  4. Risk management
  5. Underwriting
  6. Claim frequency
  7. Claim severity
  8. Exposure
  9. Coverage
  10. Retention
  11. Reinsurance
  12. Market conditions
  13. Regulatory environment
  14. Economic factors
  15. Aggregate risk
  16. Reserve adequacy

Source: Actuarial Profession Research
Leverages Existing Information

- The technique builds on (enhanced) risk register info
- Simply extend range of characteristic classifiers

Evolutionary Risk Profile

- We can identify risks which share similarities, common evolutionary paths and identify clues about future development
- We can see that these themes are common across the group but other themes such as strategy, legal and expenses are potentially big issues too

Source: Actuarial Profession Research
Assessing Scenarios

Aggregate outcome depends upon complex array of possible world states

Final outcome comprises a variety of individual outcomes all of which depend upon a complex array of possible world states

The world states can be described contingent upon the interactions and states of a variety of key factors

Source: Milliman, using AgenaRisk™

Playing out a scenario

Scenarios designed to hit “painful” parts of strategy. Dynamics identified and explored. Responses pre, during and post identified and implemented by Risk Committee
ESG doesn’t know it all

- Most models don’t contain data about stress situations
- They can be conditioned to do so quite easily

How to Manage it

- Work to the right “scale”
- Resilience
  - Short-term cost of forgone “profit” vs. Cost of being in an alternative regime (from Walker and Salt, 2006)
- Know the “Tipping points”
- Evaluate trigger effects conditional upon current state
- Use (non-linear) systems thinking and methods
Summing Up

- It IS possible to spot emerging risks (unless they are chaotic)
- It IS possible to do so formally and rigorously
- The past is helpful but not exclusively predictive
- Expert judgement is useful but not unbiased
- Combining tools and methods is highly productive
- Resilience better than optimisation
- Consider how to manage unavoidable “Tipping Points”

- Emergence can lead to innovation and opportunity