

Emerging Risks Survey

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Actuarial Survey of Emerging Risks

Emerging risks can be thought of from two perspectives: completely new risks that have never been seen before, and risks that are evolving in unexpected ways. Examples of the former include the release into the human population of the AIDS virus and the development of a previously unknown weapon, while the latter would include the home mortgage market in the United States and liability regimes. Many emerging risks fall in a gray area, where some claim to have predicted the risk in advance. Others repeatedly claim yet another “Perfect Storm” that could never have been predicted and that they should not be held accountable for not anticipating. Part of a risk manager’s job is to provide environmental scanning of potential risks. According to Nassim Taleb, author of *The Black Swan*, the goal of risk management and environmental scanning is to turn a lack of knowledge into tools that aid decision making.

The recent financial environment has given credibility to those who have been laughed at for years while trying to place topics like financial leverage on their firm’s strategic agenda. Many firms (and individuals) had no game plan in place to address the current crisis. As Taleb has stated, a Black Swan is something no one predicted in advance but everyone predicted and understands after the fact. In reality, very few were prepared for the extent of the recent impact on a wide range of financial instruments, but those with minimal leverage and long-term asset allocation strategies have had relatively better results than others. A risk manager prepares a firm to succeed across a variety of potential scenarios.

Executive Summary

Emerging risks require managers and modelers to think outside their comfort zone. Often there is no incentive for firms to contemplate risks that others are ignoring. Consider this quote from Chuck Prince, CEO of Citigroup, in summer 2008.

"When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to dance. We're still dancing."

He was referring to subprime loans and the excess margin that was being earned at that time on financially engineered securitizations. Had he elected to take Citigroup out of this market he would have been under great pressure from shareholders and other external stakeholders to maintain financial growth rates. When markets are calm, CEO’s are fired for making reasonable risk-driven decisions. When markets become volatile, they are fired for exposing the firm to unanticipated risks.

In another instance, some members of the actuarial community recognized that potential pandemics were being ignored by insurance pricing schemes. While pricing factors still do not fully consider this risk, it is now assumed reasonable to reflect this risk in economic capital calculations. This evolving process was due to a great deal of education about this risk. Emerging risk education is a natural extension of this type of evolving process. The SOA’s Futurism Section is a good source of information and tools designed to deal with future scenarios. By raising awareness of an issue, the education process can begin.

You would expect the results of a survey looking at potential future risks to be stable over time, yet comparing this survey's results to the one completed with the INARM group (International Network of Actuarial Risk Managers) in early summer 2008 does not draw this conclusion. Respondents are clearly impacted by the current environment. At the end of April 2008, when the first survey was completed, the S&P 500 stood at 1,385.59 (according to Yahoo Finance), the price of a barrel of oil was \$113.70 (per the Energy Information Administration at <http://tonto.eia.doe.gov/dnav/pet/hist/rwtcd.htm>), and the U.S. dollar was at 1.56 Euros (per www.federalreserve.gov). At that time the top four emerging risks were

1. Oil shock/energy supply interruptions (57% of respondents)
2. Climate change (40%)
2. Blow up in asset prices/excessive indebtedness (40%)
4. U.S. current account deficit/fall in U.S. dollar (38%)

The current survey was issued in early November 2008, so we will compare against rates at the end of October. At that time, using the same sources, the S&P 500 had dropped 30% to 968.75, the price of a barrel of oil had dropped 40% to \$68.10, and the U.S. dollar had strengthened 23% to 1.27 Euros. Now the top four emerging risks from the survey are

1. Blow up in asset prices/excessive indebtedness (64%)
2. US current account deficit/fall in US dollar (48%)
3. Oil price shock/energy supply interruptions (39%)
4. Middle East instability (34%)

The world changed materially between the two time periods. In the future, it might be useful to average the response rates across time to overcome this bias, and the data will be saved in order to accomplish this. Most of the same risks received top billing, but when oil prices were high in May respondents were more concerned about oil prices, and when oil prices dropped and asset prices blew up respondents shifted concerns to the risk most associated with the current financial crisis. The Mumbai attacks occurred in late November 2008 after most of the participants had completed the survey and did not impact the overall results, although it should be noted that the two survey responses received after the attacks occurred both included *International terrorism* as one of the top 5 emerging risks with one selecting it as the top emerging risk. It is human nature to react to our surroundings.

Food shortages are often an important underlying cause of unstable regions around the world. Respondents were asked to combine emerging risks that could lead to regional food shortages. Environmental risks accounted for half the responses, as might be expected. The leading combination of risks, with 25% of respondents selecting it, was *US current account deficit/fall in US dollar* and *Blow up in asset prices/excessive indebtedness*. These two emerging risks were used as parts of other combinations, along

with Oil price shock/energy supply interruptions, Middle East instability, and Fiscal crises caused by demographic shift.

The survey also asked about expectations for ERM-focused activities in 2009. Not surprisingly, given the recent financial turmoil and the background of the participants as risk managers, 65% expected the activities for their organization or clients to increase. Yet, only 33% expected funding to increase for these activities, so risk managers will need to prioritize and continue to expand efficiency efforts. Budgets may not allow increased quantitative analysis, so projects will need to be leveraged to meet multiple needs.

Background

This research project was funded by the Joint Risk Management Section of the Society of Actuaries, Canadian Institute of Actuaries, and Casualty Actuarial Society. A survey was developed and made available through an email link to members of the Joint Risk Management Section, along with others (especially INARM). A total of 89 responses were received. This represents a very small percentage of completed surveys relative to the number distributed (2,577 to JRMS). A similar survey, distributed in May 2008, collected 86 responses using primarily the INARM list serve. A brief comparison of the two surveys will follow. An article describing the earlier research can be found on pages 18-21 of the International News August 2008 issue <http://soa.org/library/newsletters/international-section-news/2008/august/isn-2008-iss45.pdf> .

Rather than developing a unique set of emerging risks to consider, a set developed by the World Economic Forum was chosen as reasonable. Their reports, starting in 2007, can be found at www.weforum.org . Additional detail is found in Appendix I. The 23 risks developed by the World Economic Forum are described in detail in Appendix I. Each risk has been categorized as Economic (5), Environmental (5), Geopolitical (7), Societal (4), or Technological (2). These emerging risks were held constant between the two surveys described, primarily in Section 1, to allow comparisons. The new survey added questions designed to provide input to several current topics.

Future surveys will focus on an evolving set of analysis and questions related to topics of current interest. Trends of the emerging risk responses, along with an average over time, will add to our knowledge about managing emerging risks. At some point the results could be viewed in hindsight to see if the survey results have been an accurate indicator of emerging risks.

Research reports do not create themselves in isolation, and the researcher thanks Beverly Barney, Dave Ingram, Barbara Scott and Steve Siegel for their help designing and implementing the questionnaire, along with gleaned information from the results. Of course all errors and omissions remain the responsibility of the researcher.

Knowns and Unknowns

Former US Secretary of Defense Donald Rumsfeld confused some and delighted others (mainly late night comedians) in a 2002 Department of Defense news briefing with his discussion of knowns and unknowns, but his comments have great relevance to emerging risks.

The Unknown

As we know,
There are known knowns.
There are things we know we know.
We also know
There are known unknowns.
That is to say
We know there are some things
We do not know.
But there are also unknown unknowns,
The ones we don't know
We don't know.

The known knowns are represented by historical data. We expect these events to continue as they have in the past. The distribution of results is stable and often can be modeled. Various property risks like homeowners' insurance fall in this category.

Known unknowns represent those risks where the distribution is not stable and we do not know which direction it will go in the future. We are consciously uncertain of the future. These risks should be stress tested to determine what could happen. By modeling both positive and negative deterministic scenarios we can learn about the risk and determine an appropriate mitigation or exploitation strategy. Examples would include a mission into space where potential negative events result in built-in redundancies, mortality trends and sales of a new consumer product like an iPod. Emerging risks that are evolving also fall in this category. A recent example is the residential mortgage backed securities market in the United States. When lending restrictions were loosened, previous modeling that had worked well to model defaults and prepayments needed to evolve to reflect the new paradigm. Another is inflation following a large government intervention as is occurring in late 2008. Stress tests of these types of risks should include stochastic analysis where assumptions are modified to determine how sensitive the results are. Analysis needs to be creative.

Unknown unknowns are what most people usually think of as emerging risks. They include Taleb's Black Swans, which are readily explained only in hindsight, as well as truly new risks that have not previously been considered. An insurance example would be the AIDS risk as viewed in 1960. It has become clear that emerging risks are not fully considered when a new product is offered or business plans developed.

Researcher

The lead researcher for this project is Max J. Rudolph, FSA CERA CFA MAAA. Additional related articles and presentations can be found at his web site. His contact information is

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Results

The survey has been separated into sections covering Emerging Risks, Modeling and Metrics, Accounting, Current Topics, and Demographics. Highlights of each are presented here.

Section 1: Emerging Risks

Results in this survey are influenced by the current environment. We are molded by the current set of expectations. In May 2008 the market was a bit rocky, but the real concern was the price of oil. In late 2008 this has all changed, with stock markets having already fallen precipitously and the price of oil subdued. It should be noted that the Mumbai attacks occurred after most of the surveys had been completed.

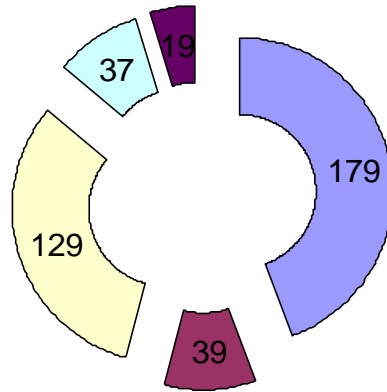
As might be expected for a group of risk professionals completing a survey asking what they were worried about, the Economic category received the most responses, followed by Geopolitical. The others trailed far behind. It will be interesting to trend over time to see if this is a lagging indicator or a contrarian indicator. Are risk professionals able to step outside their current surroundings to predict emerging risks or do they get locked in to today's major issues and ignore the risk that is about to explode into consciousness after years of calm. Many would argue this is what happened with the recent financial problems, where managing the economy to avoid the ebbs and flows made it too easy to take risk, and managers were lulled into a false sense of security.

Each respondent was asked to list up to 5 emerging risks that would have the greatest impact over the next few years. The 412 total responses, including 9 in the Other category, reflect 4.6 per respondent. First we will distribute them by category.

1. 179 responses Economic
2. 129 responses Geopolitical
3. 39 responses Environmental
4. 37 responses Societal
5. 19 responses Technological

Emerging Risks by Category (up to 5 responses per participant)

■ Economic
 ■ Environmental
 ■ Geopolitical
 ■ Societal
 ■ Technological



The top three specific responses to Question 1, *What are the emerging risks with the greatest impact over the next few years?*, were each from the Economic category. Percentages in this survey are based on the number of respondents who answered the specific survey question. This allows comparison with companion surveys done at alternative times. For example, all 89 respondents answered Question 1 and 57 included *Blow up in asset prices/excessive indebtedness* as one of their (up to 5) responses. Thus 64% ($57/89 = .64$) chose this emerging risk.

1. 64% Blow up in asset prices/excessive indebtedness
2. 48% US current account deficit/fall in US dollar
3. 39% Oil price shock/energy supply interruptions

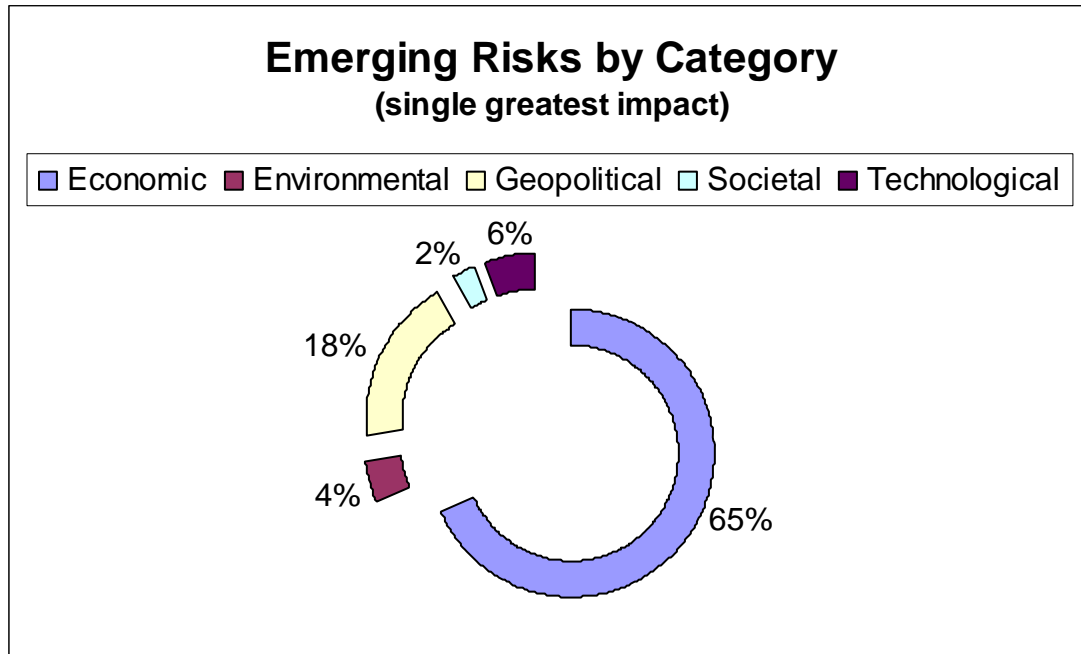
In the earlier survey, conducted in May 2008, *Oil price shock/energy supply interruptions* (57%) was the top response, with *Climate change* and *Blow up in asset prices/excessive indebtedness* tied for second (40%). In this survey, *Climate change* dropped to the sixth spot with the next two top responses from the Geopolitical category.

4. 34% Middle East instability
5. 29% International terrorism

Complete results for all survey questions can be found in Appendix II.

In Question 2, respondents were asked to state which single emerging risk they expected to have the greatest impact. Not surprisingly, the Economic category dominated this question, with Geopolitical risks again number 2.

1. 65% Economic
2. 18% Geopolitical
3. 6% Technological
4. 4% Environmental
5. 2% Societal



The top four specific responses came from the Economic category, with the fifth from Technological. 68% of results are explained by the top five responses, with the rest distributed across the remaining 18 emerging risks on our list.

1. 25% Blow up in asset prices/excessive indebtedness
2. 18% US current account deficit/fall in US dollar
3. 12% Oil price shock/energy supply interruptions
4. 7% Fiscal crises caused by demographic shift
5. 6% Breakdown of critical information infrastructure (CII)

In Question 3, combinations of risks were considered. It is interesting to look at this from several perspectives. Even though the question is about combinations of risks, we will look first at the risks in isolation. As we saw in earlier questions, Economic (49%) and Geopolitical (32%) are the most frequent responses when identified in isolation.

1. 49% Economic
2. 32% Geopolitical
3. 9% Environmental
4. 8% Societal
5. 2% Technological

Individual risks were led by the same major categories.

1. 14% Blow up in asset prices/excessive indebtedness
2. 12% Oil price shock/energy supply interruptions
3. 12% US current account deficit/fall in US dollar
4. 8% International terrorism
5. 8% Middle East instability

Each respondent could choose up to three combinations of two risks. In total there were 219 combinations suggested. Respondents were not asked to list them in priority order. Appendix II includes a grid showing all combinations. While the top three were various combinations of the most frequently listed individual risks, the fourth leading response included *Fiscal crises caused by demographic shift* teamed with *Blow up in asset prices/excessive indebtedness*. Demographic shifts in the future could lead to a variety of unintended consequences and should be considered as strategic plans are implemented.

Leading combinations were

1. 22 responses
 - US current account deficit/fall in US dollar
 - Blow up in asset prices/excessive indebtedness
2. 14 responses
 - Oil price shock/energy supply interruptions
 - Middle East instability
3. 11 responses
 - Oil price shock/energy supply interruptions
 - US current account deficit/fall in US dollar
4. 10 responses
 - Fiscal crises caused by demographic shift
 - Blow up in asset prices/excessive indebtedness
5. 8 responses
 - Oil price shock/energy supply interruptions
 - Blow up in asset prices/excessive indebtedness

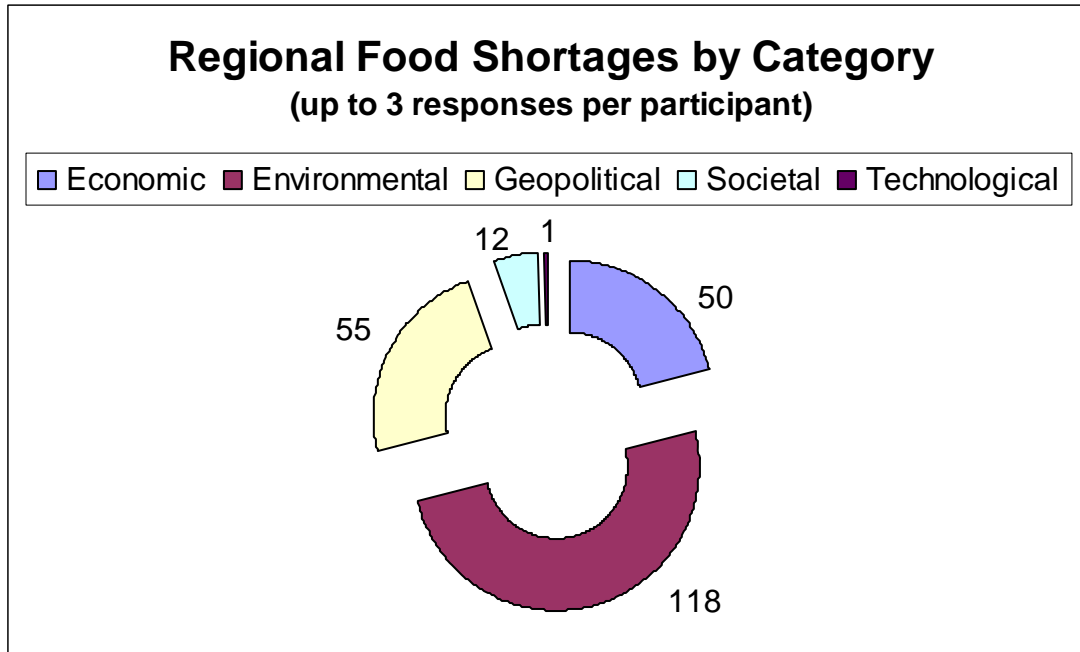
Several of these combinations could lead to a period of stagflation, so you might expect that a group answering in this way would include a stagflation scenario in their analysis.

A total of 15 combinations included two risks from the Environmental category. The most frequent combination, with eight responses, was for *Climate change* and *Natural catastrophe: Tropical storms*. This is a major risk for the casualty industry, as a warmer climate is expected to result in more active hurricane seasons.

Question 4 was not asked in the earlier survey. Regional food shortages have occurred many times in the past due to a variety of reasons. The research team thought it would be interesting to see which emerging risks the survey respondents thought could cause these shortages in the future. Respondents were allowed to include up to 3 risks, and 240

responses (2.7 per) were received. Results varied from earlier questions, as might be expected, with Environmental risks accounting for about half the responses.

1. 118 responses Environmental
2. 55 responses Geopolitical
3. 50 responses Economic
4. 12 responses Societal
5. 1 response Technological



The top two specific responses were from the Environmental category, with *Climate change* a clear top choice and *Loss of freshwater services* narrowly edging several other emerging risks for second.

1. 42 responses Climate change
2. 32 responses Loss of freshwater services
3. 31 responses Oil price shock/energy supply interruptions
4. 27 responses Natural catastrophe: Inland flooding
5. 24 responses Interstate and civil wars

Section 2: Modeling and Metrics

Actuarial modeling has evolved from a single scenario used for current year business plans to multiple deterministic scenarios to stochastic simulations. As regulatory requirements move to various forms of principle-based approaches, there is no clear consensus between the best metrics and tools used to manage these risks. This section seeks to identify which metrics and tools are favored by experts.

The Conditional Tail Expectation (CTE) metric is based on a probability distribution of results with the mean loss above a specified threshold calculated. Consider an example where 100 scenarios have been generated and sorted. CTE 95 would average the worst 5% of results -- five scenarios in this example. The Value at Risk (VaR) metric is also based on a distribution of results and measures the loss at a specified threshold. In this example, VaR 95 would report a result which has 5%, or 5 scenarios, of the results worse than it. The CTE measure is coherent, which makes it easier mathematically to combine and aggregate results.

In Question 1, the survey asks which metric is preferred for internal use. Conditional Tail Expectation (CTE) is a clear winner with 54%, beating out Value at Risk (29%). It is telling that 8% are not sure of the answer and 9% chose other metrics.

In Question 2 the survey asked if there were additional metrics that were used internally. Here VaR (33 responses) and CTE (22 responses) again shared the votes, but 14 were not sure and 10 suggested that no additional metrics were used. This is a disturbing result since internal models and metrics are used for a firm's risk management, and this apparently shows that some firms continue to manage to only a single metric. There were 26 "other" responses, with many references to multiple metrics, various comparisons to Risk-Based Capital (US insurance required capital), scenario analysis, statistical measures, embedded value, and the researcher's personal favorite, common sense. This is comforting even though no consensus has emerged about which metrics to use in addition to CTE and VaR.

Question 3 asks which primary metric is used for external required capital purposes. Here it was a virtual dead heat for the top metric, with VaR at 37% and CTE at 36%. 16% remain not sure and 11% shared an alternative measure. These included regulatory capital metrics, rating agency measures, and surplus as a percentage of revenue (SAPOR).

Question 4 asks about the preferred time horizon for external required capital. The three primary options, long/intermediate/short, were nearly a dead heat. Each received between 28% and 32% of the responses. 5% were not sure and 6% reported a preference for another option. Most of these were combinations of time horizons for different purposes.

Question 5 asked for the primary source of modeling improvements in the next few years. The responses were spread across the three options given, with Model efficiencies (38%), Tail correlations (28%), and Dependency metrics (19%) each receiving support. A further 7% were Not sure and 8% listed Other, with most of these improvements dealing with doing a better job in the tail of the distribution. Again, these results illustrate that a single best tool has not yet emerged.

Section 3: Accounting

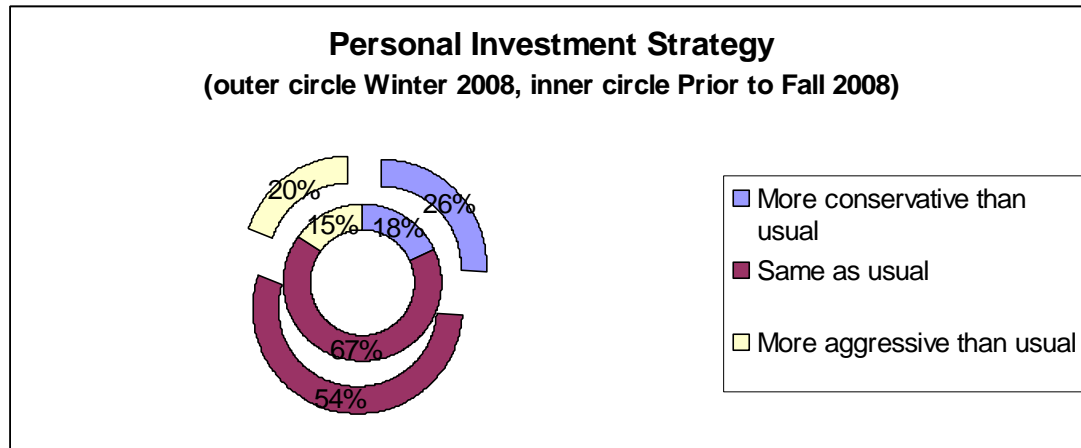
In Section 3 the survey asks if there are preferred accounting regimes for risk management purposes. In Question 1, the focus is on general risk management. Not surprisingly there is no agreement here either, with market consistent embedded value (MCEV) at 21% barely beating out the Not sure answer (18%). Current US statutory

(16%) and Solvency II (13%) follow. Question 2 asks which regime is most useful when dealing with emerging risks. The top two answers are 24% for Not sure and 19% indicating that None are useful. Respondents are not yet comfortable quantifying emerging risks. MCEV is the favorite of the actual regime options. Clearly there is no consensus and further research should be done to avoid unintended consequences of a specific choice. These results might also differ with a different regional mix of respondents.

Section 4: Current topics

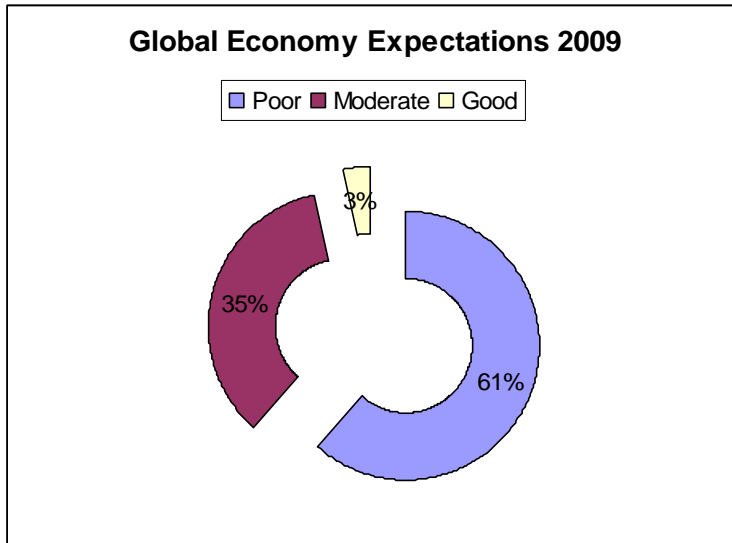
The expectation is that this survey will be repeated periodically. With that in mind, several questions about current topics were added. These would be expected to rotate over time. The first two attempt to determine the investment consistency and expectations of the actuaries responding. Both ask about a personal investment portfolio, with the first asking about the level of conservatism prior to Fall 2008 and the other asking for the current status.

	Prior to Fall 2008	Current
More conservative than usual	18%	26%
Same as usual	67%	54%
More aggressive than usual	15%	20%



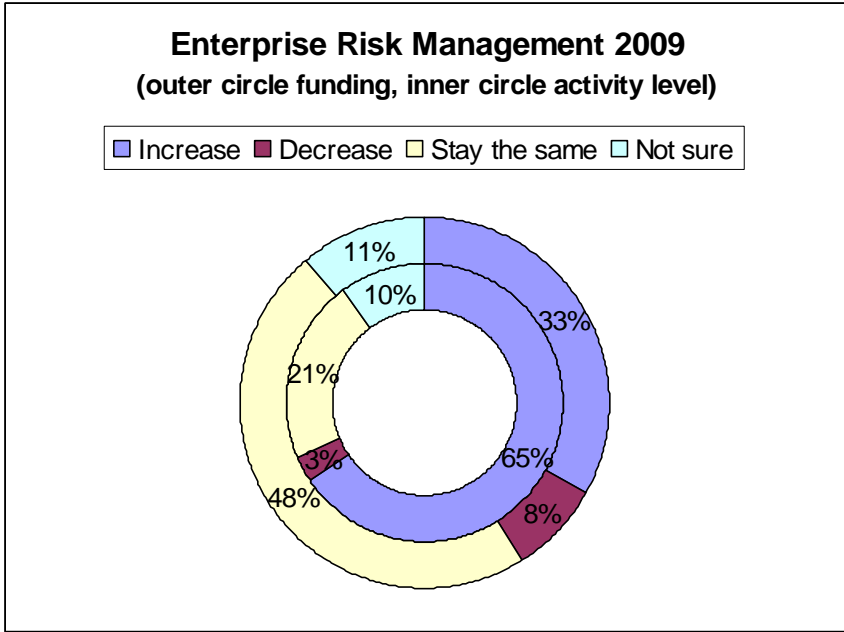
Prior to Fall 2008 15% had taken a more aggressive investment strategy than usual, with 18% more conservative and 67% the same as usual. For the current survey the percentage with a same as usual investment strategy had fallen to 54%, so by this time about half remained in the standard strategy. The survey reflects an increase in both those more aggressive (now 20%, a 5% increase) and more conservative (now 26%, an 8% increase) allocations. Time will tell who was correct.

Question 3 asked about expectations for the 2009 global economy. Not surprisingly, the results were led by 61% poor and 35% moderate. Few expect even a “good” scenario and none expect a “strong” economy.



The current financial crisis has put enterprise risk management in the spotlight, with some experts saying that it does not work because it did not prevent the current situation and others saying that it shows the ERM process should have greater exposure in organizations. In Questions 4 and 5 the survey asked if the level of ERM activities would change and then if funding was expected to change.

	Activities	Funding
Increase	65%	33%
Decrease	3%	8%
Stay the same	21%	48%
Not sure	10%	11%

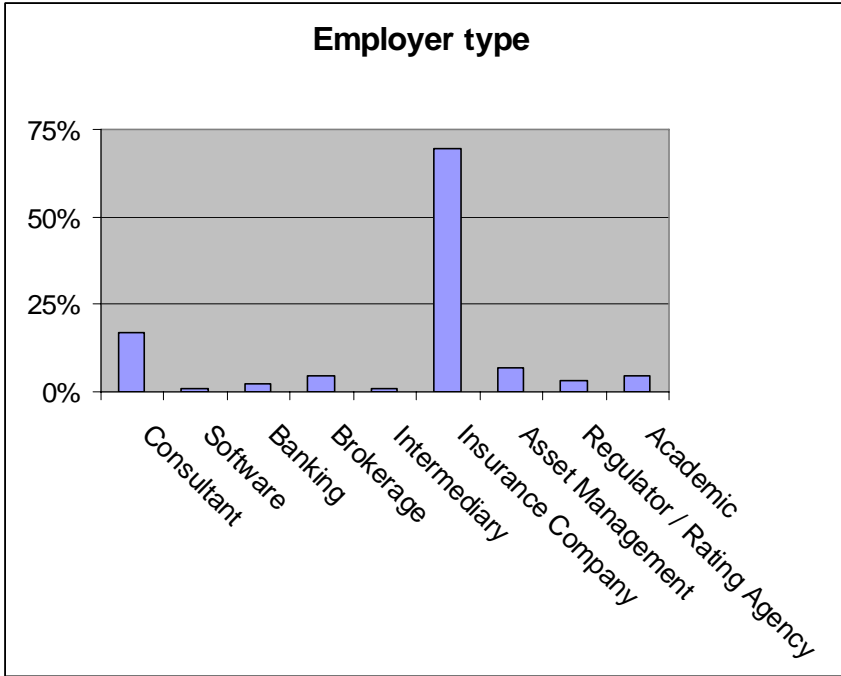


Not surprisingly, the level of activities is expected to increase much more than the level of funding. This survey was conducted before many firms had completed their budget process, and reflects expectations at that time.

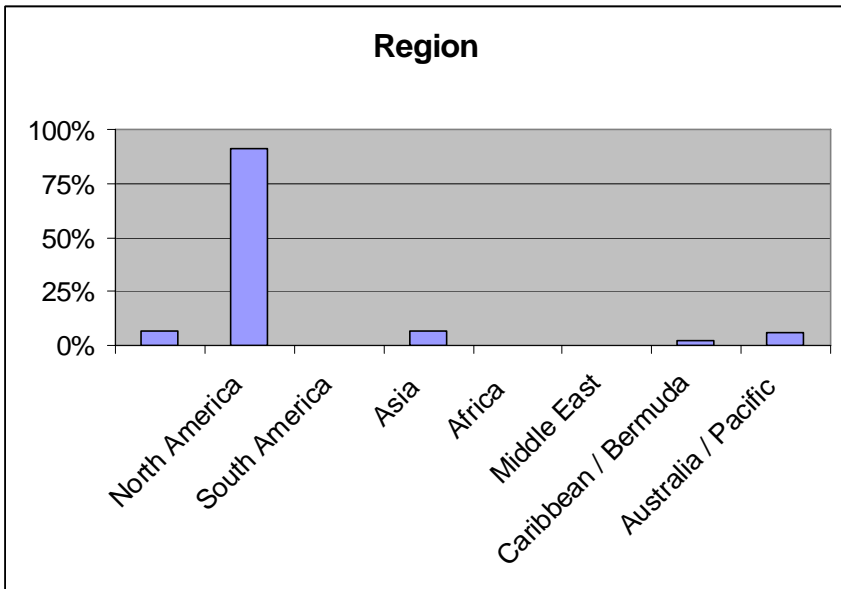
Section 5: Demographics

All but one of the respondents has an actuarial credential, and 27% hold the Chartered Enterprise Risk Analyst (CERA) credential.

Most are employed by either an insurance company (70%) or as a consultant (17%). The distribution is similar to that in the earlier survey, with Asset Management growing from 2% to 7% of the respondents.



The survey is dominated by North Americans, with fewer respondents from Europe and Asia relative to the initial survey.



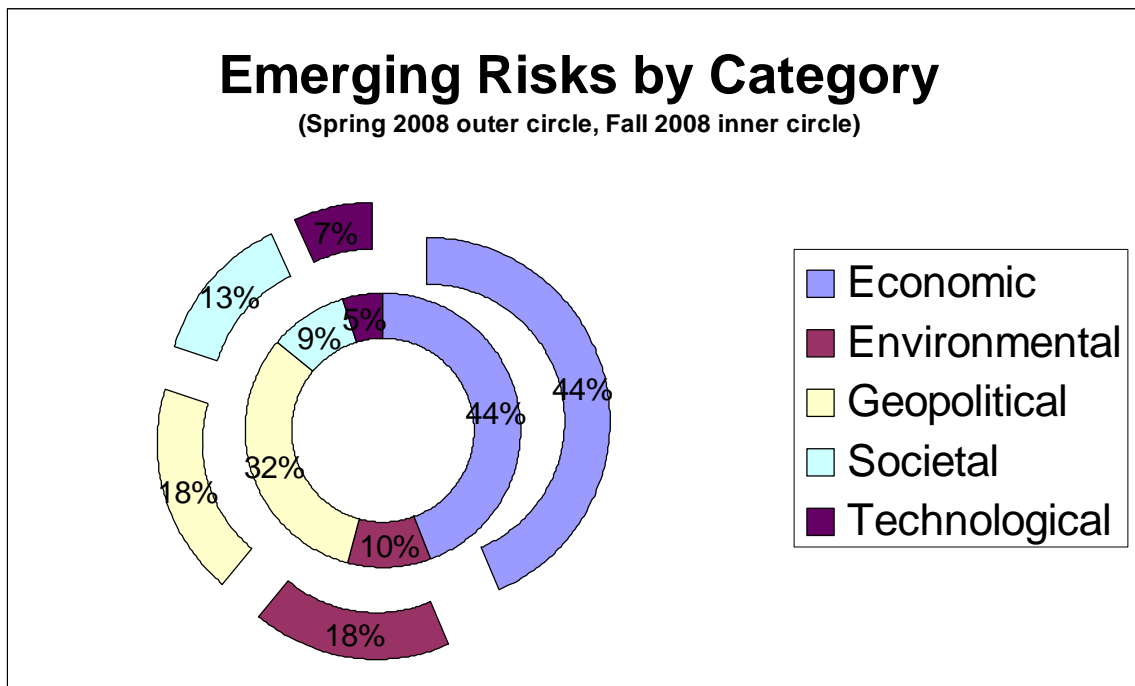
The primary area of practice responses were not as broad as had been hoped for, with life (38%), risk management (33%), and property/casualty (13%) accounting for the vast majority of the results. The survey found that 85% of the respondents belonged to the Joint Risk Management Section, with the Investment Section and Financial Reporting Section also heavily represented. 20% belong to the INARM list serve. The survey was

sent to JRMS and INARM members, but many actuaries belong to multiple special interest sections of the SOA.

Comparison with Prior Survey

The original survey asked respondents to choose their top five emerging risks, and included demographic information. Looking at the distribution by major category shows that Geopolitical increased from 18% to 32% at the expense of Environmental, Societal, and Technological. This may be due to the timing of the U.S. Presidential election during the later survey, with more media coverage of these topics at that time.

Respondent demographics are similar between the two surveys based on employer type, with most coming from insurance companies or consulting backgrounds. Geographically, Europe was not as well represented in the current survey so North American viewpoints are more heavily weighted.



Future Recommendations

If this survey is repeated in the future, a potential addition to consider would be an anchor question at the beginning of the survey. A suitable anchor question might be, *What are the top current risks with the greatest impact?*, choosing from the same 23 options. The results of this question would provide perspective to the survey responses on emerging risks and future impacts. Another helpful future addition might be a paragraph defining emerging risks as a reference for survey respondents.

Appendix I - Glossary of Risks

The following 23 core risks were defined in Global Risks 2007: A Global Risk Network Report, and can be found at www.weforum.org/pdf/CSI/Long_Global_Risk_Report_2007.pdf. What follows is a summary of the risks.

23 risks

Economic

- Oil price shock/energy supply interruptions
- US current account deficit/fall in US dollar
- Chinese economic hard landing
- Fiscal crises caused by demographic shift
- Blow up in asset prices/excessive indebtedness

Environmental

- Climate change
- Loss of freshwater services
- Natural catastrophe: Tropical storms
- Natural catastrophe: Earthquakes
- Natural catastrophe: Inland flooding

Geopolitical

- International terrorism
- Proliferation of weapons of mass destruction (WMD)
- Interstate and civil wars
- Failed and failing states
- Transnational crime and corruption
- Retrenchment from globalization
- Middle East instability

Societal

- Pandemics
- Infectious diseases in the developing world
- Chronic disease in the developed world
- Liability regimes

Technological

- Breakdown of critical information infrastructure (CII)
- Emergence of risks associated with nanotechnology

Economic Risks

- Oil price shock/energy supply interruption – Oil prices rise steeply due to major supply disruption.
- US current account deficit/Fall in US dollar - US current account deficit triggers a major fall in the dollar.
- Chinese economic hard landing – China’s economic growth slows, potentially as a result of protectionism, internal political or economic difficulties.
- Fiscal crises caused by demographics shift – Aging populations in developed economies drive economic stagnation by forcing governments to raise taxes or borrowing.
- Blow up in asset prices/excessive indebtedness – Personal assets, such as housing, collapse in the US and Europe, fueling a recession.

Environmental Risks

- Climate change – Climate change generates both extreme events and gradual changes, impacting infrastructure, agricultural yields and human lives.
- Loss of freshwater services – Water shortages impact agriculture, businesses and human lives.
- Natural Catastrophe: Tropical Storms – Hurricane or typhoon passes over heavily populated area, leading to catastrophic economic losses and/or high human death tolls.
- Natural Catastrophe: Earthquakes – Strong earthquake(s) occur in heavily populated areas.
- Natural Catastrophe: Inland Flooding – Flooding associated with rivers causes significant economic losses, fatalities and disruption.

Geopolitical Risks

- International Terrorism – Attacks disrupt economic activity, causing major human and economic losses. Indirectly, attacks aid retrenchment from globalization.
- Proliferation of Weapons of Mass Destruction – Trend fatally weakens nuclear Non-Proliferation Treaty and leads to spread of nuclear technologies.
- Interstate and civil wars – Major interstate or civil war breaks out.
- Failed and failing states – Trend of widening gap between order and disorder.
- Trans-national crime and corruption – Corruption continues to be endemic and organized crime successfully penetrates the global economy.
- Middle East instability – The Israel-Palestine conflict and Iraqi civil war continue.
- Retrenchment from globalization – Rising concerns about cheap imports and immigration sharpen protectionism in developed countries. Emerging economies become more nationalist and state-oriented.

Societal Risks

- Pandemics – A pandemic emerges with high mortality among economically productive segments of the population.
- Infectious disease in the developing world – Incidence of HIV/AIDS continues to spread geographically. Other diseases could develop.
- Chronic disease in the developed world – Obesity, diabetes and cardiovascular diseases become widespread.
- Liability Regimes – US liability costs rise by multiples of GDP growth, with litigiousness spreading to Europe and Asia.

Technological Risks

- Breakdown of Critical Information Infrastructure (CII) – A major disruption of the availability, reliability and resilience of CII caused by cyber crime, terrorist attack or technical failure. Results are felt in major infrastructure: power distribution, water supply, transportation, telecommunication, emergency services and finance.

- Emergence of risks associated with nanotechnology – Studies indicate health impairment due to under-regulated exposure to a class of commonly-used nanoparticles (used in paint, nano-coated clothing, cosmetics or healthcare) exhibiting unexpected, novel properties and easily entering the human body.

Appendix II - Survey Results

The following includes both the survey as well as the responses. There were 89 respondents to the survey. Some (only a few) respondents left certain questions unanswered. The percentages below reflect the number of responses received divided by the number who answered the specific question. Some totals may not add to 100% due to rounding.

Emerging risks are the ones that seem obvious after they happen but were not considered in advance. Many risk managers are trying to change this by identifying potential emerging risks and prioritize those that might have the greatest potential impact on society. This survey is sponsored by the Joint Risk Management Section (Canadian Institute of Actuaries, Casualty Actuarial Society, Society of Actuaries). The full report will be found at the section website on www.soa.org. A summary article will also be published in an upcoming JRMS newsletter. Thanks for participating.

Section 1: Emerging Risks

Question 1. Please choose up to 5 emerging risks that you feel will have the greatest impact over the next few years. The 23 risks shown were developed by the World Economic Forum (www.weforum.org).

403 total responses

Economic – 179 responses

- 35 responses 39% Oil price shock/energy supply interruptions
- 43 responses 48% US current account deficit/fall in US dollar
- 24 responses 27% Chinese economic hard landing
- 20 responses 22% Fiscal crises caused by demographic shift
- 57 responses 64% Blow up in asset prices/excessive indebtedness

Environmental – 39 responses

- 22 responses 25% Climate change
- 9 responses 10% Loss of freshwater services
- 3 responses 3% Natural catastrophe: Tropical storms
- 4 responses 4% Natural catastrophe: Earthquakes
- 1 response 1% Natural catastrophe: Inland flooding

Geopolitical – 129 responses

- 26 responses 29% International terrorism
- 12 responses 13% Proliferation of weapons of mass destruction (WMD)
- 9 responses 10% Interstate and civil wars
- 23 responses 26% Failed and failing states
- 7 responses 8% Transnational crime and corruption
- 22 responses 25% Retrenchment from globalization
- 30 responses 34% Middle East instability

Societal – 37 responses

- 20 responses 22% Pandemics
- 8 responses 9% Infectious diseases in the developing world
- 5 responses 6% Chronic disease in the developed world

- 4 responses 4% Liability regimes

Technological – 19 responses

- 14 responses 16% Breakdown of critical information infrastructure (CII)
- 5 responses 6% Emergence of risks associated with nanotechnology

Question 2. Out of these five, what one emerging risk would you rank number one as having the greatest impact?

Economic – 58 responses 65%

- 11 responses 12% Oil price shock/energy supply interruptions
- 16 responses 18% US current account deficit/fall in US dollar
- 3 responses 3% Chinese economic hard landing
- 6 responses 7% Fiscal crises caused by demographic shift
- 22 responses 25% Blow up in asset prices/excessive indebtedness

Environmental – 4 responses 4%

- 3 responses 3% Climate change
- 1 response 1% Loss of freshwater services
- 0 responses 0% Natural catastrophe: Tropical storms
- 0 responses 0% Natural catastrophe: Earthquakes
- 0 responses 0% Natural catastrophe: Inland flooding

Geopolitical – 16 responses 18%

- 3 responses 3% International terrorism
- 3 responses 3% Proliferation of weapons of mass destruction (WMD)
- 1 responses 1% Interstate and civil wars
- 2 responses 2% Failed and failing states
- 1 responses 1% Transnational crime and corruption
- 2 responses 2% Retrenchment from globalization
- 4 responses 4% Middle East instability

Societal – 2 responses 2%

- 2 responses 2% Pandemics
- 0 responses 0% Infectious diseases in the developing world
- 0 responses 0% Chronic disease in the developed world
- 0 responses 0% Liability regimes

Technological – 5 responses 6%

- 5 responses 6% Breakdown of critical information infrastructure (CII)
- 0 response 0% Emergence of risks associated with nanotechnology

Not Sure – 1 response 1%

Other – 3 responses 3%

- Financial sector implosion
- Investor nationalism
- Global recession: rising unemployment, reduced consumer demand & large company failures

Question 3. Are there combinations of emerging risks that you believe will have the greatest impact over the next few years? List up to three combinations of two risks.

Total mentions (risks are numbered)

Economic – 49%

- 12% 1 Oil price shock/energy supply interruptions
- 12% 2 US current account deficit/fall in US dollar
- 6% 3 Chinese economic hard landing
- 6% 4 Fiscal crises caused by demographic shift
- 14% 5 Blow up in asset prices/excessive indebtedness

Environmental – 9%

- 4% 6 Climate change
- 2% 7 Loss of freshwater services
- 2% 8 Natural catastrophe: Tropical storms
- 0% 9 Natural catastrophe: Earthquakes
- 1% 10 Natural catastrophe: Inland flooding

Geopolitical – 32%

- 8% 11 International terrorism
- 3% 12 Proliferation of weapons of mass destruction (WMD)
- 3% 13 Interstate and civil wars
- 5% 14 Failed and failing states
- 1% 15 Transnational crime and corruption
- 4% 16 Retrenchment from globalization
- 8% 17 Middle East instability

Societal – 8%

- 5% 18 Pandemics
- 2% 19 Infectious diseases in the developing world
- 1% 20 Chronic disease in the developed world
- 0% 21 Liability regimes

Technological – 2%

- 1% 22 Breakdown of critical information infrastructure (CII)
- 0% 23 Emergence of risks associated with nanotechnology

Two risk combinations

Question 3 combinations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2	11	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3	6	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4	1	5	2	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5	8	22	6	10	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6	1		2			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7				1		5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8						6		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9							1		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10						2		1		x	x	x	x	x	x	x	x	x	x	x	x	x	x
11	2	1			2		1	1			x	x	x	x	x	x	x	x	x	x	x	x	x
12											4	x	x	x	x	x	x	x	x	x	x	x	x
13	1		1		1						2		x	x	x	x	x	x	x	x	x	x	x
14	1	1	1		6					1	4	3	3	x	x	x	x	x	x	x	x	x	x
15											4		1		x	x	x	x	x	x	x	x	x
16		6	3	2	5							1		1		x	x	x	x	x	x	x	x
17	14	1	1			1					7	4	2				x	x	x	x	x	x	x
18	1	1		1		2	7		1		2					1	2	x	x	x	x	x	x
19						1							2	1		1		2	x	x	x	x	x
20				1	1													1		x	x	x	x
21																			1	x	x	x	x
22	1			1							1							2				x	x
23															1							1	x

Leading combinations are

- 22 responses
 - US current account deficit/fall in US dollar
 - Blow up in asset prices/excessive indebtedness
- 14 responses
 - Oil price shock/energy supply interruptions
 - Middle East instability
- 11 responses
 - Oil price shock/energy supply interruptions
 - US current account deficit/fall in US dollar
- 10 responses
 - Fiscal crises caused by demographic shift
 - Blow up in asset prices/excessive indebtedness

Combinations by category

Economic	Economic	75
Economic	Environmental	4
Economic	Geopolitical	49
Economic	Societal	5
Economic	Technological	2
Environmental	Environmental	15
Environmental	Geopolitical	4
Environmental	Societal	11
Environmental	Technological	0
Geopolitical	Geopolitical	36
Geopolitical	Societal	9
Geopolitical	Technological	2
Societal	Societal	4
Societal	Technological	2
Technological	Technological	1
		219

Question 4. Many of the emerging risks could lead to regional food shortages. Which risks, in your opinion, would be most likely to lead to this potential event? List up to 3.

Economic – 50 responses

- 31 responses Oil price shock/energy supply interruptions
- 5 responses US current account deficit/fall in US dollar
- 9 responses Chinese economic hard landing
- 2 responses Fiscal crises caused by demographic shift
- 3 responses Blow up in asset prices/excessive indebtedness

Environmental – 118 responses

- 42 responses Climate change
- 32 response Loss of freshwater services
- 11 responses Natural catastrophe: Tropical storms
- 6 responses Natural catastrophe: Earthquakes
- 27 responses Natural catastrophe: Inland flooding

Geopolitical – 55 responses

- 1 response International terrorism
- 1 response Proliferation of weapons of mass destruction (WMD)
- 24 responses Interstate and civil wars
- 18 responses Failed and failing states
- 3 responses Transnational crime and corruption
- 6 responses Retrenchment from globalization
- 2 responses Middle East instability

Societal – 12 responses

- 9 responses Pandemics
- 3 responses Infectious diseases in the developing world
- 0 responses Chronic disease in the developed world

- 0 responses Liability regimes

Technological – 1 response

- 0 responses Breakdown of critical information infrastructure (CII)
- 1 response Emergence of risks associated with nanotechnology

Not Sure – 1 response

Other – 3 responses

- Use of genetically modified food
- Global recession: rising unemployment, reduced consumer demand & large company failures
- Government actions like ethanol requirements

Section 2: Modeling and Metrics

Question 1. When generating financial models for internal use, which primary risk metric do you prefer?

- 26 responses 29% Value at Risk (VaR)
- 48 responses 54% Conditional Tail Expectation (CTE – also known as TailVaR or Expected Shortfall)
- 7 responses 8% Not Sure
- 8 responses 9% Other
 - Combination of metrics, including VAR, CTE, confidence intervals, etc.
 - enterprise value
 - Economic Capital
 - stress testing
 - Scenario analysis
 - Franchise Value
 - Embedded Value
 - Value at Risk - Ordinary Environment

Question 2. When generating financial models for internal use, in addition to the primary risk metric you chose, are there other risk metrics that you find useful?

- 33 responses VaR
- 22 responses CTE
- 14 responses Not Sure
- 10 responses None
- 26 responses Other
 - NAIC RBC
 - Duration, convexity
 - Mean long-term losses
 - Distribution of results
 - Economic value
 - IRR
 - Scenario analysis
 - Probability of events that (separately) ruin the system
 - Defined stress tests

- Greatest present value of accumulated loss
- Standard deviations
- Interest rate and equity 'Greeks'
- VaR at different confidence levels
- Median absolute deviation from the mean
- sensitivity testing; scenario analysis,; economic capital based on market consistent embedded value
- common sense
- rbc sapor (surplus as a percentage of revenue)
- economic capital at risk
- Scenario specific measures(e.g. 3% rate shock)
- Capital at Risk - Extreme risk
- Multiple VAR metrics to illustrate entire risk profile
- Shareholder/economic value added
- Transition and default in stressed historical time periods
- Earnings at risk
- stress tests, sensitivities (delta, etc.)

Question 3. When generating financial models for external required capital purposes, which primary risk metric do you prefer?

- 32 responses 37% Value at Risk (VaR)
- 31 responses 36% Conditional Tail Expectation (CTE – also known as TailVaR or Expected Shortfall)
- 14 responses 16% Not sure
- 10 responses 11% Other
 - NAIC RBC
 - Local stat and GAAP
 - Standard deviations
 - MCCSR
 - Common sense
 - Sapor
 - RBC and rating agency measures
 - Capital at risk – extreme risk
 - Bank capital requirements

Question 4. When generating financial models for external required capital purposes, what time horizon do you prefer to use?

- 28 responses 32% Short (e.g., 1 year)
- 24 responses 28% Intermediate (e.g., 3-5 years)
- 26 responses 30% Long (e.g., 30 years)
- 4 responses 5% Not sure
- 5 responses 6% Other
 - Varies by audience
 - Depends on the nature of the risk
 - NAIC RBC metrics

- Short term asset impacts, with long term liability experience

Question 5. What do you expect to be the primary source of modeling improvements in the next few years?

- 17 responses 19% Dependency metrics
- 25 responses 28% Tail correlations (e.g., using copulas)
- 33 responses 38% Model efficiencies (fewer scenarios, faster run time)
- 6 responses 7% Not sure
- 7 responses 8% Other
 - Hard to effectively model random, rare events
 - Better calibration of losses
 - Other tail analysis
 - Correlation understanding
 - Extreme scenario modeling
 - Better modeling of correlations between risks (market, credit, spread,...)
 - Better integration of bottom up asset and liability models

Section 3: Accounting

Question 1. Which accounting regime is most useful to you for risk management?

- 18 responses 21% Market consistent embedded value
- 5 responses 6% US GAAP
- 14 responses 16% US Statutory (current)
- 7 responses 8% US Statutory (proposed principle-based approach)
- 6 responses 7% European Embedded Value
- 5 responses 6% IFRS (International Financial Reporting Standards)
- 11 responses 13% Solvency II
- 16 responses 18% Not sure
- 5 responses 6% Other
 - Actual cash flows
 - Canadian GAAP
 - None
 - Whatever is required
 - Discounted cash flows, without any regulatory requirements to distort the results

Question 2. Which accounting regime is most useful to you for management of emerging risks?

- 15 responses 17% Market consistent embedded value
- 2 responses 2% US GAAP
- 7 responses 8% US Statutory (current)
- 7 responses 8% US Statutory (proposed principle-based approach)
- 4 responses 4% European Embedded Value
- 3 responses 3% IFRS (International Financial Reporting Standards)
- 7 responses 8% Solvency II
- 21 responses 24% Not sure
- 17 responses 19% None are useful
- 4 responses 4% Other
 - None on the list are likely. Mostly it's a much simpler model - frequency times severity - severity probably again represented as effect on cash flows
 - Scenario analysis
 - Need to project both income and regulatory solvency
 - Company mgt places the highest value on US GAAP results, as financial results on US GAAP basis are how the company is valued.

Section 4: Current topics

Question 1. Prior to Fall 2008, your personal investment portfolio was

- 16 responses 18% More conservative than usual
- 60 responses 67% Same as usual
- 13 responses 15% More aggressive than usual
- 0 responses 0% Not sure
- 0 responses 0% Prefer not to answer

Question 2. Currently, your personal investment portfolio is:

- 23 responses 26% More conservative than usual
- 48 responses 54% Same as usual
- 18 responses 20% More aggressive than usual
- 0 responses 0% Not sure
- 0 responses 0% Prefer not to answer

Question 3. Your expectations for the 2009 global economy are:

- 54 responses 61% Poor
- 31 responses 35% Moderate

- 3 responses 3% Good
- 0 responses 0% Strong
- 1 responses 1% Not sure

Question 4. As a result of the recent turmoil in the financial markets, do you anticipate a change in the level of ERM-focused activities for your organization or clients in 2009 relative to 2008?

- 58 responses 65% Increase
- 3 responses 3% Decrease
- 19 responses 21% Stay the same
- 9 responses 10% Not sure

Question 5. As a result of the recent turmoil in the financial markets, do you anticipate a change in the level of funding dedicated to ERM-focused activities for your organization or clients in 2009 relative to 2008?

- 29 responses 33% Increase
- 7 responses 8% Decrease
- 43 responses 48% Stay the same
- 10 responses 11% Not sure

Section 5: Demographics

Question 1: Do you have an actuarial credential?

- 88 responses 99% Yes
- 1 response 1% No

Question 2: Are you a Chartered Enterprise Risk Analyst?

- 24 responses 27% Yes
- 65 responses 73% No

Question 3. Employer type

- 17% Consultant
- 1% Software
- 2% Banking
- 4% Brokerage
- 1% Intermediary
- 70% Insurance
- 7% Asset Management
- 3% Regulator/Rating Agency
- 4% Academic
- 0% Manufacturing/Services
- 3% Other
 - Reinsurance only
 - Independent contractor

- Provision of actuarial consulting services

Question 4: Region

- 7% Europe
- 91% North America
- 0% South America
- 7% Asia
- 0% Africa
- 0% Middle East
- 2% Caribbean/Bermuda
- 6% Australia/Pacific
- 0% Other

Question 5: Primary area of practice

- 38% Life
- 13% Property/Casualty (General Insurance, Non-Life)
- 2% Pension
- 3% Health
- 4% Finance
- 33% Risk Management
- 3% Generalist
- 2% Other
 - Insurance and banking pension product design
 - Education

Question 6. Which of these groups/sections of the SOA and its partners do you belong to?

- 85% Joint Risk Management Section
- 47% Investment Section
- 40% Financial Reporting Section
- 4% Pension Section
- 12% Health Section
- 13% International Section
- 12% Futurism Section
- 20% International Network of Actuarial Risk Managers (INARM)

Thanks for your participation!