

Risk Assessment & Risk Management — An Overview

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Definitions

Risk assessment and risk management: the words carry freight. They are best understood in the tale of a ship and an iceberg. Risk assessment would have put, at the very least, more lifeboats on the deck and made the captain more cautious about the speed of the ship (the Titanic had received several warnings about icebergs). Risk management would have saved lives simply by ensuring that the evacuation of the ship was orderly – no boats would have been half full or overturned. Once the collision happened, the ship was doomed. But more people could have been saved.

Yet, within two years after the Titanic sank, the International

Convention for the Safety of Life at Sea had been adopted, including the standardized distress call SOS (in Morse, dot-dot-dot-dash-dash-dash-dot-dot-dot) and provisions for adequate lifeboats, and stating that all new ships were to be built with watertight doors going completely up the hull, while others were retrofitted.

Then, as now, there were hearings, in Washington and London. Then, as now, there was finger pointing, at the crew of the Titanic, at the other ships nearby, at those who could no longer speak for themselves. Yet the world, recognizing the danger of sinking, the longer-term threat, reacted.

History Does Not Always Repeat Itself

Not quite 99 years later, history did not repeat itself. A year plus on and even the exact causes and the sequence of events at Fukushima are still the subject of controversy and differing interpretations.

How is it that the world of a century ago, not connected by phone, let alone the Internet, could move so much quicker than we have managed thus far? There will be those who say the problems we face are far more complex and the dependency on nuclear energy far more intricate than the world was then. Those are debatable assertions. The world of a century ago had only steamships as physical connectors, and most power was then, as now, generated by steam boilers of various kinds. It may be worthwhile to consider that world as dependent on steam as our world is on nuclear power and jet planes combined for purposes of comparison.

In part, the answer lies in the very fabric of risk assessment and analysis: in 1912, without steamships, there would have been no worldwide commerce, no travel, and no empires. Quite literally, the entire world would have stopped.



The Titanic at the docks of Southampton

From the standpoint of objective risk assessment, the chances of the Titanic hitting an iceberg, let alone one that would rip open so many compartments, were not large. The problem was, there were no adequate contingency plans for such an event, however unlikely, no worst case scenario.

The same applies to Fukushima. If the Great East Japan Earthquake was a once-in-a-thousand-years or so event (as some of the evidence indicates), then a gambler might say TEPCO had 9-1 odds on an installation that would be on site for at most a century. Odds of 9-1 are pretty good if they involve a horse race or some other sport. The Golden Rule of Gambling: do not bet more than you can afford to lose. Don't bet the farm, the house, and all the rest. TEPCO did that, just as the White Star Line did 99 years before. But herein lies the difference: the loss of a ship, while devastating, prompted positive changes that surely saved exponentially more lives than were lost. No such solace yet emerges from Fukushima which is now a place as hostile to human life as any to be found in nature, and will remain so for a very long time to come.

Predicting the Worst or Preparing?

Neither the earthquake nor the tsunami were perfectly predictable. There was certainly evidence that the area had been hit, repeatedly, by both earthquakes and tsunami. Earthquakes are not predictable, but the risk posed by them is.

The recently released report by the Nuclear Accident Independent Investigation Commission (NAIIC) termed the Fukushima disaster both “man-made” and “foreseeable”. A large part of the report details how, and why, safety precautions against nuclear accidents were not enforced. Put differently, Fukushima was an accident waiting to happen (*Sidebar 1*).

In the early atomic experiments physicist Richard Feynman coined the term “tickling the dragon’s tail” for the technique to create a sustained nuclear fission reaction. The development of nuclear power and the atomic bomb were not simply applied demonstrations of $E=MC^2$, they were invention and reinvention of industries and they were not casualty or risk free (there was a criticality accident at Los Alamos on Aug. 21, 1945 – six days after the end of World War II).

Hindsight is always clear, but the question remains, how could rational, thinking humans have made a bet, even given the attractive odds (which paid off for decades and decades in huge profits), and been blind to every single warning? 9-1 again.

This is the central question that has not been answered, 9-1 are good odds, but they are not perfect odds. There are no perfect odds; nor any sure things unless a game has been fixed. And nature, particularly seismology, plays by its own rules and its own odds which we, even now, do not completely understand. That means the apparent 9-1 odds may not be as advertised, and the gamble not as clever as it looked. There are better and more effective ways of judging risk assessment and risk management in the nuclear age.

Sidebar 1

The Parliamentary Report on Fukushima

According to the Executive Summary of the NAIIC, the Commission found that one possible back-up power line to the No. 1 reactor at the Fukushima plant could not operate due to a plug/socket mismatch. Also cited was the failure to implement measures recommended in the B.5.b subsection of the US recommendations after 9.11. The commission clearly sets out that “TEPCO did not fulfill its responsibilities as a private corporation...the risk management practices of TEPCO illustrate this...they ignored the potential risk to the public health and welfare [sic].”

The commission concluded: “The reason why TEPCO overlooked the significant risk of a tsunami lies within its risk management mindset – in which the interpretation of issues was often stretched to suit its own agenda. In a sound risk management structure, the management considers and implements countermeasures for risk events that have an undeniable probability even if details have yet to be scientifically confirmed. Rather than considering the known facts and quickly implementing countermeasures, TEPCO resorted to delaying tactics such as presenting alternative scientific studies and lobbying.”

(All quotes from English version of the Executive Summary of the NAIIC report.)

War, children, it's just a mistake away

There were many incidents that took place during the Cold War, not simply the near war circumstances in 1962 and 1983. In 1968 a B-52 crash in Greenland forced a complete re-assessment of war planning. The crash detonated the conventional explosives surrounding the warheads with resultant contamination. The bombs lost were four 1.1 megaton (roughly 30 times more powerful than the Hiroshima bomb) hydrogen bombs. The contamination was widespread.

This and other accidents led to a redesign of nuclear bombs themselves, making them more resistant to fire or an accidental detonation. They also led to early sharing of information between the US and the Soviet Union to make it easier for each to let the other side know an accident had occurred. The loss of the plane and crew and the contamination that resulted from the detonations were tragic. World War III would have been catastrophic. Lessons were learned, and even at the height of the Cold War, they were applied. A worst case scenario was assumed (a plane flying out of Greenland could cross into Soviet airspace quickly) and a solution to it implemented. That a solution could be implemented at the height of the Cold War shows how seriously the risk of an accident that could trigger a world war was taken by both sides. The risk of an accident starting a nuclear war had to be managed. For all the terrible mistakes made by both sides, the risk was managed.

Soteigai – “beyond imagination” – that phrase used too often by

TEPCO after 3.11, has an unfortunate truth in how the average citizen, whether office worker or manager or CEO, perceived the risk, and what the reality of the risk was, on March 10, 2011.

Japan, unlike the US and Russia, has no alternative command and control centers. That meant that, in the worst case scenario (presented to then Prime Minister Naoto Kan after 3.11), the loss of Tokyo would have meant the collapse of all central government command and control functions.

This means, plainly, that prior to 3.11 there *was no worst case scenario*. There was a warning system (the SPEEDI system, which was troubled from the beginning, and in any case relied on information that it could not receive because some of the sensors at Fukushima had been destroyed) and what information was provided sent some people directly into the radioactive plume rather than away from it.

Taken alone, these facts show that the risk assessment and risk management plans were not only inadequate, they were farcical. While it is true that the US and the Soviet Union had to plan for the destruction of their main command and control structures, and make arrangements accordingly (such as secret bunkers for government officials, for official records, for the ability to launch retaliatory strikes), again, these were far more complex undertakings than having alternate command and control in a civil emergency caused by a natural disaster, or a nuclear disaster, or both.

And they reveal a stark difference. The worst case in the US and the Soviet Union was assumed to be a nuclear war. The worst case, in Japan, was barely considered. It would be a civil matter, handled by a private company, perhaps needing some government assistance (and TEPCO's attitude, early on in the crisis, revealed how pervasive that mentality was, just as the company report blames "interference" by the government at the very same time that other investigations are showing that TEPCO, before and during and after, withheld critical information from the government). They did so even at a time when they clearly knew the situation had escalated well beyond their ability to contain it. They were not only willing to mislead the public, but the government as well. To say that is not risk management guided by a complete risk assessment is to state the obvious.

The Sum of All Fears?

Risk assessment and risk management, to be successful, require the difficult balance between short-term thinking, long-term thinking, and worst-case-however-unlikely thinking. When the B-52 carrying



DAYTON, Ohio - Mark 28 Thermonuclear Bomb on display at the National Museum of the US Air Force. These 4 bombs are 120 times more powerful than the Hiroshima bomb.

the hydrogen bombs crashed, the solutions implemented were clearly a successful combination of all three. But they were thought up and executed by people who understood clearly that failure could, in the worst case, destroy civilization. Of course, these were military operations personnel and contractors, handling extraordinarily dangerous materials.

A real risk assessment plan starts from the point of view where the 9-1 odds do not pay off. Of course, it is in the casino or racetrack's interest to make the 9-1 seem like a sure thing. And a real risk management plan begins with the situation where they do not pay off, where the one comes up instead of the nine, and what measures need to be taken.

While this sounds like a task for a Philosopher King, or an Einstein, Lloyd's of London has been doing it for centuries (since 1688 as a coffee house meeting place for ship news, and since 1771 if we think of the business of underwriting and insurance, the foundations of risk assessment). The year before the Titanic sailed, Lloyd's was already writing aviation insurance policies. And it was Lloyd's that insured the Titanic for what was then the large amount of 1 million pounds sterling.

Obviously, the learning curve was steep and long. The world of 1771 was a world of sail, not steam. Crossing the Atlantic took weeks, not days. Crossing the Pacific took longer. The most educated risk assessments were at best educated guesses and gambles on a particular ship and cargo making port. And when they did not, their exact fate was often not known for years, if ever, let alone the cause of their sinking. Yet there was an accumulated body of knowledge, and, of course, more ships made port than sank. What had been educated guesses and gambles became closer to real risk assessments.

It is also worth noting that like TEPCO, Lloyd's has had a very close relationship with the British government for much longer than TEPCO has existed. Very sensitive cargoes were sometimes insured by Lloyd's in the middle of World War II, when the risk from German surface raiders and U-boats was very real.

Insuring against Calamity

Iain Ferguson, president and COO of Lloyd's Japan, Inc., has commented: "Catastrophe modelling plays a hugely important part of how the insurance industry – and Lloyd's specifically – plans for the impact of such disasters, but events such as this one underscore just how many uncertainties natural disasters pose. Lloyd's Realistic Disaster Scenarios (RDS) model for an industry loss well in excess of the Tohoku losses and for levels of claims above those incurred. But the specific nature of the event and magnitude of the earthquake surpassed levels generally thought possible in this region and those used by the Japanese government and the scientific community."

He also noted that in the relatively rural areas worst affected many of the damaged or destroyed structures were not compliant with the latest updates to Japan's building codes: "Of course there may still be insurance losses to machinery and stock even if the structure remains intact and flood waters do not penetrate. Most notably the electronics and semiconductor industries were affected by movement during the earthquake shock (or resultant contamination of previously sealed 'clean' areas) that has required the repair or recalibration of a great deal of sensitive and high value equipment. The problems for these industries were exacerbated by continuing aftershocks. Affected companies are reconsidering their risk management approach to locating assembly in locations susceptible to earthquake shock damage and how they can improve construction protection around vulnerable equipment and 'clean' areas."

Risk comes in all shapes, sizes and flavors. Nuclear apocalypse, icebergs and torpedoes are easy to understand.

Randy Nornes is an executive vice president of Aon Risk Solutions. He points to a phenomenon that in chaos theory is called "the butterfly effect" in which a seemingly minor event in one place has an outsized effect in another. "Somewhere in the world there is always something happening, an earthquake, a flood, hurricane, typhoon, a fire, a strike, even a change in government. Depending on the business, having no inventory, no redundancy in the supply chain or no stockpiles of strategic materials puts a company at the mercy of forces it cannot possibly control." A fire in a chip plant in New Mexico in 2000 is a much cited and studied example of this point.

The plant was supplying chips to both Nokia and Ericsson. This was not an out of control fire/explosion and at the time it was thought the damage was minor. It was after the fact when everyone realized that the smoke and water, and even people needing to move through various areas, had caused far more damage. Nokia reacted quickly and was able to reach other suppliers. Ericsson moved

slowly, they had no back-up suppliers. They lost over a billion dollars, and 3% market share. Within a year they were out of the mobile phone business. (Ericsson combined with Sony in a joint venture, effectively exiting the market.)

The Damage that Can Be Done

In fact, the damage to a company can be many-fold and have outsized effects. Research by Professor Vinod Singhal at the Georgia Institute of Technology, cited in *The Economist* and based on several cases of supply-chain disruption, showed that this kind of event caused a larger drop in share price (8%) than delay in the launch of a new product (5%) or even financial irregularities (3-5%). That share price decline comes on top of whatever other damage occurs (sales, operating income, profits, even corporate goodwill and reputation).

Deborah Hayden, managing partner at Kreab Gavin Anderson (*Sidebar 2*), a communications and public relations company, noted: "Some of our clients had to explain what damage their facilities had suffered and on top of that [because of Fukushima] they had to answer questions about whether their products were safe."

After 3.11, General Motors had to shut a plant in Shreveport, Louisiana, for lack of parts, and Volvo, based in Sweden (like Ericsson), gets 10% of its parts from 33 different suppliers in Japan. Of those seven were in the disaster zone (directly affected by the earthquake and/or tsunami) and one was at the edge of the Exclusion Zone around Fukushima. Although there was no direct dramatic cause/effect as there was in the Ericsson/Nokia example, the damage totals are orders of magnitude higher (and even the estimates are necessarily incomplete because of Fukushima).

Fukushima and the developments there, ongoing now as they will be for years, are the large elephant in the room.

Nornes points out, "Insurers and reinsurers have almost no choice but to carefully scrutinize their exposure in Japan, both existing and prospective. They are operating with a lack of information and sometimes a daily flood of contradictory

Sidebar 2

The Human Intuition Factor

So much of risk assessment and risk management is about logic and contingencies, and how in the midst of incredibly disruptive and destructive events to handle situations that can overwhelm even the most meticulous plans. Deborah Hayden recounted a story that is a reminder that even amidst catastrophe, human intuition and preparation and learned experience play a role: "I am from New Zealand and I was following the events in Christchurch. About a week before the earthquake here I sent a memo to all my staff to check that everyone had the simple kit, walking shoes, the maps on how to walk home, water, some food, and anything else they thought they would need to get home on foot if they needed to."

information. They have to answer not only to their shareholders, but to ratings agencies who may judge that their exposure to circumstances in Japan is excessive. And this, also in turn, can have a knock-on effect for business.”

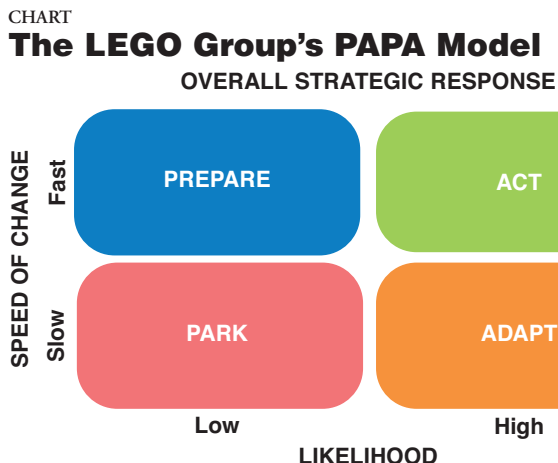
Thinking the Unthinkable, Imagining the Unimaginable

Professor Mark L. Frigo is director of the Center for Strategy, Execution and Valuation and the Strategic Risk Management Lab at the Kellstadt Graduate School of Business at DePaul University in Chicago. In his studies of corporations and risk management he has found “the companies that took a systematic approach, adding appropriate redundancy in their supply chain, focusing on their vulnerabilities and consistently updating them, outperformed their counterparts in wealth and value creation.”

An example he cites is Lego, the toy company, which uses what it calls the “PAPA Model” (Chart). PAPA stands for Prepare, Act, Park, and Adapt. The model allows the company to divide issues into particularly categories. That which is *parked* is not shoved over on the side to be forgotten, these are simply issues and events that have a low probability of occurring as well as occurring slowly. On the other hand, the issues that must be *adapted* to are trends (for a company like Lego demographics are a key factor in determining trends). Trends will continue and become facts or have a high probability of doing so but they will unfold slowly giving the company time to adapt and to form strategies that incorporate the change(s). An example might be the change in children’s play expectations, or even the demographics in certain countries. *Prepare* refers to events that are low probability but, if they occur, will be fast moving. These include all disruptions, whether natural disasters (earthquakes, tsunami, hurricanes, etc.) or any other event, however unlikely, that would cause an interruption or disruption in Lego’s existing business (the company keeps an Enterprise Risk Management database to ensure that there are contingency plans). *Act* refers to events that are high probability and fast moving which the company must react to as part of its ongoing business (in Lego’s case, a frequently cited factor it must act on is connectivity, which is clearly growing and changing the way children play and thus directly affects the company’s business in an ongoing and fast-moving way).

The PAPA model is, of course, only one method for a company or government or any organization to create its risk assessments and organize its risk management.

Frigo cites another example that is directly on point: “A company moved a very high-tech factory to a remote area. Because it was a high-tech factory it was recommended that they install a back-up power system in case the primary power system failed. They chose not to do so. Of course, there was an incident where they lost power, and because of the nature of the plant, they did not lose just a few hours (the length of the interruption) but days and days because all



Source: “Strategic Risk Management at the Lego Group” *Strategic Finance* (February 2012)
Mark L. Frigo & Hans Læssøe

of their equipment had to be recalibrated and brought back online.” The process he describes would be familiar to many plant managers in Japan. The difference is that the loss of primary power was/is an event that can be compensated for. A mega-quake and resulting aftershocks are not so easily managed.

Commenting on the impact of 3.11, Frigo said, “Clearly the risks could have been assessed better. Lacking the appropriate redundancy and back-ups set the stage for a high impact event.”

Norness spoke of the position of Aon: “We, as an intermediary, can only operate as well as the information we get [from companies].” Aon has seen an increase in inquiries and even launched a new product after 3.11, with Zurich, called “Brand Restoration” to allow companies to have embedded specialists who can, in a critical event, work with internal staffers to manage the effects of large-scale disruptions such as those cited by Deborah Hayden at Kreab Gavin Anderson.

These are all steps in the process Frigo comments on: “I think the way companies do risk management has to be redone and reinvented so that it is moved away from the *ad hoc* current situation.”

And in Japan, even as power companies are pondering whether they can survive without nuclear power, or even afford to decommission their existing nuclear plants, the government is raising concerns that the power supply may not be adequate without them. On the other side, all of Japan’s utilities are facing increased costs for insurance, as well as access to global equity, debt and loan capital markets, and credit default swaps have risen, reflecting both the perception of increased risk and what Norness cited as both a “lack of information and a flood of contradictory information.”

Soteigai may be the appropriate word to describe what will happen next. **JS**

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