

An Introduction to Insurer Operational Risk  
Topic 1: Risk Management of an Insurance Enterprise

Mango, Donald and Venter, Gary

Guy Carpenter & Co., LLC

DM: 44 Whippany Road

Morristown, NJ 07960 USA

Tel: 001-973-285-7941

[Donald.F.Mango@guycarp.com](mailto:Donald.F.Mango@guycarp.com)

GV: One Madison Avenue, 4<sup>th</sup> Floor

New York, NY 10010 USA

Tel: 001-917-937-3277

[Gary.G.Venter@guycarp.com](mailto:Gary.G.Venter@guycarp.com)

Originally published in a modified format in *Enterprise Risk Analysis* (Guy Carpenter & Company, LLC, 2007) pp. 144-172. Reprinted by permission of the author and the publisher.

## 1. Definition

The use of the term “operational risk” in banking first came to prominence in the mid-1990s and, along with the major banking scandals around that time, in many ways contributed to the evolution of the role of the Chief Risk Officer. This is a role that is spreading from the banking industry to the insurance industry.

Operational risk is defined by the Basel Committee on Banking Supervision as “the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk, but excludes strategic and reputational risk.” [1]

This definition is deceptively short for such a broad area. To elaborate, the Basel Committee issued a July 2002 consultative paper, “Sound Practices for the Management and Supervision of Operational Risk,” where they defined the following seven types of operational risk loss events at category level 1 [2]:

**Internal fraud.** Acts of a type intended to defraud, misappropriate property or circumvent regulations, the law or company policy, excluding diversity/discrimination events, which involve at least one internal party. Examples include intentional misreporting of positions, employee theft and insider trading on an employee’s own account.

**External fraud.** Acts by a third party, of a type intended to defraud, misappropriate property or circumvent the law. Examples include robbery, forgery, check kiting and damage from computer hacking.

Employment practices and workplace safety. Acts inconsistent with employment, health or safety laws or agreements, or which result in payment of personal injury claims, or claims relating to diversity/discrimination issues. Examples include workers compensation claims, violation of employee health and safety rules, organized labor activities, discrimination claims and general liability (for example, a customer slipping and falling at a branch office).

Clients, products and business practices. Unintentional or negligent failure to meet a professional obligation to specific clients (including fiduciary and suitability requirements), or from the nature or design of a product. Examples include fiduciary breaches, misuse of confidential customer information, improper trading activities on the bank's account, money laundering and sale of unauthorized products.

Damage to physical assets. Loss or damage to physical assets from natural disaster or other events. Examples include terrorism, vandalism, earthquakes, fires and floods.

Business disruption and system failures. Disruption of business or system failures. Examples include hardware and software failures, telecommunication problems and utility outages.

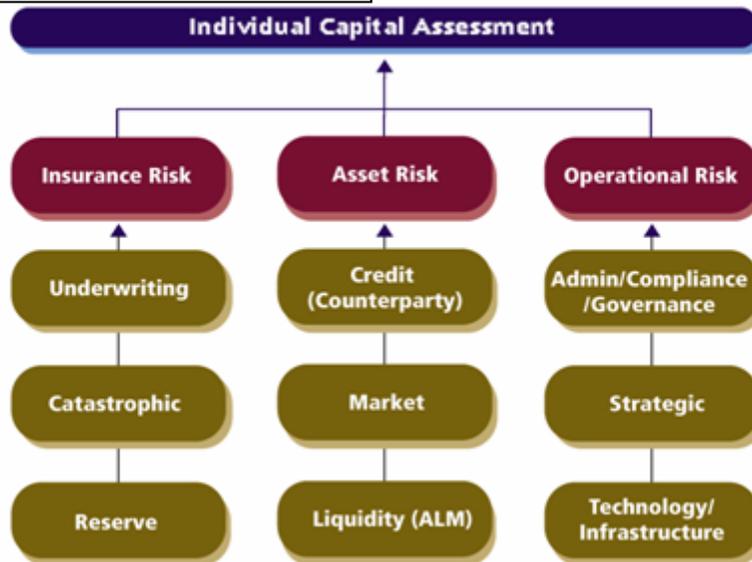
Execution, delivery and process management. Failed transaction processing or process management, and relations with trade counterparties and vendors. Examples include data entry errors, collateral management failures, incomplete legal documentation, unapproved access given to client accounts, non-client counterparty misperformance and vendor disputes.

The committee defined subcategories of these loss events at category level 2 and further suggested example activities at level 3. However, the committee has left it to the banks to define appropriate heterogeneous groupings.

While inevitably banking focused, the Basel Committee definition has gained substantial visibility and acceptance as the field of ERM has developed over the last ten years. However, there is not yet consensus on this categorization. But as many financial conglomerates have both banking and insurance operations, and are regulated by the same authority with converging regulatory ideas (e.g., Financial Services Authority (FSA) in the UK and Australian Prudential Regulation Authority (APRA) in Australia), one can easily imagine that greater use will lead to wider acceptance.

Many firms include reputational and strategic risks under the operational risk banner. One example for insurers comes from the ERM framework of the UK. FSA breaks down the universe of insurer risk as illustrated in Figure 1 (note the placement of strategic risk).

FIGURE 1 FSA RISK MAPPING



In some ways, except for regulatory requirements, one could argue that it does not matter whether strategic or reputational risk is included in operational risk, as long as it is considered in isolation and not overlooked altogether. Figure 2 shows some examples of insurer exposures to each subcategory of the Basel II definition:

FIGURE 2 INSURER EXPOSURE TO BASEL 2 CATEGORIES

SUBCATEGORY	EXAMPLES OF INSURER EXPOSURE
Internal Fraud	Employee theft, claim falsification
External Fraud	Claims fraud, falsifying application information
Employment Practices and Workplace Safety	Repetitive stress, discrimination
Clients, Products and Business Processes	Client privacy, bad faith, red-lining
Damage to Physical Assets	Physical damage to own office, own automobile fleets
Business Disruption and System Failures	Processing center downtime, system interruptions
Execution, Delivery and Process Management	Policy processing, claim payment errors

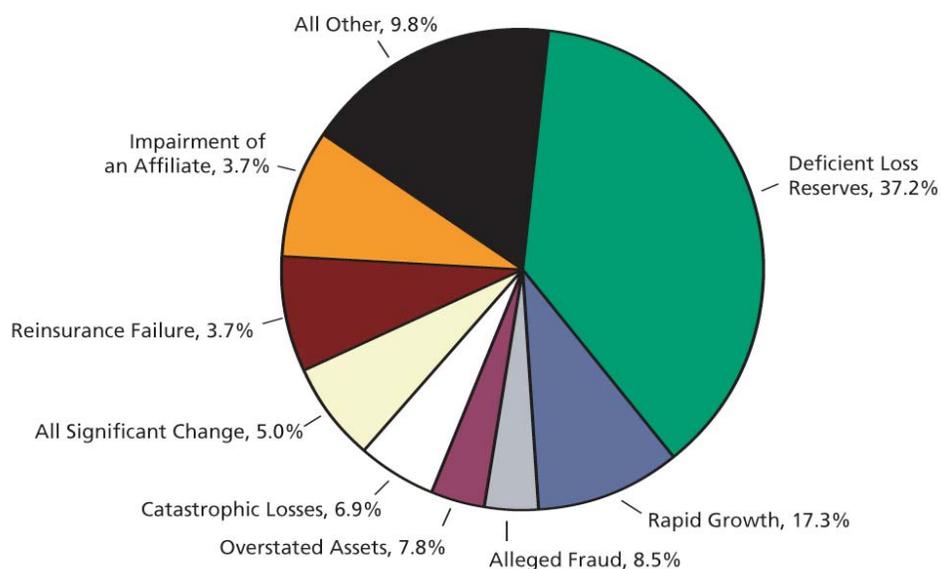
Inevitably, the definitions by regulators are compromises. However, useful practical refinements and insights have been added by ORX (Operational Riskdata eXchange Association [www.ORX.org](http://www.ORX.org)) and ORIC (Association of British Insurers Operational Risk Insurance Consortium [www.abi.org.uk](http://www.abi.org.uk)), which have developed operational risk loss data consortiums for the global banking industry and the UK insurance industry, respectively.

## 2. Operational Risk in Insurers

A.M. Best periodically issues studies of the causes of impairments or insolvencies in the U.S. insurance industry. Figure 3 summarizes the breakdown of the causes for insolvencies between 1969 and 2002, as reported in A.M. Best's 2004 study.

FIGURE 3

Primary Causes of P&C Company Impairments  
(1969-2002)



The A.M. Best findings are consistent with those in “Failed Promises: Insurance Company Insolvencies,” a 1990 U.S. Congressional Report by the Committee on Energy and Commerce Subcommittee on Oversight and Investigations. That report attributed insurer failures to underreserving, underpricing, insufficiently supervised delegation of underwriting authority, rapid expansion, reckless management and abuse of reinsurance. Australia’s HIH Royal Commission, looking into the collapse of one of Australia’s largest insurers, arrived at similar conclusions (see [www.hihroyalcom.gov.au/finalreport/indext.htm](http://www.hihroyalcom.gov.au/finalreport/indext.htm)).

Mark Verheyen [7] questioned whether the conclusions from A.M. Best, “Failed Promises” and HIH indicate that, in fact, operational risks are the primary causes of insurer failures. He further suggested that “the significant sources of operational risk are implicitly included in regulatory and rating agency capital models.” Indeed, the capital charges for premium, reserves and growth are in some part proxies for operational risk. This is a compelling reason to unbundle them from underwriting risk and consider them explicitly rather than implicitly.

This is precisely the reason that in banking, operational risk has been added to market and credit risk (Basel I). Operational risks have brought down many banking institutions (e.g., Barings, Long-Term Capital Management) and undermined the confidence in the banking system. Now that it is clearer that operational risks have heavily contributed to insurance impairments and insolvencies, they require explicit consideration in order to more fully protect the insurance industry and the underlying policyholders.

### 3. The Risk Fulcrum: Plan Loss Ratios

Insufficient reserves are technically a condition of every impairment and insolvency. Identifying “reserve deficiencies” as the cause of impairment is akin to citing “heart stoppage” as cause of death. It is factually accurate, but not very informative or useful.

The root reason for insurer failure is the accumulation of too much obligation (exposure) for the supporting asset base. Insufficient carried reserves are the symptom of a series of company analyses and managerial decisions. They are lagging indicators of insufficient initial reserving – which is primarily driven by optimistic plan loss ratios – or premature reserve releases. In fact, if one wanted to begin exploring the operational risk dynamics of an insurer, the “fulcrum” of that risk may well be the plan loss ratio determination process. The planning process could be the “perfect storm” of potential failure of people, processes and systems.

Consider the following thought experiment: Lemur Insurance writes a substantial book of long-tailed business. We will assume “long-tailed” means that historically it takes five years from policy year (PY) inception for 50 percent of the ultimate losses to be reported and 10 years for 90 percent to be reported.

Lemur (like most insurers) always “makes plan,” especially its premium goals, as often bonus schemes are driven off these targets. The premium targets are to a large extent driven by the assumed plan loss ratio – ostensibly an unbiased, realistic forecast of the loss ratio for the upcoming underwriting period. If a line of business is forecast to be at a lower loss ratio next year, it is almost certainly a line the company will want to grow in. If the firm has a reasonable model for forecasting plan loss ratios, then such growth decisions make sense.

Lemur sets its plan loss ratios using a “bridging model,” where more mature prior-year ultimate loss ratios (taken from the reserve review) are bridged forward using estimates of year-over-year loss cost and price level changes. The plan loss ratio selection, is based on a set of these bridged loss ratios, based on mature prior years.

Reserve review ultimate losses for immature prior years (those five years and younger) are calculated using the Bornhuetter-Ferguson (B-F) method, with expected loss ratios (ELRs) equal to the initial plan loss ratio for each prior year. This means that in the most recent few years, a prior-year ultimate loss ratio is quite close to its plan loss ratio.

One operational problem with such a bridging process is the high degree of interdependence and autocorrelation it induces among prior-year ultimate loss ratios. Absent any other information, optimistic older prior-year loss ratios can propagate

forward and lead to optimistic plan loss ratios. By simply following this process, underwriters can inadvertently string together a series of optimistically forecasted prior years. This is equivalent to betting a slate of long shots at the racetrack: The chance of hitting them all is quite small.

Eventually, Lemur's older prior years begin to deteriorate, and via the bridging, the B-F ELRs for the newer prior years also increase. This "reserve conflagration" actually represents unanticipated model risk – pure operational risk – associated with Lemur's loss ratio and reserving process. The conflagration of loss ratio increase creates a dilemma for Lemur's management: Either book the indicated deficiency and suffer a rating downgrade, or convince their auditors of the need to legitimately change their reserving process. Needless to say, they foresee no success with the latter tack, so they opt for the substantial reserve increase. The downgrade puts the firm at a claims-paying rating below levels acceptable to their core clientele. This leads to massive nonrenewing and no new business volume. Six months later, with the franchise in ruins, Lemur is put into runoff.

What are the proximate causes of Lemur's demise? The underwriters decry the poor performance of Lemur's actuarial staff: We followed directions and made plan, they say. The actuaries blame management, who in turn point the finger at the inherent, irreducible unpredictability of long-tailed business. This is the nature of insurance, they claim. This "pure insurance risk" argument is well-known in the industry. The fundamentally volatile loss-generating process, plus the confluence of economic and social forces, means even the most skillful forecasters can only get so close to the true answers. Forecasting errors such as happened to Lemur are inevitable and benign, indicating no wrongdoing.

While this argument makes the actuaries feel better about their own poor track record, the separation between underwriting (reserving) risk and operational risk is unclear. A forensic analysis of Lemur's plan loss ratio process reveals at least three explanations:

1. The plan loss ratio model could not accurately forecast the loss ratio.
2. The plan loss ratio model could have accurately forecasted the loss ratio, but was improperly used.
3. The plan loss ratio model did accurately forecast the loss ratio, but their indications were unpopular and therefore ignored.

A similar analysis of their reserving process reveals the same explanations:

1. The reserve review models could not accurately forecast reserves.
2. The reserve review models could have accurately forecasted reserves but were improperly used.
3. The reserve review models did accurately forecast reserves, but their indications were unpopular and therefore ignored.

Explanation #1 lines up well with the inherent uncertainty argument and helps many professionals save face. However, were #1 the truth, there is some operational risk – the plan loss ratio process failed to accurately forecast the loss ratios (process and system failure). If no competitor had any more success in this product line, then we could accept #1 in totality, without operational risk implications. But if there were

competitors with better forecasting models, then Lemur's planning system failed to deliver its intended product, namely accurate loss ratios.

Explanation #2 is pure people failure (improper use), and #3 is process and governance failure, what former president of the Faculty and Institute of Actuaries Jeremy Goford calls "corner office risk."

#### 4. Operational Risk and Cycle Management

Rather than list all the many possible operational risks insurers face, we will demonstrate the relevance of some of the critical risks in a setting that is familiar: cycle management. While meaning different things to different people, cycle management can be thought of as the prudent management of underwriting capacity as market pricing fluctuates in what is known as the underwriting cycle. The industry knows all too well that irresponsible, simplistic strategies ("maintain market share") during soft markets increase the likelihood of impairment, failure and destruction of franchise value. While there is much debate and speculation over the true causes of underwriting cycles, we can analyze a typical fictional insurer's response strategies from the perspective of people and process performance. We might ask:

1. Does the company have a proactive cycle management strategy? If not, does it believe it needs one?
2. Does the company know where in the cycle the market stands at any given time?
3. Are underwriters making decisions that are consistent with #1 and #2?

We will assess Foresight Insurance from a system performance perspective. That is, an insurer is a financial security system, a persistent pool of money. Policyholders can be thought of as members who purchase the right to access the system at a future time, should they need to. System performance assessments of, for example, utilities focus on stability, availability, reliability and affordability. Users depend on the system, and performance perturbations have undesirable ripple effects. So through this lens, we have to ask if Foresight is stable, available, reliable and affordable. Would an effective cycle management process improve its performance assessment?

##### 4.1 Performance Assessment Under Naïve Cycle Management

As a starting point, consider Foresight's performance as it follows the "maintain market share" strategy. As price adequacy drops via either pure price decreases or expansion of coverage, Foresight maintains premium volume but takes on more exposure. For a period of time, Foresight appears to its constituents to be performing well. Policyholders see premium decreases, coverage expansion or both. Prior policyholders are still getting their claims paid. However, once the cycle hits bottom and Foresight can no longer avoid recognition of its mounting claim exposures from the recent past, the situation changes dramatically. Foresight may be downgraded below a level acceptable to some policyholders, forcing them to switch carriers – failures on both a stability and availability basis. Foresight's insolvency means many policyholders will receive only partial recoveries on claims – failures in reliability and affordability. One might question how default is an affordability issue, since in insurance usage, that term typically refers to premiums. However, a partial claim

payment means the policyholder must bear a portion of the cost itself, which for large claims it may well be unable to afford.

## 4.2 Performance Improvement Via Cycle Management

Foresight knows a naïve strategy will likely lead to poor performance, so its managers wish to implement effective cycle management. Many similar firms fail to deliver on their initial commitment due to the overwhelming scope implied in cycle management. Essentially, an insurer must reengineer its underwriting decision processes. Given the continuous nature of the business (e.g., renewals, claims), for most insurers such an undertaking would be like rewiring the house with the lights still on. It is daunting because it impacts so many critical areas simultaneously: planning, underwriting, objective setting and incentive bonuses.

Respecting those realities, Foresight could still achieve meaningful process improvements by focusing on intellectual property, underwriter incentives, market overreaction and owner education.

### Intellectual Property

The majority of an insurer's franchise value is in intangible assets, also referred to as intellectual property. Examples include the experts in underwriting, claims, finance and actuarial; the proprietary databases of policyholder information (purchased via underwriting losses); the forecasting systems (pricing and reserving); and market relationships and reputation. Like all assets, these require care and maintenance. They are time-consuming to build and easy to lose or destroy. Therefore, prudent managers must focus on maintaining the core assets throughout the cycle. This has several implications. First, they must retain their top talent throughout periods of capacity retraction and continue to grow and develop their skills. Second, they must maintain a presence in their core market channels. Finally, they must maintain a consistent pattern of investment in systems, models and databases.

### Underwriter Incentives

Cycle management requires adaptability and responsiveness. Typical underwriter incentive plans are written once a year, with hard-coded bonus formulas tied to making "the plan," which is based on one assumed market situation. This structure is the antithesis of flexibility. In order to ensure underwriting decisions are in line with the corporate objectives and needs at the time the decisions are being made, the incentive plans need to be based on how well underwriters supported the portfolio goals throughout the year. Those goals will be fluid and changing based on inevitable market condition changes. If prices drop to an unacceptable level, underwriters may have to stop writing new business, with complete confidence that their bonus, and their long-term employment prospects at the firm, will be unaffected.

### Market Overreaction

The industry has a proven track record of aggregate overreaction in both directions. Market prices and coverage soften far below sensible levels, until the pain becomes too great, at which point the prices and restrictions overcorrect to the other extreme. In anticipation of such overreaction, Foresight may find another reason to prudently manage capacity. The firms with the most available capacity during the price-improvement phase will reap windfall profits that can offset many years of small underwriting losses.

### Owner Education

Foresight's owners must understand that under cycle management, certain financial figures may appear out of step with their peer companies. For example, premium volumes will drop. While those unfamiliar with insurance may see this as a decline in revenue (an undeniably bad signal for most types of firms), in an insurer practicing prudent cycle management, it is a sign of good stewardship of the franchise and the financial security system. Premium is an aggregate result of (i) amount (and nature) of exposure taken on, and (ii) price per unit of that exposure. It is imperative that owners understand what they are seeing and do not make ill-advised calls for top-line growth or increased market share at the worst possible point in the cycle.

Another example is the overhead expense ratio. Again, for most types of firms, the ratio of overhead expense to revenue is a critical indicator of operational efficiency. Based on the prior discussion of intellectual property, though, one can see that the portion of current-year overhead expense related to expert underwriter salaries, or IT costs for the claims and underwriting systems, could in fact be considered capital investments in these assets. One could make a compelling case that an underwriter's activity this year will produce benefits to the firm in subsequent years. That would argue for less emphasis on the overhead expense ratio.

A case in point can be found in the 2004 Berkshire Hathaway letter to shareholders. Figure 4 is taken from that letter (see [www.berkshirehathaway.com/letters/2004.html](http://www.berkshirehathaway.com/letters/2004.html) ).

FIGURE 4 BERKSHIRE HATHAWAY RESULTS				
PORTRAIT OF A DISCIPLINED UNDERWRITER NATIONAL INDEMNITY COMPANY				
YEAR	WRITTEN PREMIUM (IN \$ MILLIONS)	NO. OF EMPLOYEES AT YEAR-END	RATIO OF OPERATING EXPENSES TO WRITTEN PREMIUM	UNDERWRITING PROFIT (LOSS) AS A PERCENTAGE OF PREMIUMS (CALCULATED AS OF YEAR-END 2004)
1980	\$79.6	372	32.3%	8.2%
1981	59.9	353	36.1%	(.8%)
1982	52.5	323	36.7%	(15.3%)
1983	58.2	308	35.6%	(18.7%)
1984	62.2	342	35.5%	(17.0%)
1985	160.7	380	28.0%	1.9%
1986	366.2	403	25.9%	30.7%
1987	232.3	368	29.5%	27.3%
1988	139.9	347	31.7%	24.8%
1989	98.4	3320	35.9%	14.8%
1990	87.8	289	37.4%	7.0%
1991	88.3	284	35.7%	13.0%
1992	82.7	277	37.9%	5.2%
1993	86.8	279	36.1%	11.3%
1994	85.9	263	34.6%	4.6%
1995	78.0	258	36.6%	9.2%
1996	74.0	243	36.5%	6.8%
1997	65.3	240	40.4%	6.2%
1998	56.8	231	40.4%	9.4%
1999	54.5	222	41.2%	4.5%
2000	68.1	230	38.4%	2.9%
2001	161.3	254	28.8%	(11.6%)
2002	343.5	313	24.0%	16.8%
2003	594.5	337	22.2%	18.1%
2004	605.6	340	22.5%	5.1%

Note that this “portrait of a disciplined underwriter” shows, over a 25-year stretch, significant fluctuations in premium volume but far fewer fluctuations in number of employees. The result, predictably, is fluctuation in the ratio of operating expense to written premium, often to levels unthinkable to many management teams (e.g., 40 percent). National Indemnity is fortunate to have an owner (Warren Buffett) who understands the franchise he has built, who gives his underwriters clear guidance and incentives and has demonstrated over time that their jobs will be preserved during soft markets.

## 5. Agency Theory Perspective

Agency theory looks at management as the agents of owners, but agents with potentially divergent interests ([4], [5], [6]). The private interests of management create a type of operational risk faced by most widely held companies. One goal of agency theory studies is how to align management and owner interests, and another is to understand the impacts of potential divergence.

Some of this is difficult to quantify and to fund for. It is hard to ask an employee or even a consultant to compute the probability that the CEO will be overpaid at the expense of the shareholders. Even if this were quantified, would you want to increase capital to fund for this risk?

More generally, what is the probability that the incentive compensation plan will lead to inappropriate managerial behavior and decision making? Rather than quantifying and funding for such risks, studying the plan and understanding its incentives and, if necessary, adjusting it would be more useful.

It is often difficult to align management and owner interests. For instance, a start-up company can agree to pay management a percentage of the increase in its market cap after five years. That might give investors and management the same perspective. But if the management has a certain attitude towards risk, it could decide to take very risky actions to try for a major increase in firm value, figuring they could end up either very wealthy or right where they are now. This is essentially incenting them to gamble with someone else’s money.

Paying management in stock grants or stock options is often viewed as a way to harmonize management and shareholder incentives, but this too could backfire. It is quite possible that shareholders become much more diversified than management, which then becomes more risk averse. A widely held company could be run like a closely held family enterprise as a result.

In the insurance industry, it is not just senior management incentives that are an issue. Production incentives are not uncommon but can lead to sloppy underwriting or mispricing. Recognizing and controlling this risk is central, although it might be worthwhile to try to quantify its probability and potential impact and even hold some capital for it. Using MGAs to produce business has similar risks.

There are no simple answers to the problems of agency theory. Different people may react differently to any given incentive program, depending on their own risk

preferences. Being aware of the potential problems and monitoring results are key. Perhaps there is a role for independent board members in this process.

## 6. Operational Risk Management in Banking and Manufacturing

Many operational risks are common to all businesses, but identifying them as risk sources and managing their impacts can avoid unexpected problems and lead to profit opportunities. This section will cover some general operational risks and explore the elements of good operational risk management used in banks and manufacturers.

### 6.1 General Operational Risks

Pension funding issues combine financial and HR components. Sometimes, changes in funding adequacy are not highlighted in financial statements; so this is not given as much focus as other issues, but it can have significant economic impact. Models that incorporate financial risk with firm demographics would be needed for quantifying this risk.

IT failure risk has been quantified to some degree. Besides traditional hardware and software failure, there are new issues of virus and other Internet attacks. Monitoring and control with contingency planning is critical, but quantification and funding of the residual risk is possible.

Other HR risks include loss of important staff, perhaps due to misdesign of compensation and benefit programs, employee liability, fraud by employees, rogue trader risk, inadequate training, errors, rule breaking, incompetence, etc. Again, identification and control of these risks are more critical than their quantification and funding. They also have opportunity elements. These risks, as well as property damage, etc., have some insurance coverage available, so analyzing the company as a client can help quantify such risks.

Reputational risk can arise from product tampering, bad press coverage, etc. Firms' reputations and images have even been severely damaged from off-hours behavior of key employees. It is not clear that adding extra capital would help in such cases. Thus, for much of operational risk, the primary role of ERM would seem to be identification and management of such risks rather than quantification and funding for them.

Lawsuits can be brought for anything from making too much money to making too little. Sometimes, a company can feel it has proper business practices, but these can be misinterpreted or reinterpreted through changing standards of jurisprudence. Monitoring behaviors is important for this, but perhaps there is a role for funding as well. Corporate culture can also make a difference, but this may be difficult to determine in a risk analysis.

### 6.2 Control Self-Assessment (CSA)

The Institute of Internal Auditors (IIA, [www.theiia.org](http://www.theiia.org)) defines control self-assessment<sup>40</sup> as “a process through which internal control effectiveness is examined and assessed. The objective is to provide reasonable assurance that all business

objectives will be met.” The focus on internal controls is consistent with internal auditing professional standards. According to IIA standards, the primary objectives of internal control are to ensure:

1. The reliability and integrity of information.
2. Compliance with policies, plans, procedures, laws, regulations and contracts.
3. The safeguarding of assets.
4. The economical and efficient use of resources.
5. The accomplishment of established objectives and goals for operations or programs.

According to the IIA’s Professional Practices Pamphlet 97-2, “Assessing and Reporting on Internal Control”, the IIA supports the COSO41 recommendation that organizations “should report on the effectiveness and efficiency of the system of internal control, which is defined as:

*“...a process, effected by an entity’s board of directors, management and other personnel, designed to provide reasonable assurance regarding the achievement of objectives in the following categories:*

- 1. Effectiveness and efficiency of operations.*
- 2. Reliability of financial reporting.*
- 3. Compliance with applicable laws and regulations.”*

### 6.3 Key Risk Indicators (KRIs)

Davies and Haubenstock [3] provide the following definition of risk indicators:

Risk indicators are a broad category of measures used to monitor the activities and status of the control environment of a particular business area for a given operational risk category. While typical control assessment processes occur only periodically, risk indicators can be measured as often as daily. Risk indicators help keep the operational risk management process dynamic and risk profiles current. As the use of risk indicators becomes integrated into a risk management process, indicator levels/measures must have a frame of reference, commonly referred to as escalation criteria or trigger levels. These levels represent thresholds of an indicator or a tolerance that, when passed, require management to step up its actions.

KRIs are forward-looking, leading indicators of risk, whereas historical losses are inevitably backward looking.

Mark Verheyen [7] suggested the following insurer KRIs:

- Production — hit ratios, retention ratios, item count, pricing levels (renewal business and new business), rate per unit of exposure;
- Internal controls — audit results, audit frequency;
- Staffing — employee turnover, training budget, premium per employee, policies per employee;
- Claims — frequency, severity, new classes of loss.

## 6.4 Six Sigma

Six Sigma is a management framework born out of the manufacturing world, which was originally invented by Motorola in 1985. It has connections to Total Quality Management (TQM) and Statistical Process Control (SPC). The name means that customer-specified tolerances for output quality (defects) are plus/minus three standard deviations (“sigma”) from the mean (hence, Six Sigma). Major corporations that use Six Sigma include Motorola, General Electric, Honeywell (Allied Signal) and Ford.

Six Sigma provides a framework encompassing process redesign, project management, customer feedback gathering, internal communication, design tradeoffs, documentation and control plans. This framework is typically applied in two different settings: existing process improvement and predictive design. While developed in manufacturing, Six Sigma has value in financial services, where there is a predominance of high volume processing, and has been used as a means of operational risk mitigation. Specifically, Six Sigma can help firms identify and eliminate chronic process issues: inefficiencies, errors, overlaps and gaps in communication and coordination. The end result will be reduced operational loss potential, from potentially both a frequency and severity perspective.

Some examples of insurer processes that might benefit from process improvement are:

Underwriting — exposure data verification, exposure data capture, price component monitoring, classification and hazard selection.

Claims — coverage verification, ALAE, use of outside counsel and initial case reserve setting.

Reinsurance — treaty claim reporting, coverage verification, reinsurance recoverables, disputes, letters of credit and collateralization.

## 7. Operational Risk Modeling

A comprehensive operational risk management system is akin to a captive insurance company. This suggests that a centralized operational risk management group is a de facto insurance captive manager. The portfolio consists of all the operational risk exposures that are either transferred (insured or transferred to the capital markets) or retained, regardless of whether retention is by virtue of decision or by necessity (because some risks are either not insurable or no insurance exists). Drawing on the key elements of insurance portfolio risk management, the necessary steps for operational risk portfolio management might therefore include:

1. Identify exposure bases for each key operational risk source. Examples include payroll, head count, policy count, endorsement count, claim count and premium volume. Typically, these are KRIs whose levels are regularly recorded by each business unit (BU) and monitored by the centralized operational risk group.
2. Measure the exposure level for each BU for each operational risk source. This might be based on exposure modeling, experience modeling and industry data, supplemented by (large) loss scenarios and adjusted for the future business

environment, or a combination of any of these. The goal is the best assessment of exposure using the best and most appropriate techniques available.

3. Estimate the loss potential (frequency and severity) per unit of exposure for each operational risk, reflecting the existing level of internal controls and process effectiveness.
4. Combine #2 and #3 to produce modeled BU loss frequency and severity distributions.
5. Estimate the impact (reduction) of mitigation, process improvements or risk transfer on the BU loss frequency and/or severity distributions.

Structurally, this exercise is no different than standard property-casualty (general insurance) actuarial analysis. The difference is that many of these exposures have never been covered under any insurance program, so (ironically) there is no loss history on some of these insurer operational risks. It is worth noting that some of this loss information may be in existence, although it may not have been recorded for managing operational risk per se. For example, the general ledger accounts might well record some “operational risk” losses. Consequently, it is well worth investigating internal systems to discover what operational risk loss information might be recorded, perhaps in an uncoordinated manner, and systematize and institutionalize its future collection.

Also, Step #5 will likely be an area where significant expert opinion is required. It is unlikely that organizations will have significant amounts of operational loss data both before and after every possible mitigation effort. Banks use Control Self-Assessments (CSAs) as a source of information to help gauge the degree of process and control improvement.

This is similar to the determination of the mandated premium discounts for tort reform. Actuaries do not have the luxury of “rerunning the experiment” before and after tort reform – that is, what would the claim experience have been had these reformed tort laws been in effect over the past several years? Significant detailed analysis of claim and policyholder information is required, along with informed estimation and judgment.

## 8. Conclusions

Our understanding of operational risk is in its infancy, especially as regards quantitative modeling. Each step we make in our progress merely increases its importance. It is essential that ERM practitioners do not lose sight of operational risk simply because it is soft, difficult, poorly understood or lacking historical track record. It is just these characteristics that make operational risk fertile ground for historically relevant research, with undeniable benefits to flow to our industry and economy. However, it is our contention that this effort will be rewarded with superior operating performance.

## References

- [1] Basel Committee on Banking Supervision. "International Convergence of Capital Measurement and Capital Standards – A Revised Framework." November 2005, Part 2, Section V-A.  
Available online at [www.bis.org/publ/bcbs118.pdf](http://www.bis.org/publ/bcbs118.pdf).
- [2] Basel Committee on Banking Supervision. "Sound Practices for the Management and Supervision of Operational Risk." July 2002. Available online at [www.bis.org/publ/bcbs91.pdf](http://www.bis.org/publ/bcbs91.pdf).
- [3] Davies, Jonathan, and Michael Haubenstock. "Building Effective Indicators to Monitor Operational Risk." *The RMA Journal* (May 2002) pp. 40-43.
- [4] Hoskisson, R., M. Hitt, and C. Hill. "Managerial Incentives and Investment in R and D in Large Multiproduct Firms." *Organization Science*, 3 (1992) pp. 1-17.
- [5] Jensen, M. "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers." *American Economic Review*, 76 (1986) pp. 323-329.
- [6] Jensen, M., and W. Meckling. "Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure." *Journal of Financial Economics*, 3 (1976) pp. 305-360.
- [7] Verheyen, Mark. "Operational Risk Management in a Property/Casualty Insurance Company." Casualty Actuarial Society Spring Meeting presentation (2005). Available online at [www.casact.org/education/spring/2005/handouts/verheyen.ppt](http://www.casact.org/education/spring/2005/handouts/verheyen.ppt).