OPERATIONAL RISK QUANTIFICATION: SCENARIOS

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ABOUT THE AUTHOR
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Statement of intent
THE QUANTIFICATION OF OPERATIONAL RISK SERIES
This is the second in a series of five papers exploring the quantification of operational risk. The focus of this paper is scenarios, as used by firms and sometimes as part of the AMA (Advanced Measurement Approach) calculations for determining operational risk regulatory capital.
The topics of the other four papers are: AMA, stress testing, structural models and cost: benefit analysis. The last two papers are more speculative as they consider quantification techniques that are not yet widely used.
WHAT IS A SCENARIO?
The term “scenario” is often used with the assumption that there is widespread understanding of what the term means. This is an assumption that has led to confusion and frustration.

Scenarios have been used as part of risk management for years. Sometimes they have been called “thought experiments” or had other labels applied.

Additionally, scenarios are required as part of AMA (Advanced Measurement Approach) models — for example as direct inputs or to validate results from loss data.

Definition
For the purpose of this paper a “scenario” is a description of a possible sequence of events. A risk scenario will usually include an assessment of the likelihood of the event occurring and an estimate of the severity of the adverse consequences.

A strategy scenario may have similar elements, including the likelihood of occurrence, and the impact on the firm’s balance sheet and revenue.

In this paper “scenario” should be taken to mean “risk scenario”.

Scenarios are related to stress tests. One of the key differences is that the assumed likelihood of the stress test events occurring is 100%. As a result, firms are expected to have measures in place to enable them to survive the events described in the stress test. Stress tests are discussed in more detail in the next paper in this series.

USES OF SCENARIOS
Although scenarios may be used in managing credit, liquidity, market or enterprise risk, the central focus of this paper is upon operational risk scenarios. Some of the points raised may also apply to scenarios relating to other risk types.

In terms of the output of an operational risk scenario, including an assessment of the likelihood of the event occurring and an estimate of the severity of the expected adverse consequences, quantification is a key benefit. There will undoubtedly be uncertainty about the quantification result. In some cases the quantification results will only be accurate to an order of magnitude. In other cases the results may be expected to be accurate to ± 20%.

The level of acceptable uncertainty over the result may depend upon why the scenario has been created. Amongst the primary reasons for creating scenarios are:

— decision making
— capital calculations
— searching for potential surprises

Decision-Making
To aid with decision-making, the scenario indicates the scale of the issue concerned and helps to explore the circumstances behind that specific scenario. For example, if a risk and control self-assessment indicates a topic of potential concern, then a scenario might be completed in order to gain a better understanding of the wider issues at play.

The scenario creation process and outputs are effectively the analysis and comparison against benchmark elements of the risk management cycle. The next stage is to take a decision about whether to accept, avoid, reduce, transfer or transform the risk.

Scenarios can also be used as inputs to projects. The scenario might determine the change (if any) in the risk profile after
completion of the project, compared to the status quo. If the project is for risk mitigation, then having reasonably accurate results will be helpful, but if the project is proceeding for other reasons then an indication of scale or magnitude might be sufficient.

Scenarios are also useful when exploring an emerging risk. A risk might emerge, or have the potential to significantly raise its profile, in response to changes in either the internal or external environment. The external environment could include the wider economy, legal precedents or pressure from society and regulators.

**Capital Calculations**

As mentioned in the first paper in this series on the AMA, scenarios are a required regulatory input when producing the capital estimate for operational risk. Scenarios can be used as direct inputs into the calculation or to validate the capital estimate.

A firm could use scenarios as direct inputs into their capital calculation as a means to fill in knowledge gaps. For example, the firm may have peers that have experienced large losses, but may not (yet) have experienced such losses itself. The firm may take the decision that it has an exposure to the events that have led to the losses and that these losses could materialize over the following 12 months (the AMA time horizon). The firm may therefore create a scenario to provide a data point in the form of a loss or a distribution to render the AMA estimate more complete. Towards one end of the spectrum of AMA methodologies, a firm’s AMA result may be dominated by scenario results as opposed to historic loss data originating with the firm itself or its peers.

The indirect use of scenarios in relation to the AMA is to help validate the AMA estimate. In this situation a number of scenarios are needed to cover the main unexpected losses. The portfolio of scenarios is aggregated and values are taken from the aggregate loss distribution and compared to the loss data dominated AMA.

**Potential Surprises**

The ‘search for potential surprises’ is sometimes known as a reverse scenario. For reverse scenarios an aggregate loss number is provided (for example $1 billion) and the business is asked for examples of how they could potentially lose that amount over a 12-month horizon and as a result of a single event. The aim is to arrive at an extreme, but plausible scenario — chemical attacks by rogue states are out of scope!

The reverse scenario challenge requires the business to survey its activities and processes and to arrive at a combination or convergence of events that could give rise to a loss of a specific size. The loss could be expressed as a specific amount, for example $1 billion, or as a percentage of the previous year’s profits/revenues.

**FEATURES OF A SCENARIO**

The fields included in a scenario template - and their relative importance - can vary depending on the intended use of the scenario, as outlined above. The following groupings of data fields might be expected in a scenario template:

- purpose
- categories
- story
- effects
- quantification

The rationale for including these groupings is that they help the reader to understand the implications of the scenario, to make decisions about how to use the scenario and to decide how much reliance to place on the quantification results. It should be borne in mind that readers include individuals who
are not familiar with the business and may be reading the template several months or even years after it was created.

**Purpose**

This field not only helps the reader, but also those completing the template. For example, for some scenario uses the focus is only on low frequency, high impact events. Other scenarios seek to gain an appreciation of the scale of possible losses and to explore the control environment in order to make risk management decisions of accept, avoid, reduce or transfer/transform.

**Categories**

Categories are the labels that describe where the envisaged event takes place within the firm (e.g. business line, process, region, etc.). The business line and product labels indicate which Profit and Loss (P&L) statements could be affected. The event type provides a rough idea of ‘what actually happened’ and the role of the firm and the counterparty type (retail vs. peer) indicate how the firm could be involved.

Some or all of these categories should also be field labels in the internal loss database and perhaps even the external loss database. Access to related loss data assists with the quantification and managing of biases when creating or validating scenarios, especially anchoring.

**Story**

The story provides a description of the events. It tends to be in the form of a free text field rather than selecting labels from a predetermined list. For example, in the case of the categories, it might be useful to look at the description in a report describing a limit breach or excess. The description needs to inform the reader, but not be a dissertation!

The story may need to comment on some specific features. For example, if the scenario relates to an imagined terrorist incident, then the reader will need a more in-depth description than “terrorist incident”. A terrorist incident could range from anti-money laundering to the destruction of bank property. Moreover, there is a big difference between an incident involving, for example, an ATM and that involving a branch, a regional office, head office or a data center. Some of these properties may not be owned by the firm, but rather rented or leased.

For other scenarios an important detail is how the scenario description and quantification relate to the control environment. Does the description relate to inherent risk or residual risk, after taking into account preventative and detective controls? Does the quantification reflect the use of mitigating controls, such as a back-up data center or how far away the nearest alternative ATM is located?

**Effects**

Including information on the effects of the scenario emphasizes that the financial impact of two scenarios may be the same, but the implications for the firm could be different.

Pre-determined effects labels (in no particular order) could include:

- regulatory fines
- regulatory investigations
- compensation paid to customers
- costs to fix – internal and/or external
- interest costs
- opportunity costs
- reputational impact

Some of these effects will be linked to the category selections. The choices include stating that they are part of the total effect on the firm, or going as far as apportioning the loss across the various effects. If the compensation to customers is high enough, then the regulators are likely to be involved. In turn this has implications for the resourcing
of the regulatory relationship team. When working with colleges of regulators, the resourcing implications may not be limited to head office.

**QUANTIFICATION**
Quantification can be the most challenging part of completing a scenario. The degree of accuracy (not necessarily precision) and the level of uncertainty are linked to the purpose for which the scenario is being created. For some purposes the users may just want to know about operational increases or decreases, for example the current environment versus the post-project implementation environment. To help the creators and users of scenarios, it may help to clarify what is needed, as opposed to what is wanted by various users.

**Uncertainty**
It is debatable whether allowing the scenario creators to provide an estimate of their uncertainty around the quantification outputs will help or hinder the process. A possible scale for uncertainty is:

<table>
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<th>Terminology</th>
<th>Degree of Confidence</th>
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<tr>
<td>Virtually certain</td>
<td>&gt;99% Probability</td>
</tr>
<tr>
<td>Very likely</td>
<td>&gt;90%</td>
</tr>
<tr>
<td>Likely</td>
<td>&gt;66%</td>
</tr>
<tr>
<td>About as likely as not</td>
<td>33% - 66%</td>
</tr>
<tr>
<td>Unlikely</td>
<td>&lt;33%</td>
</tr>
<tr>
<td>Very unlikely</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>Exceptionally unlikely</td>
<td>&lt;1%</td>
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The expectation is that by using subject matter experts in creating the scenario, the confidence around the estimates should be greater than 33%. However, to the creators of the scenario, the ability to provide an estimate of the certainty around their estimates may prove to be seductive and so “unlikely” or lower becomes the default level of confidence. An alternative is to provide this information as part of the validation process.

**Biases**
Another element that is present when creating scenarios - and especially the quantification - is bias. Biases are part of the human decision-making process.

Some of the biases express themselves in the discussion around the quantification, for example “it couldn’t happen here”, or “a number that size is not going to be popular” or, worse, a complete lack of discussion. The initial step in managing bias is to recognize its presence.

A high level view of the creation process, for example of a scenario to be used in a capital calculation, might look as follows:

1. Determination that a scenario is needed
2. Broad specification (e.g. event type level 1)
3. Working group formed to create the scenario
   i. Working group produces initial story
   ii. Reference data provided in the form of descriptions of related internal events with loss amounts
   iii. Initial quantification estimates
   iv. Reference data provided in the form of descriptions of related external events without loss amounts
   v. Revised quantification estimates
4. Scenario enters validation stage
5. Validator provided with external loss data to use in support of validating the quantification results
6. Scenario used in capital calculations
Providing data at steps 3ii, 3iv and 5 helps to mitigate against bias in the description, the quantification and the validation.

Process
The process by which the quantification estimates are created can vary from asking an individual to asking an entire group of people. Asking a group can help to mitigate some biases, such as anchoring bias that can occur when an individual responds alone. The detailed activities can range from an open group discussion which results in some estimates, to the provision of anonymous estimates which are then discussed and followed by another round of estimates.

Some care is needed in deciding when to inject loss data into the process of creating estimates. In the above high level process, different loss data is used in steps 3ii and 5. If the same loss data was used in 3ii and 5, then the validation check would be less valuable, because the validator has the same data as the working group and is, by definition, less independent. Then if the validator disagrees with the working group, it could come down to a difference of opinion and whose opinion (bias) is preferred. Additionally, the firm is unlikely to have access to loss data for every possible scenario. This is where the certainty/confidence around the estimates becomes useful. For example, the firm may use the internal loss data as part of the discussion following the initial loss estimates. The external loss data can then be used in validation.

Data
The creators of scenarios tend to be asked for estimates of losses or the frequency and severity of losses. Sometimes the data request is couched in terms of confidence intervals, such as 99% over a particular time horizon e.g. 12 months.

The confidence interval values fit nicely into some uses of scenario outputs, for example risk appetite, capital and certain other uses.

But what does a 1 in 100 year or 1 in 1000 year event look like, especially when considering the evolution in banking over the past 30 years? The difficulty is that many subject matter experts, and others, do not think in terms of confidence intervals; they probably think of a “bad year” and a “really bad year”. This difference in perspectives can produce some very frustrating discussions and outcomes.

One way to overcome this difficulty is to include a translation layer between the subject matter experts and the end user. For example, it is probably easier for a subject matter expert to formulate an opinion as to how often something could go wrong over 1, 2, 5 or even 10 years, effectively creating a frequency estimate.

The request for severity information can be handled in several ways. One approach is to ask the relevant expert to provide an estimate as to how many losses are likely for a given loss ‘size bucket’. There may be 2 to 5 loss ‘size buckets’, where the size of each bucket is influenced by the internal and/or external loss data.

Another approach is to ask the expert to assign a rating for an average loss and for a particularly severe loss, for example 1 in 20 or 5 in 20.

Both of these approaches can then feed a translation layer containing statistical distributions for frequency and severity. Whether the distribution is log-normal, Pareto or something else will be determined by fitting the existing internal and/or external data. This translation layer then enables the quantification results to be expressed in a way that is useful for the scenario users.
The overall result might be a higher degree of confidence in the results that are provided by the subject matter experts, with an assumption about the correct distribution to use in the translation layer.

**POST-CREATION PROCESSES**

The purpose of the scenario will determine the rigor of the post-creation processes. For regulatory or capital purposes the rigor will be higher than if one is simply trying to get a directionally correct trend for the risk being assessed.

The immediate process is likely to be validation. A rigorous validation needs to be carried out by an independent party. Possible candidates include a subject matter expert from a different part of the firm, somebody from the group function or even an external person.

As a minimum, the validation will confirm that everything on the template has been completed. Thereafter the quantification results must be validated.

Whether the validator is a subject matter expert or an individual from a group function, they will both need an adequate description in terms of the data categories and story. Having a story of “natural disaster” is inadequate. Describing a sequence of events, such as the impact of the event on the back-up site, the ability of staff to get to the back-up site, the number of days to get the main site up and running again, the damage to buildings, etc. helps provide the validators with some reference points.

Some scenarios are created for a one-off purpose, for example to support a particular decision. Other scenarios might be used regularly, including as inputs to capital calculations. For scenarios that are to be used regularly, there needs to be a review process to determine their on-going relevance as well as the quantification results. The relevancy aspect of the review process should determine whether an old scenario, for example one created and quantified in the previous year, is relevant in the current environment. Re-using a scenario reduces the costs for the business and reviewing and revising an existing scenario is cheaper than creating a new one.

The starting point for the relevancy review process is an intuitive judgment based on the data categories and more specifically on the story. Does the story describe events that could still happen or has the environment changed so that the described events could no longer happen? If so, does the scenario need to be discarded or tweaked to be made relevant and fit for purpose?

A difficult aspect of the relevancy review process is determining if the existing quantification results are still valid. Comparisons with statistical distributions of losses can help, but because they are backward-looking by definition, they cannot correctly anticipate the current or future environment. At the moment this is still a challenge for most of the industry. A partial solution may be found in the use of risk drivers (see below).

**PROS & CONS OF SCENARIOS**

**Pros**

The word “scenario” describes a combination of a process and a product.

One of the main benefits of scenarios is their flexibility. They can be applied at the organizational level, divisional level, location level, new product level or even transactional level.

Scenarios encourage engagement between the various support and control functions of a business, as they seek to understand what could go wrong. This in turn leads to greater preparedness and resilience.

The inclusion of separate effects leads to
discussions about what changes can be made and how resilience can be enhanced.

Standard templates are a useful place to start and provide structure for the scenario creation process. They also promote consistency and enhance comparison between scenarios.

Recognizing the different possible purposes in creating a scenario assists in fine-tuning the efforts involved. Some individual scenarios can remain useful for several years.

**Cons**

Today the biggest “con” of scenarios probably relates to quantification. The requested data needs to be asked for in terms that the experts who provide the estimates can readily comprehend in practice rather than in theory.

As the quantification is dependent upon opinions, biases need to be recognized and mitigated, where possible.

Validation of scenarios is no easy matter. While the story may be plausible, it can be difficult for an independent person to match the story to the quantification. The person conducting the validation brings their biases to the process as well.

Validation and decisions about the on-going relevance of a particular scenario are helped by a well-written story. Although the story does not need to be as long as a novel, it does need to be as complete as possible. This requires some guidance in the scenario procedures and some effort by the scenario creators.

**SCENARIO WISHLIST**

So what is on the wish list for the next generation of scenarios?

The most difficult aspect of scenario formulation is the need to provide estimates of loss amounts and/or frequency and expected severity. Using a translation layer between what the subject matter specialists can provide and what the users need is a possible solution, however it does not specifically support reviews of on-going relevance or quantification.

One approach, which is explored later in this quantification series, is the broad concept of structural models. The suggested starting point when gathering data for these models is to analyze the factors that influence or drive the frequency of operational risk events and their severity.

For transaction processing, a frequency driver might be the quality of the data arriving from databases used to populate the fields needed to complete the process. The size of the transaction could be a severity driver, since it influences the time needed to find an error.

The frequency driver can focus attention on preventative controls and features that the firm can influence. The severity driver can provide an upper limit on the loss. For example, it is difficult to lose more than 100% of the value of the transaction being processed, regardless of whether it is a retail bank check or an over-the-counter derivative transaction.

The advantage of using frequency and severity drivers is that much of the data will be readily available as part of existing datasets and reports. Using the same data twice is efficient.

The on-going relevance of the quantification of a scenario can also be easily monitored. For example, if the average transaction size has increased by 20% since the scenario was originally created, then the potential loss probably needs to be re-estimated.

**SUMMARY**

The creation and use of scenarios is extremely flexible and that is part of their intrinsic value. They do not constitute a new technique and many of us have been using them informally for years. With the regulatory requirements of the AMA, Pillar 2 Internal Capital Adequacy
Assessment Processes and stress testing, it has become necessary to adopt a more formal approach to scenarios.

At the heart of a scenario are individuals trying to describe and quantify what might happen in the future, but scenarios are not forecasts.

Central to the process are the opinions of the individuals involved, either as scenario creators or validators. As part of our thinking processes we bring our own biases, and partial mitigation of these biases can be achieved by the provision of a structured approach and supplementary reference loss data.

This paper introduces the concept of risk drivers. These can be useful for arriving at the quantification estimate and also in determining the on-going relevance of a scenario. If any one of the drivers has changed significantly, then the scenario probably needs an updated quantification. Risk drivers will be explored in more detail in the paper on structural models.

REFERENCES

1 Colleges of regulators are connections between the main regulators for a banking group and are managed by the lead regulator for the banking group.
3 Ibid Chapter 3 p55
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