OPERATIONAL RISK QUANTIFICATION: THE ADVANCED MEASUREMENT APPROACH

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Statement of intent
THE QUANTIFICATION OF OPERATIONAL RISK SERIES
This is the first in a series of five papers exploring the quantification of operational risk. It sets the scene by focusing on the Advanced Measurement Approach (AMA), as used by firms and sometimes recognized by regulators for determining regulatory capital for operational risk.
The topics of the other four papers are: scenarios, 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.
In the late 1990s, the Basel Committee on Banking Supervision was in the process of significantly altering the way that internationally active banks estimated their regulatory capital requirements. Alongside the changes to the credit and market risk regimes, a new risk emerged: operational risk. Originally this referred to all risks other than credit or market risks, but the impossibility of trying to quantify such a vague concept soon became apparent. (Some might say that it is not much easier quantifying operational risk.)

As with credit and market risks, Basel II provides relatively simple approaches for determining the regulatory capital for operational risk. As for credit and market risks, there is also the opportunity to use regulatory approved models to determine the regulatory operational risk capital requirement known as the Advanced Measurement Approach (AMA).

This paper focuses on these AMA models — their data requirements, the link to risk management and the issues surrounding them.

MINIMUM REQUIREMENTS
To appreciate the AMA, consider the following comments about the simple alternatives for determining the regulatory capital for operational risk.

Simple Calculations
There are two simple alternatives to the AMA — the Basic Indicator Approach and the Standardized Approach.

The Basic Indicator Approach is the entry level operational risk capital calculation. For internal purposes firms can use something else.

The calculation is the indicator multiplied by a factor. The indicator is gross income averaged over three years, where gross income is positive. The gross income is for the entire firm and there are a number of exclusions, such as provisions.

The Standardized Approach is similar. It is based on the gross income indicator multiplied by a factor. The increased sophistication is created by applying a different factor to gross income for eight standard business lines.

There are some entry criteria necessary in order to graduate from the Basic Indicator Approach to the Standardized Approach. These entry criteria include a conceptually sound operational risk management system with clear responsibilities and tracking of material losses.

Models
Firms can use an AMA model for internal purposes, but they need regulatory approval to use an AMA model to determine their regulatory capital requirement.

The model output needs to be equivalent to a 99.9% confidence interval over a one year horizon. This confidence interval is similar to the standard contained in Basel II for credit risk regulatory capital. The model output can reflect diversification benefits and, to a limited extent, the benefits of hedging operational risk, for example via the purchase of insurance contracts.

The Basel II paper also requires the use of the following as part of the model inputs:

- internal loss data
- relevant external loss data
- scenario analysis
- business environment and internal control factors

1 Essentially it means a rare event. E.g. If there are 250,000 transactions in a year then 250 will go wrong.

2 Diversification benefits are an element of the portfolio approach to risk. If there are two processes then the likelihood of them both failing is less than the likelihood of each of them failing independently. 1 + 1 = <2. There are statistical assumptions embedded in diversification benefit measures, such as correlation.
The external loss data helps firms to be aware of the risks to which they may be exposed, but have not yet experienced. It also helps to fill in gaps in statistical distributions based on internal loss data, especially in the tails of the distributions.

The business environment and internal control factors are more widely known as Key Risk Indicators (KRIs). Their inclusion helps to make the AMA estimate more forward looking.

There is a great deal of flexibility in how this data is assembled to produce the 99.9% confidence interval over one year. At one extreme are the models based entirely on loss data and at the other extreme are models entirely dependent upon scenarios. Most firms are probably somewhere in the middle. An example is where an initial estimate of operational risk capital is generated via loss data and then validated against results generated from a scenario-based model.

Whichever methodology is used to estimate regulatory capital must also be used for internal purposes. For example when estimating economic capital. This increases efficiency by using much the same code and processes for both calculations, and any issues identified by management will also probably apply to the regulatory approved model. This aligns the regulatory and management interests in the model and its results.

Data to Feed the Models

The four data types - internal and external loss data, scenarios and KRIs - required by the AMA models need to be sourced. As the data does not magically appear, this implies a supporting infrastructure! For some firms it is the cost of this data collection that has made them reluctant to migrate from the Standardized Approach to the AMA.

LINK TO RISK MANAGEMENT

Operational risk has been managed for years - it simply hadn’t yet been labeled as operational risk. Having a regulatory definition has assisted in the identification of gaps and the integration of management. One way that this integration has been achieved is via the use of common terms and categories, such as ‘event types’. Without common categories at firm and industry levels, it becomes difficult to use data, whether sourced internally or externally.

Businesses pay for data collection, storage and analysis infrastructure – either directly or indirectly. Gaining benefits in addition to a capital estimate is the sort of efficiency that firms like to see. For example, by collecting internal loss data, businesses can estimate if their revenues are adequate compensation for the risks that they are taking, as expressed in terms of allocated capital. This is essentially the beginning of a discussion about risk-based pricing. Those firms that do it will have an advantage over those that don’t.

Additionally, the external loss data enables firms to benchmark themselves and answer questions like “Is my retail banking division better or worse than that of my competitors?”

Business line data may not be sufficiently granular for risk adjusted pricing. For example, Operational Riskdata eXchange (or ORX) has introduced product categories. Let us digress and consider the implications for business tactics and pricing in particular. How should the industry set prices, fees or the bid-offer spread for transactions? If the industry prices products and services in line with the firm with the highest costs, including operational risk losses, then some will be obtaining a return in excess of their risks. Alternatively, if these “better” firms use pricing based on their risks, then the worst firm will be making an inadequate return on the risks that it is taking and it will be

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RAROC is Risk Adjusted Return on Capital, a performance metric that is also used in planning to support the allocation of economic capital and risk appetite around the firm.
evident in RAROC\(^3\). This is part of the value proposition for actively managing operational risk.

The process supporting scenarios enables firms to conduct what-if analyses. There are many starting points. For example, events that have been experienced by peers but not yet experienced by the firm. Another benefit of scenarios is the creation of a process that allows firms to consider emerging risks — perhaps a series of experiences in other industries like insurance. In the case of cyber security, any industry could act as a benchmark. (Scenarios are discussed in more detail in the next paper in this series.)

From a data perspective, the regulators, by forcing banks to collect these additional data types, have increased the amount of data available to assist with decision making. This decision making is what regulators mean when they refer to the “Use Test”.

**Governance**

From a governance perspective, the AMA results are extremely useful for some users. For example, the Board of any firm needs to have an accurate picture of the degree of each type of risk being taken, in order to compare this to their agreed risk appetite statement.

Providing the Board with data on all of the individual loss events, individual scenarios and KRIs would be counter-productive. They will be buried in detail and not see the wood for the trees.

As with credit and market risk model results, the AMA aggregates all data to arrive at a single figure. In turn this is compared to the information that the Board receives on credit and market risks and is expressed in similar units, including a confidence interval and a period of time.

However, arriving at an operational risk appetite in terms of an amount at a given confidence interval and period into the future, is of limited value. The limitations, in comparison to credit and market risk, are that for operational risk it is difficult to reverse engineer the components that make up the AMA total. For market risk, value-at-risk (VaR) calculations it is possible to determine the contribution that each risk factor makes to the whole. For credit risk the contribution that various segments make to both risk and return can be identified as part of credit portfolio risk management. For some firms the contribution that each individual credit or market risk taker makes can be identified.

This level of granular detail is not usually available as a standard by-product of AMA calculations.

In summary, the AMA calculation is very good at aggregating a diverse data set for reporting to the Board. However, it is less valuable when taking the Board’s operational risk appetite and cascading it down through the organization.

**Feedback Loops**

If risk management is the first defense against operational risk and capital is the second, then it would be useful if there was a relationship between the two. A positive feedback loop between actions to reduce the probability of occurrence or severity and the risk estimate, AMA, would be extremely valuable.

It can be seen that for the factor-based approaches — the Basic Indicator Approach or the Standardized Approach — the only way to reduce the risk estimate is to make less gross income — not a popular objective for many stakeholders!

However, for the AMA with internal and relevant external loss data, KRIs and
scenarios, a positive feedback loop should be possible. For businesses the choice is simple: invest in controls and other measures to reduce operational risk, or generate sufficient returns to make the targeted return on capital for the accepted risks.

In credit or market risk, if the source of exposure is removed from the balance sheet then there is an impact on the capital estimate. The reduction in the risk estimate may not be 1:1 owing to portfolio diversification benefits, but it is expected to be directionally correct. Does the same hold true for operational risk? Possibly not.

There is an ongoing debate about the use of historic data in AMA calculations. Firms with AMA approval will use about five years worth of historic loss data. During this five year period the internal control environment will have changed significantly. As a result, should a relevancy test be applied to internal data? This relevancy test could be applied to areas where the business environment has changed. For example in response to a large operational risk loss. The impact on the AMA figure may not be 1:1, but it should encourage investment in risk management actions by businesses.

If the focus is applied to KRI, then there are similar questions. KRI are intended to reflect the future of operational risk, so it is not the absolute level of the KRI that is important, but the change between two periods to determine whether the environment is getting better or worse.

The impact on KRI is influenced by how they are included in the AMA. The choices are:

i. Only increase the AMA result
ii. Only decrease the AMA result
iii. Increase or decrease the AMA result

For example, if KRI can only increase the AMA result, this effectively implies that if the KRI were showing a perfect score then the best estimate of future operational risk is derived from historic data.

If KRI can increase or decrease the AMA result, should the effect be symmetrical, e.g. 5% up or down, or asymmetrical, e.g. maybe 10% up and 5% down?

How big an impact should the KRI have on the AMA result? If the assumption is that the future is reasonably represented by the past, then KRI should have little impact. Another aspect to consider is the motivation of the business and its risk takers. For example, if KRI can achieve a 10% reduction in the AMA estimate, it is directionally correct, but is it enough to motivate the business to manage the KRI down - and by extension to bring the risk down?

**PROS & CONS OF AMA MODELS**

Before considering the pros and cons of AMA models there are a couple of details to remember. Firstly, AMA models have probably been in existence for a maximum of 10 years. In comparison to credit and market risk models, 10 years is a relatively short period.

Secondly, at the beginning of this quantification journey, the academic foundations for the AMA models were not as readily identifiable as modern portfolio theory was for the Market Risk Model. As a result, the operational risk pioneers had an almost blank canvas with just the regulatory prescribed inputs and outputs and a big white space in-between.

**Pros**

The regulators, providing the option to use AMA models and specifying the required inputs, supported risk management. Firstly, the resources became available to collect

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4 The “relevancy test” is used to determine whether the risk data is still relevant. It can also include “fit for purpose” criteria. For example, if a division has been sold, is the operational risk loss data still relevant for inclusion in the AMA calculations? Probably not. If the control environment has been updated and re-energized, how relevant are historic losses? This is less clear.
the data. Secondly, the collected data could be used for risk management as well as for measurement purposes. As a minimum, the data enabled monitoring and escalation thresholds to be established, whether derived from internal losses, KRI s or scenarios.

The technical obstacles that were overcome when devising these models and methodologies have moved risk measurement onwards. For example, the statistical distributions of the data are “fat tailed”. Additionally, as firms get better at managing operational risk, the data will decrease as there are fewer losses. (But it may take years for this to become a limiting factor!) Finally, incorporating the benefits of hedges such as insurance contracts has required an understanding of how they work (differently to other hedges such as futures, swaps and options) and their incorporation into simulation models. Techniques for co-movement, such as copulas, have been borrowed from credit risk and extended to address the features of operational risk data.

From a governance perspective, AMA models are an achievement. The outputs are in units comparable to those for credit and market risks. This, in turn has promoted aspects of enterprise risk management at the top of the firm. Further, the outputs aggregate a large variety and quantity of data into a single number. This single number promotes the establishment and monitoring of a risk appetite at the Board level.

Cons

Although AMA models have now made data available for risk management, the model outputs are not easy to use in risk management decisions. Unlike credit and market risk, it is technically difficult to allocate operational risk capital to the risk taker at the portfolio level. (Even for market risk there are issues: a VaR allocation does not tell a trader whether to buy or to sell.) For example, if operational risk capital was allocated to the physical security department, what could they be expected to do with that number? For them, and many other functions, KRI s and scenarios are more meaningful. In practice the regulatory “Use Test” requirements need to vary in terms of granularity within the organization. At the top of the firm the AMA output may be appropriate, but lower down the firm the KRI s, scenarios and other inputs to the AMA will be more useful.

As mentioned above, one of the issues is the feedback loop between risk management actions and the impact on operational risk capital. If the relationship is too weak, or too delayed, then the incentive to proactively manage operational risk is diluted.

To support this feedback loop it may be necessary to introduce the concept of “relevant internal losses”. This relevancy concept is applied to external data.

It is accepted that the AMA is good at aggregating a large variety and quantity of data when reporting upwards. However, for risk appetite purposes the information has to flow downwards as well. This is where the variety and quantity of data is a disadvantage. However, perhaps the days of being able to set and monitor the risk appetite through a single number, although attractive, are over. There are a number of individual operational risks for which firms have low or zero appetite. These individual risks would be hidden in a single number like operational risk capital.

5 From a risk perspective a “fat tailed” distribution means that, statistically, big risks are more likely to appear. The oft-cited example is that jumps (up or down) in stock markets occur more often than forecast by “normal” or “thin tailed” statistical distributions.

6 Copulas are statistical techniques to measure the co-movement or occurrence of operational risk events. For risk measurement purposes, they are advanced when compared to correlations.
Despite these “cons” AMA models are still preferable to the Basic and Standardized Approaches in terms of risk sensitivity and risk management support.

**AMA WISHLIST**

So what is on the wish list for the next generation of operational risk quantification?

Many of the issues described above arise from trying to get the maximum benefit from the AMA model inputs and outputs, something that is desirable for both regulators and firms. As experience of AMA models has grown, so has the wish list.

On the technical side, using a directly observable value from an aggregate loss distribution at the 99.9% confidence interval has issues. For example, it is difficult to validate the value and it can be volatile. This volatility in the value can be a significant distraction to discussing and managing operational risk. An alternative approach might be to take the value for a lower confidence interval and scale it to produce a value equivalent to 99.9%. In practice this might involve taking the value for the 95% confidence interval and multiplying it by a standard factor. This improves the circumstances around validation: 1-in-20-year events are more likely to be within the range of experience of the firm or understanding of individuals than 1-in-1,000-year events. (This approach is not new, as when market risk VaR was introduced there was a minimum scalar of 3.) This approach is also likely to reduce the volatility of the AMA results from one period to the next and significantly minimize a distraction from managing the risk.

A stronger link between risk management actions and risk measurement results is to be encouraged. This will support proactive risk management in conjunction with performance management metrics.

In turn, this will strengthen the motivation of businesses and their support functions to manage operational risk as opposed to resorting to “fire-fighting” mode. Recent large operational risk events have strengthened the assumption that “prevention is cheaper than a cure”.

While this feedback loop may be limited in currently configured AMA models, perhaps the gap can partially be filled by more granular models, which may also support threshold monitoring and risk appetite at lower levels in the firm. These more granular models can be more transparent and engaging for risk takers and decision makers, a desirable feature. The greater use of scenarios and the introduction of structural models could be partial solutions to feedback loop and transparency issues and are covered in parts 2 and 4 in this series, respectively.

**SUMMARY**

With the benefit of hindsight, regulators performed a great service for risk measurement by permitting operational risk to be modeled. The data required for AMA provided a foundation on which the discipline of operational risk management has been built. Operational risk was managed before Basel II, but in a less coordinated way.

The alternative of only having the Basic Indicator or the Standardized Approaches would have meant that:

i. The link between risk management and measurement/capital would have been tenuous at best

ii. The data needed to advance operational risk management practices could still have been collected but its utility would have been reduced because it would not have been used in risk measurement.

The comments about AMA enhancements
are the result of several years of experience and the recognition of shortcomings. Some of these shortcomings are in comparison to the benefits and transparency available with credit and market risk models.

The benefits from the interaction between risk measurement and management mean that continued evolution is needed. Possible applications and evolutionary paths for operational risk quantification will be explored in this series.

REFERENCES
ii Basel II para 669 e
iii ORX is the Operational Riskdata eXchange (www.orx.org)
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