TREASURY WORKING PAPER

00/10

A theoretical framework for operational risk management and opportunity realisation

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ABSTRACT

Advanced probability models are used to evaluate risks and to justify decisions where reliable data is available, e.g. reinsurance, money markets and nuclear energy. Operational risk management – the trade-offs made to run an efficient and effective organisation – has much less, and lower quality, data.

In the first part of the paper, observations are made about the factors shaping operational risk management: the increasing shift of influence from tangible to intangible variables; the intuitive manner in which most operational risk is managed; the dynamic nature of the trade-offs balancing risk and reward; and in particular, that the critical factor in managing risk and opportunity is often how each choice feels rather than how a rational choice should be made.

An economic framework is then used to examine the optimal relationship between operational risk and reward. Although operational risk management has many investment characteristics, players are bias towards minimising risks rather than maximising opportunities. This is because of uncertainty over the variables, and better knowledge of costs than rewards.

The conclusion is that an overt, systematic approach to managing operational risk will be more effective and efficient than allowing an informal, intuitive process to operate. This requires that assumptions and the judgement process must be made explicit; that the value of intangibles should be appreciated; and that the knowledge gained by individuals in managing risk should be codified and retained by the host organisation.

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SUMMARY

This paper was written mainly for people who manage operational risks and opportunities. It looks behind management techniques to see what concepts can be used to describe what happens, why it happens, and how these concepts can be used to improve the techniques that are in use. The paper should also be of interest to people who are curious about the factors that shape the way decision-makers respond to the challenge of balancing risk and opportunity.

The paper takes a broad, high-level view, using various perspectives to examine the trade-offs made between risk and opportunity to run an efficient and effective organisation. Consequently there is no detailed investigation of specialist areas of risk management such as structural engineering, clinical risk management or risks relating to financial instruments.

For the purposes of this paper, operational risk management is defined as the systematic assessment and management of the trade-offs made between risk and opportunity to run an efficient and effective organisation.

Operational risks and opportunities managed implicitly and intuitively by individuals will not be managed as effectively or efficiently as those managed by an explicit and rational system. In either case, the *up-front* investment costs of mitigating risks or realising opportunities are much better known than the *potential* costs associated with realised risks or missed opportunities. (This is true of both tangible and intangible factors, although by definition, the intangibles are more difficult to measure.)

As a consequence, there is a bias towards sub-optimal reduction in investment costs, and a value placed on wait-and-see options. As the drivers of organisational behaviour in both private and public sectors move organisations towards increasingly abstract, difficult to measure intangibles such as convenience, there is a higher reliance on the judgement of operational decision-makers. Many operational decisions must be subjective, yet they will be less fallible if they are made with the help of systematic and explicit assessment of risks, opportunities and investment costs.

The interpretive information screens which decision-makers use are initially implicit. If this allowed to continue, unconscious sifting of data will occur, and the knowledge assets to manage operational risk will be built up covertly, making it difficult for the host organisation to retain or access the knowledge. It will also be difficult to enhance the efficiency and effectiveness of the assets through codification and abstraction.

Techniques and methodologies to manage operational risks and opportunities are filters. They are designed to economise on the processing and consumption of data. Given that astute data manipulation offers a lever to exert a magnified influence over physical factors, the trade-off between data and

physical inputs will shift in favour of data over time. As data is collected and collated, the emphasis will shift in turn towards identifying patterns and trends, so that the use of data can also be reduced. Using more data, less physical resources occurs as decision-makers move up the risk management learning curve. In combination with insight jumps in productivity, the complexities of managing operational risk are reduced, which frees up capacity for new learning.

As different parts of an organisation standardise "best practice" risk management approaches around the most valued features, there is a danger that the assessment process will ossify. When the operational risk/opportunity context changes, this will render the 'optimal' risk management system sub-optimal. If this situation is allowed to continue, the system will fall into disrepute, causing individuals to revert to their own, unassisted judgement. Articulation of the knowledge gained in managing operational risk so that it can be captured in a formal risk management system offers the means to reduce contextual complexity. This is preferable for most organisations rather than allowing enabling individuals to absorb complexity, managing operational risks and opportunities by implicit – and opaque – judgement.

Whatever approach is adopted, individuals and organisations are faced with the same investment decisions when deciding what treatment is appropriate to reduce exposure to risk or to realise opportunities. The value of the risk or opportunity must exceed the cost of treatment. Investment will not occur in either risk mitigation or realisation of opportunity until the required margin above the resource cost and uncertainty value. In this respect, the value of a decision-maker lies in how well he or she manages the trade-off between opportunity, treatment, and risk.

Due to the conditional nature of decisions to invest in risk/opportunity treatment, there is often an incentive to retain the *option* to invest rather than to invest fully. The wait-and-see approach is rational on four counts:

a) at least part of a treatment investment is an irreversible sunk cost,
b) the opportunity cost of not pursuing other treatments is uncertain, but could overtake the investment treatment under consideration,
c) the probability of success is variable, and
d) treatment factors are invariably 'lumpy'.

Decision-makers do not operate in a vacuum. Examining contextual drivers, and the marginal costs and benefits of investment decisions is helpful in understanding the behaviour of decision-makers in how they view operational risks and opportunities. There is a bias towards:

a) under-investment in treatment,
b) minimisation treatment costs, and
c) reducing risk exposure.

Investment to realise opportunities suffers accordingly – which is compounded where there is an inherently low organisational appetite for risk. Because of the difficulty measuring intangible factors, decision-makers tend to wait-and-see, and to err towards under-investment. Consequently decision-makers will tend to fall short of the optimal points of investment in risk mitigation and, especially, in realising opportunities.

A brief background goes through some of the factors leading to the current situation. At the moment, those managing operational risks are doing so mainly on an intuitive rather than intellectual basis. The key features of the current situation are described before going on to describe the particular objectives and scope of the paper.

The main body of the paper examines the forces underlying operational risk management. A simple framework is proposed to illustrate the dynamics of risk and opportunity. Using this framework, various inferences are drawn which are then compared with observations made about risk management in public and private sector practice.

The paper is summarised in a brief conclusion, which points out some advantages of the framework while acknowledging its limitations.

PART I: INTRODUCTION

A Brief History of Operational Risk Management

Humans have been managing risk ever since they were capable of coherent thought – weighing up the risks of attacking large animals against the reward of tasty food; investing in the planting of crops for the reward of the harvest; sacrificing to the gods in expectation of reward in the afterlife. Taking the opportunity out of risk and taking the risk out of opportunity is natural. However, making that process explicit, systematic and logical – risk management – only really began with the coming of probability mathematics.

Since then areas and industries lending themselves to quantitative analysis have devised increasingly sophisticated mathematics and methodologies to determine the likelihood, impact and exposure to risks. Where data is available the results have been largely successful, but by definition the outcome of risk management is uncertain. Where relevant data is incomplete or unable to be collated into useful information, judgement is involved. The decision-maker has to form an opinion about the situation and evaluate the costs and benefits of various action or inaction.

Further uncertainty arises in the area of operational risk due to the value of economic intangibles such as goodwill, and the volatility of interrelationships amongst the factors determining each aspect of risk and opportunity. Both the value of economic intangibles and volatility of interrelationships have been increasing rapidly over the last ten years.

Given these features, risk management remains more of an art than a science, despite the growing body of literature classified as risk management. In terms of quantitative work, substantial progress has been made. The basic principles of risk management are simple but lend themselves to elegant theories where data and process can be brought together in specialist niches.

Similarly, there is a growing body of methodologies and case studies, which demonstrate how various risk management approaches can be used to bring structure to the management of operational risk. This is in response to the mounting appreciation of the value that systematic management of risk provides, even in areas where reliable quantitative data does not exist.

Risk management has been recognised as a valuable discipline within various activities for some time, even if different terminology has been used. These range from nuclear energy to policing initiatives. A particularly strong tradition has developed in areas where there is sufficiently reliable data to use mathematics to produce useful quantitative analysis. Momentum has been building in applying the same principles in operational risk management, where data is less reliable or is unavailable, and subjective judgement is used to provide more qualitative assessments.

While there has been steady progress in areas such as environmental care, various events around the world have accelerated the use of a systematic approach to the management of potential future events. In the United States the loss of the *Challenger* space vehicle and collapse of thrifts had an impact; in New Zealand it was the collapse of the scenic *Cave Creek* viewing platform. While these events were sufficiently shocking at a national level to promote the advent of recognised operational risk management processes, at an organisation level localised shocks caused similar demands to put risk management systems in place. This is particularly true of health and safety systems.

With the rising awareness and recognition of operational risk management as such, various generic standards were published. These have been successful in providing a reference against which individual organisations can compare their own methodologies. The Australian/New Zealand Risk Management Standard is one example. First published in 1995, it was revised in 1999 to incorporate some of the communication aspects highlighted in the Canadian standard. This advancement has been reflected in ancillary aspects of risk management, for example in the management of governance risks through the Treadway Commission - Blue Ribbon Report process in the United States of America, King recommendations in South Africa, and Cadbury-Hampel process in the United Kingdom.

A major feature of operational risk management as it is used by line managers in both private and public sector organisations (rather than vocational specialists) is the degree of judgement involved. Usually the critical factor in being a good manager of risks for these decision-makers is not the *rational* reason for dong one thing rather than another but how each choice is *felt*. In the absence of complete or reliable quantitative data, and under time pressure, they resort to using intuition to evaluate cause and effect. This is done instinctively rather than intellectually, so that emotions indicate when an ex ante decision is right, wrong or in some grey zone of doubt.

It is increasingly recognised that a systematic evaluation process will improve on that approach. Methodologies based on the same principles outlined in the AS/NZS Risk Standard show in better perspective the risks and opportunities facing organisations.

Key Features of Current Operational Risk Management Practice

- *Complexity.* The rate of change in technology, relative competence and environment makes it too expensive and cumbersome to quantify all relevant variables to any great depth. Operational risk management tends to use only simplistic mathematical modelling, since assigning more detailed values quickly becomes arbitrary and the results misleading through unsubstantiated pretensions of accuracy. For example, a car manufacturer could compare precise monetary values on potential legal claims if it continues to install petrol tanks knowing that they are likely to

explode in an accident, against costs to retool production, yet discount a vague figure for loss of reputation, which could eventually be catastrophic.

- *Judgement.* Due to incomplete and imprecise data, the screens that filter information into the knowledge used to make decisions inevitably skew interpretations to fit the organisational model. An organisation that is driven by technocrats to making sound ecological decisions for the disposal of obsolete plant could be badly wrong-footed if it ignores an emotive campaign waged by ecological activists. For this reason, the filters need to be made explicit and recognised as such. Organisational custom and practice, the 'tone at the top' and ethical norms will shape interpretation of the environment and potential events.

Risks and opportunities are therefore subjective, making operational risk management inherently imprecise. The situation is compounded because events are not often well documented. Key players tend to move on, and managing the ramifications of an event takes precedence over analysing the causes

- *Extrapolation is dangerous.* Probabilistic uncertainty remains high when managing operational risks. As Heraclitus noted, "Everything flows and nothing stays… you can't step twice into the same river". Twenty-six centuries on, organisational rivers flow a little quicker than they did in his time. Even in the public sector, organisational and environmental dynamics render past experience as no more than an indication of future interactions.

- *Operational risk is idiosyncratic and situational.* A risk management system, which works well in one organisation, industry or sector, will not necessarily work well in another. Analytical perspectives and filters will be different, as will data sources. In addition the impact of externalities will have varying impacts on different organisations e.g. a change of government philosophy regarding import tariffs will impact Customs, importers and retailers in different ways and to different degrees.

Where possible, managers of operational risk will use quantitative assessment, but the balance is by necessity skewed towards non-quantitative methods. Translating qualitative assessment into quantitative form allows clearer identification and setting of relative priorities in the treatment of risks and opportunities. Giving judgements consistent values and making the judgements explicit makes the risk assessment process more transparent, and introduces some robustness into what can be an otherwise arcane process. The danger is that the mathematical veneer can be mistaken for something more substantial, when in reality it is merely a crude conceptual tool with which to handle incompatible data.

Assessing operational risk can be compared in some ways to the study of Black Holes. Specific data is unavailable about the actual phenomenon itself, but an

indication of what goes on can be gleaned by the behaviour of variables on the periphery. By using deductive reasoning to assess the risks and opportunities, decisions can be made about the most appropriate treatment to mitigate risk and realise opportunities which have a high probability of occurring. It is more probable that adverse events will occur where there has been unsystematic assessment of the latent conditions leading to the event.

However, it has to be acknowledged that the very uncertainty of the operational environment will occasionally cause adverse events to arise from extremely unlikely aberrations. Risk assessment uses assumptions to gauge probabilities, not certainties. For this reason risk-averse managers will tend to mitigate the risk that procedures will fail to treat latent risk appropriately; in other words invest in 'fail-safe' systems that other managers consider redundant.

Risk Appetite

The appetite for risk can be determined in a less ad hoc fashion. Appetite for risk is the point of balance between risk and reward at which a decision-maker feels most comfortable. Being consciously aware and explicit about that point is the necessary first step in the management of risk. In the absence of a simple model, it can be difficult for a decision-maker to describe or explain adequately why some risks are accepted and some opportunities are rejected. Being specific, explicit and providing a reference point allows much greater order in the assessment of potential events. It also provides for greater understanding of the action taken to mitigate risks and realise potential.

Observations About Management Behaviour

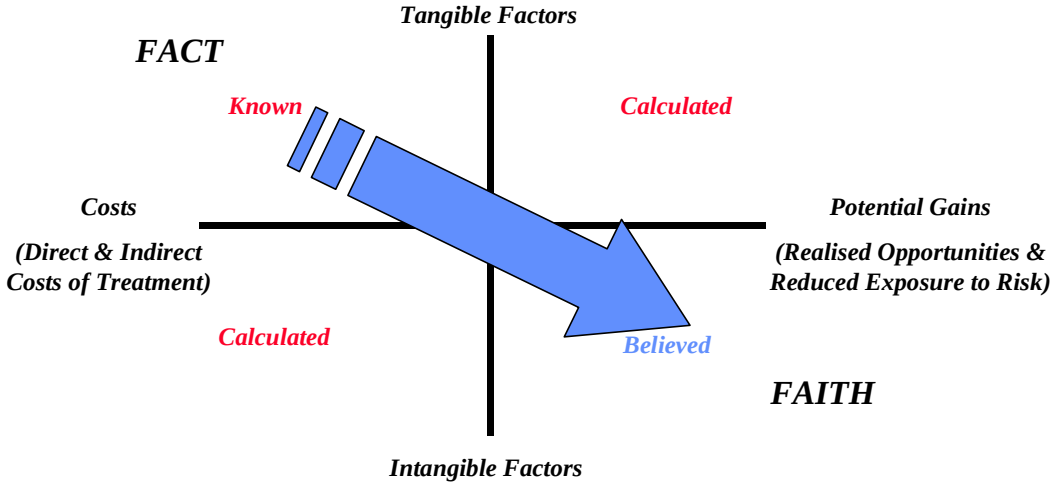
In managing operational risks and opportunities, managers deal with tangible and intangible factors. They manipulate these factors wittingly or unwittingly to trade risk against reward according to their own risk appetite. Tangible factors are by definition easier to measure and are easily identified as costs. For example, the costs of data base processing are straightforward calculations, whether for potential reward (such as direct mail advertising) or to reduce risk (screening for patterns of fraud in credit card usage).

Intangible factors are less easy to identify and reduce to a value that can be compared with tangible costs (e.g. staff morale and credibility with customers). Due to the lack of direct measures, any measures are used are tangible proxies to estimate the value of intangible factors (e.g. comparing sales of Coca-Cola against cola to derive brand value) – although the number of extraneous variables can make the results very debatable. Such “Black Hole” calculations are unsatisfactory, but are increasingly necessary, given the shifting premium afforded to tangible factors.

The astonishing value of .com shares is not entirely irrational, even if it is highly contentious. It just reflects what has been happening in the area of ‘goodwill’ in apparently physical sectors. BMW stresses its technological expertise and innovation as support for extracting value out of abstract, conceptual benefits such as prestige, membership of an exclusive club and ‘the driving experience’. For ‘luxury’ goods not necessary to sustain life, physical characteristics give way to abstract perceptions to achieve higher value.

Those people managing operational risk usually have to do so without all the information they would like, with less time for consideration than they would prefer. Tangible factors (mainly costs) are easier to grasp, require less defence in their presentation and can be considered with a good deal of certainty. Conversely, intangible factors are contentious and difficult to quantify. Given that risks and rewards lie in the uncertain future, but costs begin in the present, there is an inherent bias for managers to stay within a least cost / wait-and-see ‘operating zone’.

Knowledge Profile Underlying an Organisation's Appetite for Risk



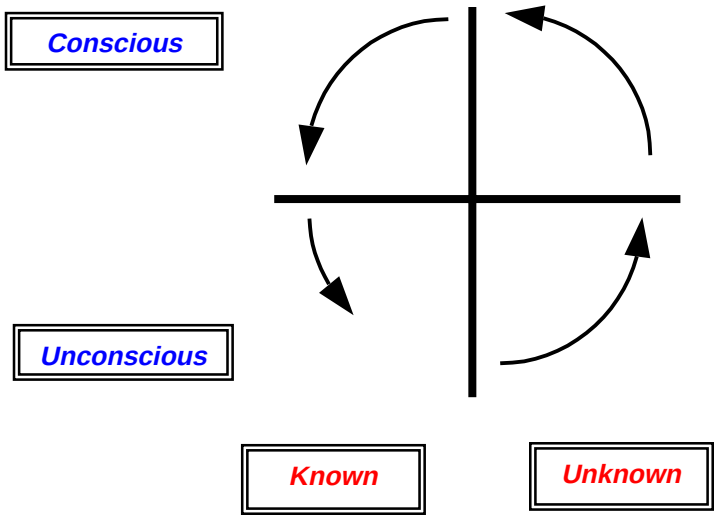
As a broad generalisation, managers of operational risk find themselves facing tangible and cost factors that are known, or can be calculated. Potential gains are at best only highly probable. Tangible gains can to some extent be calculated, but the gains in intangibles are not only uncertain but also ephemeral. The rewards therefore need to be highly lucrative or easy to defend relative to costs before the appetite for risk will allow action to be taken on faith.

For example, the direct costs of setting up a statistically significant audit of insurance fraud are known (computing power required). Indirect costs are also known (hiring new staff to take over the duties of staff transferred to audit duties). Intangible costs to some extent can be calculated (the drop in productivity attributable to staff unrest caused by a perception that clients are somehow being unfairly treated). Tangible gains can be calculated (tighter focusing of investigations to yield better returns). All of these things can be weighed up relatively easily. However, one of the most useful long-term effects of an audit sample is accurate knowledge about offending patterns and the dissuasive impact on potential offenders. As a result, unless the tangible benefits can be calculated to outweigh the known and calculated costs involved by a clear margin, the decision-maker has to have sufficient faith that the programme will yield sufficient intangible benefits to go ahead.

While this might be acceptable to a brand manager comfortable dealing with images and perceptions, it is very unattractive to public sector agencies. Furthermore, many organisations have long institutional memories of unpleasant intangible costs associated with a course of action. In these cases, faith in the opportunity on offer has to be almost evangelical before a manager will take the risk.

Line managers are paid for their judgement in managing the shifting dynamics of tangible and intangible risks and rewards. While they can be reasonably assumed to have a good understanding of the tangible factors influencing their organisations, there is some doubt that they have the time, inclination or training

to cope with intangibles on an unsystematic basis. In other words, there is a danger of not appreciating what one doesn't know (i.e. intangibles). To take advantage of opportunities and to anticipate exposure to risks, systematic reflection is increasingly recognised as necessary. This is recognised by the more widespread practice of operational risk management. Initially operational risk management is of necessity iterative, but it does provide a foundation for more precision and rigour in the management of an organisation.



Using a common psychological model of learning gives another perspective to illustrate the same points, using as an example the appointment of a new personnel manager into a stevedoring company.

In the absence of an explicit operational risk management process, the personnel manager is initially not conscious or aware of the risks to which she is exposed and the potential opportunities available. She develops the knowledge to manage risks and opportunities as the learning cycle progresses. As she becomes aware of the situation, she will become conscious of things that she knows little about, but which have an impact on achieving her tasks – such as the 'pecking order' amongst crane drivers, stevedores, packers and wharfside workers. During the third phase, she will become aware of what she needs to know, and practise that knowledge consciously – protocols for addressing workers, when to involve union representatives, and so on. Finally, once conversant, the knowledge is practised unconsciously and she will know "intuitively" the best way to get an agreement.

This cycle of learning in relation to operational risk management is not often articulated. This means that the process is longer than it needs to be, and individuals gain the knowledge rather than the host organisation. Since the risk management knowledge is not articulated, it is not codified nor is it transparent. Consequently, when operational variables change, the assumptions and

processes used by a decision-maker may be aligned with the past rather than the present.

Drivers

The forces driving things to happen in organisations are changing. Listed below are some of the changes to the way that different facets take organisational power directly and transmit momentum to other parts.

Mature	Organisational Facet	Fresh
Functional silos, hierarchy	*Structure*	Fluid, cross-functional teams
Direction	*Working environment*	'empowerment'
Undifferentiated mass production	*Scale*	Mass customisation
Input unit costs	*Emphasis*	Customer value outcomes
Tangibles	*High value production factors*	Intangibles
Loyalty, seniority	*Rewarded human value*	Skills, performance
Centralised	*Technology*	Distributed

The changes reflect the imperative to focus resources to maximum effect; to gain higher value return on investments (which is measured more and more abstract terms such as convenience and status). This means flexibility, responsiveness, anticipation and targeted specificity in delivery of goods and services.

Given the difficulties of measuring currently unmeasurable values, decisions are taken on judgement and intuition. Unfortunately, where metrics are introduced, their introduction and presence in itself can cause a distortion. In the absence of a systematic assessment of the risks, opportunities, priorities and appropriate treatment, there is a danger that decisions will be taken with an increasingly poor appreciation of the organisational ramifications. Many companies are plagued, for example, by marketing divisions that launch products for which their colleagues in operations are ill-informed and unprepared. A promotion is launched, the telephones go mad – and customers wait twenty minutes to speak to frazzled customer service agents who know little about the new product.

As a result, operational risk management methods and techniques have been introduced as tools to help guide those who take decisions at any level of an organisation. This ranges from a salesman in a car yard “knowing” when to let a prospective customer test drive a $100,000 car, to fire fighters knowing which intervention to choose when a toddler’s life is at stake.

The rest of the paper uses a simple framework to look at some aspects of the forces underpinning these methods and techniques.

PART II: THE KNOWLEDGE PRODUCTION FUNCTION

The first part of the framework follows Max Boisot's model of the production function[1] in which he describes how knowledge minimises an organisation's consumption of energy, space and time for a given amount of effort.

Key Factors

The key factors in the knowledge production function are defined as follows:

- ***Data*** *is a property of things*.
  A distinction between physical states, which may or may not convey information to an agent, depends on the agent's knowledge capacity to distil the data into information.

- ***Information*** *is selected and re-arranged data*.
  Information effectively establishes a relationship between things and agents; it is that part of the data residing in things that sets an agent in motion, having been filtered by the agent's perceptual or conceptual apparatus.

- ***Knowledge*** *builds on information that is taken out of data*.
  Knowledge is a property of agents inclining them to act in particular circumstances. Knowledge cannot be directly observed, but it can be viewed as a set of probability distributions held by an agent, which orient the agent's subsequent actions.

When a knowledgeable person does not explicitly articulate his knowledge, his actions seem to be intuitive – by instinct or 'sixth sense'. Many successful entrepreneurs have learnt how to take data, rearrange it, and use their appreciation of the context to make profitable deals. The same can happen with teams.

Failing to make knowledge explicit means that it can be lost when the individual (or group) is no longer available in person. No-one is now sure how the pyramids were built with such precision, for example. The knowledge can also become redundant or become inflexible 'received wisdom'. Unlike intuition the knowledge may be explicit, but it becomes irrelevant because the data-information-knowledge relationships are allowed to ossify.

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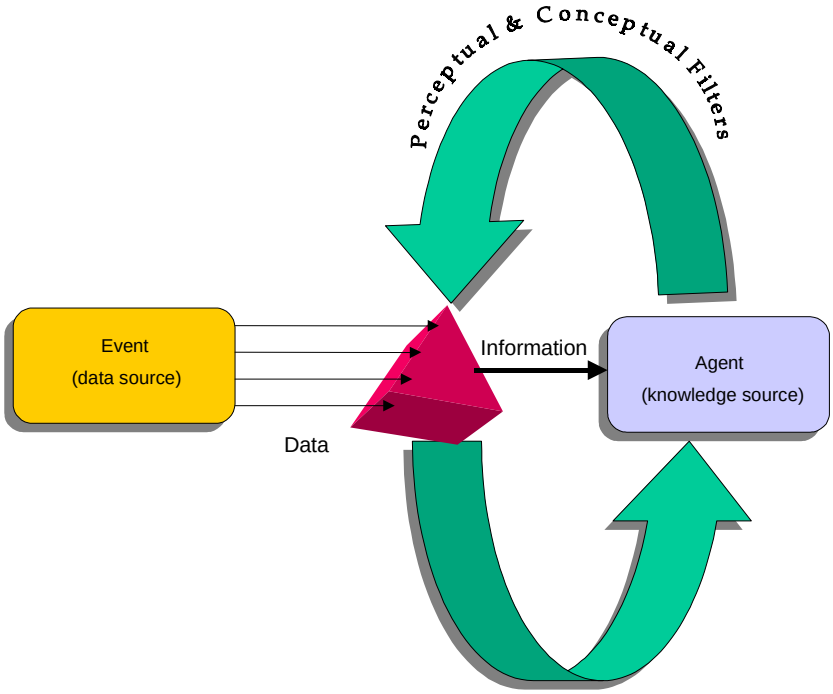
1 Boisot (1998)

Model of Knowledge Use and Formation

The knowledge to manage operational risks is often held by agents and organisations insensibly. The interpretative information screens used to sift operational data are therefore shaped unconsciously, as new information arrives to either consolidate or modify implicit probability distributions. Risk management knowledge builds up over time to guide the reduction of exposure and realisation of opportunities, while simultaneously economising on the consumption of physical resources.

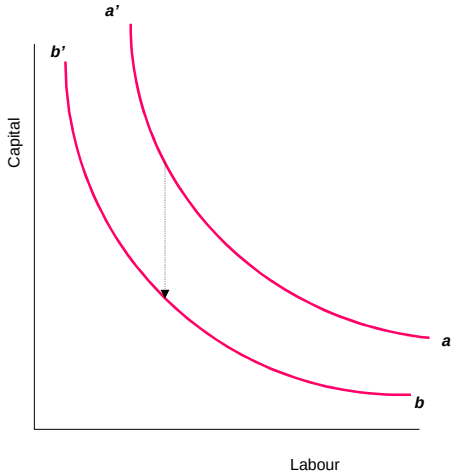
As an example, a soldier on peacekeeping duties see an explosion (an event) and provides details (data) to an Intelligence Officer, who uses specific and general techniques (perceptual and conceptual filters) to provide a situation assessment (information) to the Commanding Officer (Agent), who then decides what risks and opportunities are latent, and what action should be taken.



Given that codification and abstraction reduces the costs of converting potentially useable knowledge into knowledge assets, then allowing operational risk management to work in a covert, intuitive fashion is inefficient. If the existence and nature of knowledge can only be inferred from the action of agents, then knowledge assets have to be understood in a roundabout way. In short, making operational risk management explicit is an important step towards better effectiveness and efficiency in running an organisation. This applies not only to the techniques and methodologies applied to operational risk management, but also to the theory underpinning them.

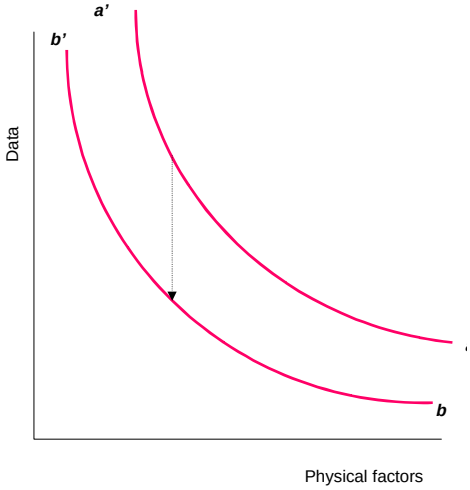
Evolutionary Production Function

Using capital and labour as traditional factors of production, curves ***aa'*** and ***bb'*** indicate the different mixes of treatment which can be applied to reduce exposure to risk (or alternatively, realise opportunity). Moving along either of the given curves gives the rate at which one factor can be substituted for another.



Applied to operational risk management, technical progress acts to reduce the quantity of capital and/or labour to achieve a given level of risk exposure (or realise a given level of opportunity). This shifts the curve towards the origin, from ***aa'*** to ***bb'*** – an exogenously given discontinuity.

However, following Boisot, it can be assumed that factors of production such as labour and capital can be decomposed into entities possessing both physical and information attributes. Information attributes have the capacity to modify the behaviour of physical attributes, and hence decrease their rate of consumption for a given benefit.



These information attributes and the knowledge capacity to manipulate them are becoming increasingly valuable[2]. Boisot goes on to separately abstract physical and information attributes from the factors of a conventional production function to describe an evolutionary production function. Using this model, data about operational risks and opportunities provides the raw material for information, so that the judgement decision-makers possess (knowledge assets) can be modified appropriately. The knowledge assets dispose the decision-makers to act in a particular way. Risk management methodologies and techniques help shape the knowledge assets possessed by individuals, and to build up the knowledge assets of the organisation. The methodologies and techniques act as information filters, which economise on the consumption and processing of data.

Irrespective of an organisational risk management system being in place, the judgement of decision-makers emerges as a valuable knowledge asset for which the individual is rewarded. However, without an explicit system of capturing the knowledge, those assets are seldom recognised as such and

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2 See for example K Sveiby "Managing Know How" (1987) and G von Krogh "Knowing in Firms" (1998)

even less frequently captured systematically into the host organisation's institutional memory.

Boisot's evolutionary production function offers two insights into the management of operational risk.

Trade-Offs

The first is that there is a trade-off between consumption of data and consumption of physical resources, (shown in the above diagram by moving up the curve ***aa'***). Two simple examples are the use of Collators on major police investigations, and Account Managers in consultancies who enable more focused use of professionals to solve crime and sell services respectively.

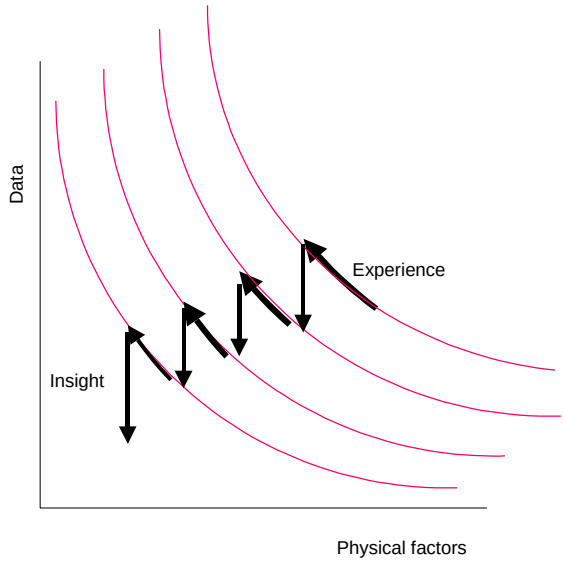
The second is that as organisations evolve, the trade-off between physical and information inputs is asymmetrical, having a tendency to shift towards increasing the processing and consumption of data. A process of differentiation, integration, and creation of memory-models do this. Where these remain implicit in the realm of operational risk management, the working of this evolutionary production function is less efficient than where the models are explicit.

Even if it were entirely efficient, the management of operational risk would still require some element of physical resource. Furthermore, decision-makers confront the need to economise on the consumption of data as well as physical resources. Filtering information from the data, and discarding the remaining data (represented here by the discontinuous jump down from one curve to another closer to the origin) does this.

Decision-makers, as managers of operational risk and opportunity intuitively look for the regularities that suggest patterns. Once a pattern is discerned, the need to deal directly with the data is largely for verification only. The focus consequently shifts from data to pattern – focus is much sharper when screening filters, information and knowledge are made explicit and subject robust examination.

Differentiating between risk and opportunity priorities can be achieved by insights which reduce the amount of data and physical resources by jumping to a curve closer to the origin. It can also be done by substituting data for physical resources i.e. an upward and leftward shift on the ***aa'*** transformation curve.

Mirroring technical change in the more conventional production function, the data-economising process is characterised by



discontinuities (as is the knowledge to which it gives rise). The potential for endogenous discontinuity is therefore an inherent feature of operational risk management systems, whether the system is explicit or implicit. It is obviously easier to realise that potential when the system is made explicit. A given insight will reduce data handling, the weight on the system's recall and the load on data exchange. An insight however cannot be predicted from a prior knowledge of the data to be processed or the characteristics of the data processing agent. Paradoxically therefore, an operational risk management system that is working well tends to pursue a discontinuous, unpredictable course.

Over the last five years operational risk management have provided sound models to guide the extraction of information from data in a methodical, codified fashion. However, even leading methodologies such as AS/NZS 4360:1999 do not deal with abstraction in building up the knowledge assets that result.

What is generally inferred in the methodologies is that there exists a direction to the technical change (unlike traditional production functions), in that over time the trade-off between factors will usually favour the use of data over physical resources. The knowledge assets used to manage risks are generated as data accumulates, interpretative models are improved (moving productive activity upwards and to the left) and insights occur (dropping productive activity vertically downwards to another curve as better information is dug out of the data). This assumes that the knowledge assets develop in such a way that they yield a net gain, given that the operational context is dynamic and so liable to make some aspect of the knowledge asset redundant as the relative value of risks, opportunities and treatment costs fluctuate.

The starting point for the implicit, intuitive risk management process used by most operational decision-makers is accumulation of tacit, experiential knowledge. This ability to absorb complexity is controlled by individuals within an organisation. In the absence of a coherent process, such knowledge can only be articulated and communicated with difficulty.

At the most basic level the absence of commonly understood terminology will lead to confusion. Knowledge remaining in the heads of individuals makes its value to, and existence within, an organisation, precarious.

For this reason, it is better for organisations to invest in the expression of knowledge and to reduce complexity, rather than to allow a risk management system to revert to the natural status quo (i.e. the absorption of complexity and the concomitant accumulation of tacit knowledge). This can be seen in the way that mechanical diagnosis has been 'built-in' to modern cars, so that the value of remedial actions is retained and used not only to reduce exposure to breakdown risks, but also to realise latent design opportunities.

Where operational risk is managed implicitly, the knowledge assets, which determine the management of operational risk, are not as appropriable as physical assets. The more widely organisations rely on implicit knowledge

assets to manage operational risk, the more difficult it is to capture and retain whatever value is created. Even in the public sector this is a concern. For the private sector this suggests that it will be difficult to defend the return from any competitive advantage brought from advanced operational risk management.

Learning and Insight

To summarise, the knowledge assets emerging in risk management are the product of both moving up the learning curve, and of insight. Insight is triggered by empirical data, and in return insight provides a base from which to improve the type of data collected. Making explicit the development of operational risk management knowledge allows faster incorporation of useful data within the information structures created by insight; it also quickens the consequent shedding of excess data by enabling selective purges of redundant data. This has the effect of reducing complexity, creating fresh capacity for further improvements and insights. The types of models that can be built using this approach include credit scoring for bank loans.

When operational risk management is left as an intuitive process, the rate of progress along the curve is limited to the capacity of individuals. This is because the organisation does not systematically collect, collate or share individuals' experience. When users are educated and acquire experience in a shared, transparent process then upward movement along the learning curve is hastened.

Introducing systematic risk assessment is not without drawbacks. A standard pattern of risk assessment and management will tend to emerge as performance improvements occur around those features that are most valued. Initially, the standardisation process moves in relatively large insight leaps downward from one experience curve to the next. The insights also stimulate progress along each curve, which in turn leads to further insights. Data complexity is reduced and factor savings result, but the closer the improvements come to the origin, the more constraining structures and standards become. Hence, once established, risk management systems can ossify if it becomes accepted wisdom that optimal treatment has been determined.

As previously discussed, the context in which knowledge assets develop is continually changing, so that a good operational risk management process must take care to steer between reducing complexity in the amount and nature of data that is processed, and absorbing complexity in the information screens that filter the data which feeds it.

Logically, organisations should choose to invest in the means to articulate and capture knowledge so that it can be shared and used to facilitate good operational risk management. Investment in operational risk management however, is inherently skewed towards the alternative, which is to allow knowledge to remain tacit, and to enhance the ability of individuals to cope with higher levels of complexity. This is examined in the next section.

PART III: INVESTMENT TO MINIMISE RISK AND REALISE OPPORTUNITY

This part of the framework follows Dixit & Pindyck in their work on investment[3] and applies their reasoning to operational risk.

Risk and Opportunity "Options"

Dixit & Pindyck assert that the value of a risk must exceed the purchase and installation cost of the action necessary to treat it appropriately, i.e. by an amount equal to the value of keeping the investment option alive. The opportunity cost of investing in the treatment can be large; and the opportunity cost is sensitive to uncertainty over the future value of the investment undertaken.

It follows that there is an incentive to pay an exercise price for holding a risk or opportunity in abeyance rather than treating it, since exercising the treatment option is at least partially irreversible. The option to invest is valuable in itself, because the potential realisation of an opportunity or a risk is uncertain. If the value of the risk exposure or opportunity reward rises, the net value of investment in the treatment rises accordingly – and vice versa. If the situation remains unclear, the organisation need not invest to the full extent and will suffer only the cost necessary to obtain deferral of the investment decision.

The cost of postponement must be assessed against the costs imposed by a realised risk or missed opportunity. Doing little or nothing is a valid choice, which is rational if considered assessment is made of the likelihood and impact of a potential event.

In the absence of clear parameters and data to populate such a rational model, it could be argued that the value of a manager lies in the judgement to "know" when, and how much, to invest in the treatment of each risk and opportunity. This is particularly true in relation to real and anticipated changes in the relative values of treatment cost, opportunity and risk.

> "Most investment decisions share three important characteristics in varying degrees.
>
> 1. First, the investment is partially or completely *irreversible*. In other words, the initial cost of the investment is at least partially sunk; you cannot recover it all should you change your mind.
> 2. Second, there is *uncertainty* over the future rewards from the investment. The best you can do is assess the probabilities of the alternative outcomes that can mean greater profit (or loss) for your venture.
> 3. Third, you have some leeway over the *timing* of your investment. You can postpone action to get more information (but never, of course, complete certainty) about the future."[4]

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3 Dixit & Pindyck (1994)

Since the option value increases with the sunk cost of an investment and with the degree of uncertainty over future prices, the opportunity cost of the action chosen to treat a risk is a significant part of an investment decision.

The nature and degree of uncertainty over future costs will have a significant effect on the treatment decision. The higher the degree of uncertainty, the more valuable becomes the freedom not to invest if the treatment price goes up. Often, action such as organisational restructuring takes place in several phases but uncertainty pertains to the total cost of the investment. Information will be revealed after the first few steps of the project are undertaken, so the pilot or proving stages have value above that suggested by traditional net present value calculations.

Finally, the value of greater flexibility provided by a small scale investment might offset the economy of scale advantage enjoyed by a larger investment. This is a particularly appealing notion if it is accepted that those managing operational risks and opportunities have a low risk appetite and follow a wait-and-see approach.

In summary, operational risk management involves sunk costs; each decision must be made in an uncertain environment, and each choice allows some freedom of timing. Consequently there will be a full commitment to mitigation of risk, or realisation of an opportunity until one of two conditions occurs. The first is that the value of the marginal output of the investment is perceived to be sufficiently above the cost. The second is that the required margin or multiple above the resource cost is higher than the value of the sunk cost and / or the uncertainty of the outcome.

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4 *Investment Under Uncertainty*, Dixit & Pindyck, p.3

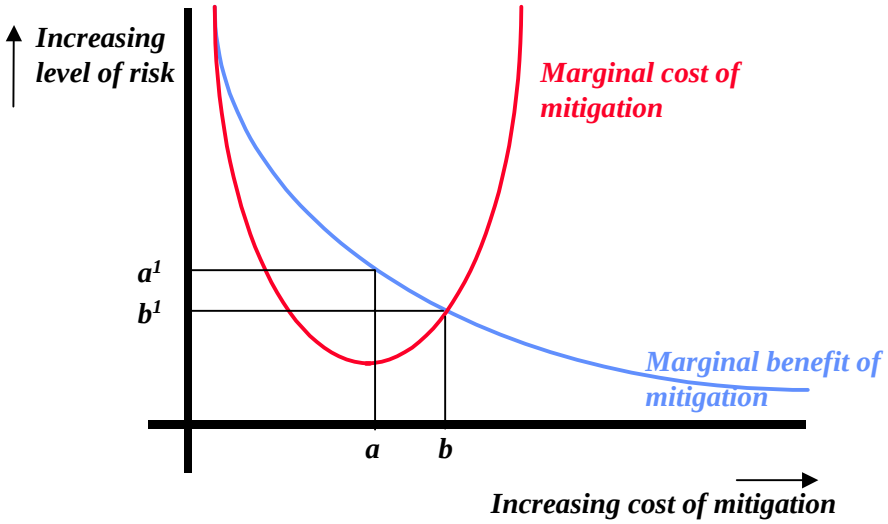
PART IV: ECONOMIC FRAMEWORK

Optimising Exposure to Risk

For any organisation it should be remembered that the costs are not only direct, (such as contracting in skilled assistance), but also indirect and intangible, (such as damaging staff morale by diverting resources promised to one team to another team so that an opportunity can be realised elsewhere). Managers have to set and justify priorities by some basis. This is more easily done if the decision-making model is specific, logical and transparent.

This is the final part of the framework. It proposes a simple economic model of the trade-offs made between risk and opportunity to run an efficient and effective organisation.

Optimising Exposure to Risk



aa¹ : optimal efficiency
bb¹ : point of diminishing returns

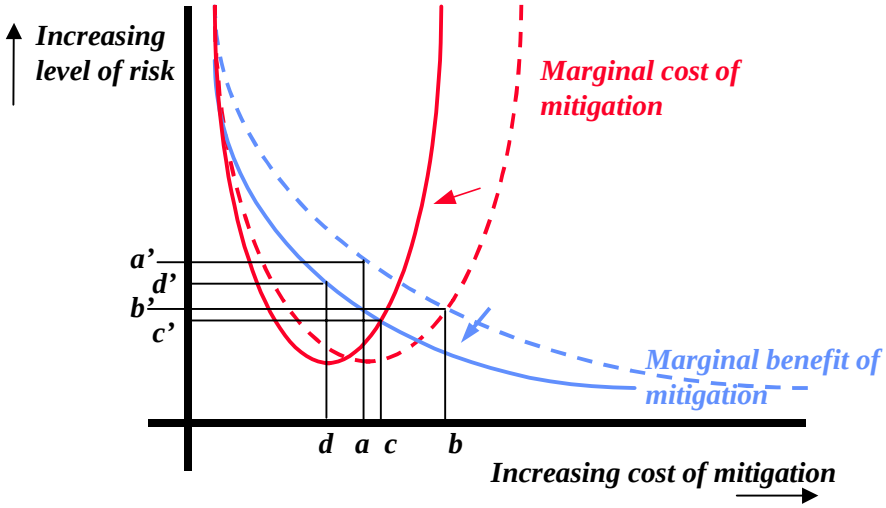
The marginal benefit of mitigation is described by a curve representing the decreasing exposure to risk as increasing resources are allocated to treat the risk. Exposure to risk can be tangible with a specific monetary value (e.g. a ship sinking), intangible with an inestimable monetary value (e.g. loss of a government agency's credibility with a Minister), or some combination of the two. Likewise, mitigation costs can be tangible, intangible, with a specific or uncertain monetary value.

The model proposes that the marginal cost of mitigation decreases as economies of scale occur, until such time ***a*** that each additional unit of treatment is more expensive than the last. This occurs commonly with re-writes of policy advice in government agencies.

In these circumstances, it can be argued that there are two logical points at which investment in mitigation treatment should be made. The first, ***aa'*** provides for the most efficient return on investment. The second, at ***bb'***, is at the point of diminishing returns, beyond which the additional resources allocated to treat the risk yield less return in reduction in exposure than value expended.

"Good" management of operational risk can therefore be said to lie somewhere in the region of ***ab*** investment in mitigation.

Shifting the Optimal Point of Exposure to Risk



Simultaneously improving the marginal benefit of mitigation (e.g. improving workforce skills at constant labour rates) and shifting the marginal cost of mitigation (e.g. changing the conditions for insurance cover) combines to offer a range of choice in how to take the better return on investment. This ranges from a reduction in exposure of ***b'c'*** at the point of diminishing return (still allowing ***cb*** reduction in treatment cost); to a reduction in treatment cost of ***ad*** at the point of optimal efficiency (still allowing ***a'd'*** reduction in exposure)

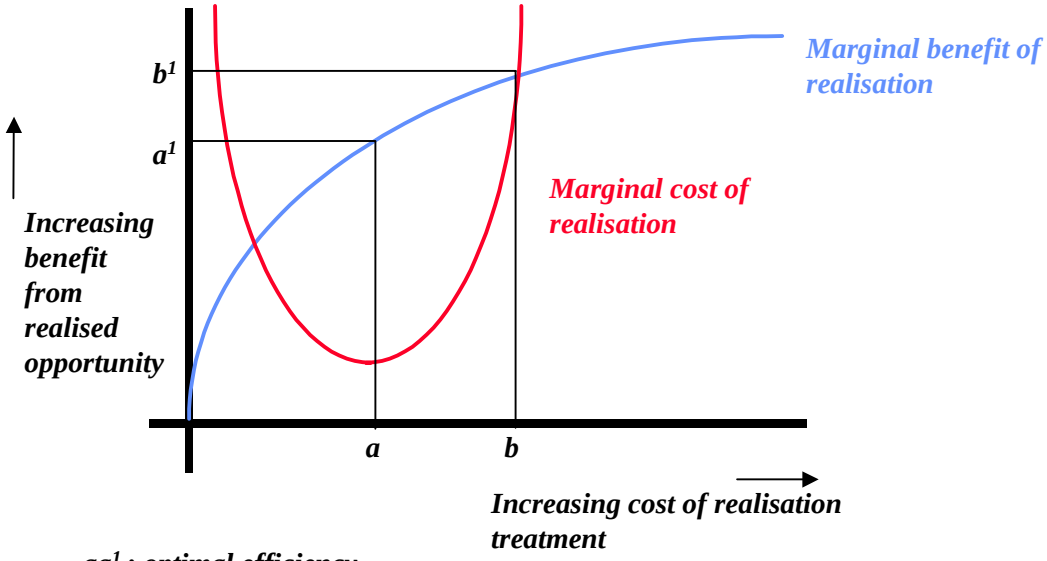
Optimising the Realisation of Opportunity

Risk and opportunity lie at opposite ends of the operational spectrum. While the same forces are present, the opportunity model can be shown to work in a different fashion.

At the most basic level, it is necessary to effect some level of investment in the action (treatment) necessary to realise latent opportunities. This can be tangible, (installing hot dog stands at a new football stadium), or intangible, (devising a new training policy to suit workers recruited into a new factory).

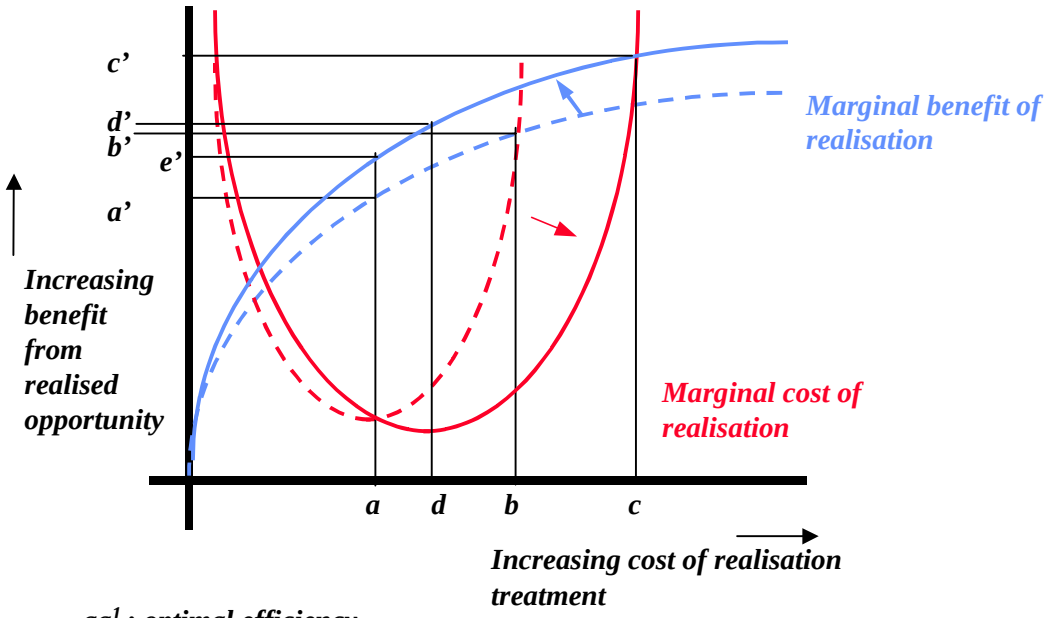
Each additional unit of investment will initially yield an increasing amount of realised opportunity, but this will gradually diminish as it becomes more difficult to realise value latent in available opportunities. At the same time, the marginal cost of realisation will initially fall through economies of scale, but start to rise past a critical point due to the inefficiencies of crowding out. As with risk, the decision maker is faced with a choice as to which point to target investment – ***aa'*** where marginal benefit and marginal cost are furthest apart, or ***bb'***; beyond which the marginal cost is greater than the marginal benefit.

Optimising the Realisation of Opportunity



aa^1 : optimal efficiency
bb^1 : point of diminishing returns

Shifting the Optimal Point of Realising Opportunity



aa¹ : optimal efficiency
bb¹ : point of diminishing returns

Opportunity faces the operation decision-maker with different dynamics, however. Taking steps to improve the marginal cost curve by shifting it to the right, and increasing the yield on each unit of investment at the margin, has the effect of incurring additional cost in realising additional marginal benefit at the point of diminishing returns. In other words, shifting from bb' to ***cc'*** realises ***b'c'*** more opportunity, but requires ***bc*** more investment. Continuing to operate at the point of optimal efficiency, moving from ***aa'*** to ***dd'*** also incurs additional investment cost ***ad***, albeit for the gain ***a'd'*** in realised opportunity.

Given the bias towards minimising investment costs in preference to making the most of opportunities, it becomes rational for decision-makers to leave investment cost structure alone, and to concentrate on realising more opportunity for each unit of investment. This means remaining at ***a*** investment levels, but seeking ***ae'*** additional realised opportunity.

Further Considerations

The task of optimising exposure to risk and realising opportunity risk is complicated by further considerations; not least of which is that treatment factors tend to be lumpy. As noted earlier, the tendency is to minimise investment costs. Tangible factors have a known cost which is resisted overtly (e.g. funding for a computer programme), and intangible factors are resisted covertly (e.g. dissipating officially-dedicated senior management time to promote ethical standards).

The operational environment has an infinite variety of possible dimensions and rates of change in which it can move. Assigning probabilities to the future shape of the operating environment at any point in the future is at best educated guesswork. This means that what is perceived to be appropriate treatment of potential opportunities and risks must, to some extent, be reactively triggered. This has implications for decision-makers dealing with operational risk:

a) Speed in adjusting treatment is important, not of itself, but to minimise the lag between the change in opportunity or risk and the most effective and efficient way of treating them.

b) Flexibility of treatment is vital. The situation is analogous to pilots of modern 'fly-by-wire' jets having to rely on computer systems to cope with the volume and speed of data flow. It means that the underlying systems must be reliable with built in 'fail-safe' systems to avoid disaster.

c) Anticipation of appropriate treatment actions is a cost-saving advantage.

Explicit knowledge about risks and opportunities is a key feature of advanced operational risk management. It recognises that:

- good data collection is essential for efficiency;
- systematic collation is required to allow sound judgement in the setting of priorities; and
- astute analysis must be available to provide insight and anticipation.

Awareness of the factors underlying operational risk management practice will help those managing operational risks to take better decisions. In particular, it will help them build up the institutional knowledge assets to:

a) Know and focus on key risks and opportunities.

b) Know and understand the effectiveness of the available treatment options.

c) Be efficient in applying the selected treatment options, including exercising the 'waiting' option.

CONCLUSION

The framework presented looks at the features underlying operational risk management. It provides different perspectives to see where the costs incurred by an organisation to manage its risks and opportunities are at their lowest, and where the potential to realise opportunities is greatest.

Management of operational risk is best done through the systematic assessment and treatment of the trade-offs between risk and opportunity. In doing so, the drivers of operational risk management need to be considered, as illustrated by some observed characteristics of operational risk management practice in the public and private sectors.

It is clear that an organisation's approach to operational risk management must be explicit if intangible risks and opportunities are to be well managed; and for knowledge assets in this area to be acquired and nurtured by the organisation. It is also apparent that investment decisions on the treatment of risk exposure, and particularly in the realisation of opportunities, need to be made with a clear understanding of the drivers that tend to skew decisions towards minimising cost and risk rather than maximising opportunity.

Making the dynamics of operational risk management more transparent hinges on a) recognising the intangible factors involved and b) gauging the relative values of tangible and intangible factors. This is not easy.

Where it can be achieved, it allows more precise and better management of risks and opportunities. It also helps investment decisions to be made consciously and in alignment with the appetite for risk in each of the important dimensions of an organisation's operations.

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GLOSSARY OF TERMS

The following interpretations have been made for the purpose of this paper.

Risk appetite	The point of balance between risk and reward at which a decision-maker feels most comfortable.
Cost	Total price to be paid by an organisation (being the sum of direct and indirect, tangible and intangible charges).
Event	An incident or situation that has occurred.
Exposure (residual risk)	Risks remaining after risk treatments have been applied.
Impact	Realised potential of a risk or opportunity, i.e. the effect of an event or a potential event.
Inherent Risk	Risks intrinsic to a given situation prior to the application of any alleviating or aggravating treatment.
Likelihood	A value assigned to the probability or frequency with which a potential event is estimated to occur.
Operational Risk Management	The systematic assessment and management of the trade-offs made between risk and opportunity to run an efficient and effective organisation.
Opportunity	A potential event deemed to have a positive effect on an organisation. (Evaluated by estimating the combined impact and likelihood.)
Risk	A potential event deemed to have an adverse effect on an organisation. (Evaluated by estimating the combined impact and likelihood.)
Risk Assessment	A systematic process of analysis and evaluation of risks and opportunities.
Risk Management	The systematic and conscious understanding, organisation and treatment of risks and opportunities.
Sunk Cost	Costs which cannot be recovered when an organisation withdraws from providing a good or service
Residual Risk (exposure)	Risks remaining after risk treatments have been applied.
Treatment	Conscious action in relation to a risk or opportunity: ▪ ***Reject*** (walk away). ▪ ***Transfer*** (split the risk with another party*).* ▪ ***Accept*** (take the risks & opportunities as they come). ▪ ***Optimise*** (reconfigure strategy, operations, culture, etc. to maximise opportunity and/or minimise risk).
Uncertainty	Context in which an event occurs with some probability, the distribution of which is unknown