Risk Accounting: An Accounting Based Approach to Measuring Enterprise Risk and Risk Appetite

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Abstract

The resetting of the risk management agenda through successive capital accords has had little impact on the ability of many firms to prevent losses which raises concerns as to whether the risk calculation methods applied in the calibration of regulatory capital are fit for purpose. This has been the focus of recent public comment by global regulators, central bankers and industry commentators who suggest that excessively complex and flawed capital adequacy rules that rely on risk modeling techniques such as Value-at-Risk (VaR) were a contributing factor in the financial crisis.

We argue that the disclosure of an enterprise's financial condition and the concomitant determination of its capital adequacy must be a function of accounting rather than financial modelling. We further argue that if accounting is to fulfil this core function, the current practice of basing accounting on fair values must be adapted such that accounting is based on the risk exposures inherent in approved transactions. In this paper we demonstrate how this may be achieved by adding risk information to the existing management information that is attached to transactions upon their registration in accounting systems. The incremental risk information enables a calculation of risk-weighted transaction values that are accounted for using a new risk abstraction - the Risk Unit (RU). In this way a comprehensive risk management system is created that is tied to the financials of the enterprise.

We further demonstrate how risk accounting aligned with management accounting can produce a system of integrated risk and management reporting by, for example, group, organisation unit, product, customer and geography which, in turn, enables the risk appetite setting process to become an integral part of the enterprise's financial planning and budgeting cycle.

Over time, risk accounting outputs can be correlated with expected and actual losses thereby imparting a monetary value to the RU abstraction which can be used in the determination of regulatory capital requirements, the computation of risk adjusted return on capital (RAROC) and adjusting the betas in the capital asset pricing model (CAPM) thus bridging accounting with economic theory and risk management concepts.

Key words: Risk accounting, Basel II, Basel III, Risk measurement, Risk management, Operational risk, Enterprise risk, Risk appetite

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Introduction

This paper reports on the results of further research applied to the accounting based approach to measuring enterprise risk and risk appetite, referred to as risk accounting, elaborated by Hughes et al (2010)[1]. It assesses the relevance and viability of the proposed solution in the light of recent regulatory developments, validates the solution's operationality through the development of prototype software and the simulation of complex financial transactions and proposes potential applications of the method for regulatory capital calibration, computation of risk adjusted return on capital (RAROC) and adjusting the betas in the capital asset pricing model (CAPM).

A fundamental principle of risk management is that the basic framework comprising the setting of an institution's risk appetite, the determination of its capital requirement and the pricing of risk inherent in its financial products should be derived from a common risk measurement framework. If it is to be meaningful and effective, such a framework also requires a common unit of risk measurement to ensure its consistency and comparability across and between diverse operating environments and enterprises.

The lack of a common measurement framework for the determination of an institution's risk appetite represents a major problem for financial firms and their investors and regulators. Deloitte (2010)[2], when reporting the results of a survey of risk appetite-setting practices concluded, "A better understanding of risk appetite is needed... Defining, managing and monitoring risk appetite is key and a lynchpin to achieving targets set under the Walker Review and by the UK Financial Services Authority... Neither businesses nor the regulator have yet developed a clear model of how this is best done. It is arguably the most significant unsolved challenge arising for the market." KPMG (2008)[3] in an industry advisory paper also commented on the lack of a clear definition of risk appetite and basis of common measurement; "… organizations of all kinds and sizes are grappling with the concept of risk appetite… Thinking about risk appetite is often unclear, definitions are vague and contradictory and the gap between theory and practice is wide. Efforts to quantify risk appetite can sometimes produce an illusion of precision."

Risk appetite setting is analogous to a firm's financial planning and budgeting whereby related processes are connected through a common understanding of core methodologies, i.e. transfer pricing, unit costing, net-present-value of future costs and earnings, etc. and a common unit of measurement, that being monetary value in the firm's base currency. The absence of a similar set of core methodologies and common unit of measurement applied to risk appetite means that investors and regulators have no readily accessible, understandable and comparable set of measurement-based metrics through

[1] Hughes P, Grody AD, Toms S, 2010, *'Risk accounting - a next generation risk management system for financial institutions'*, The Capco Institute Journal of Financial Transformation, 29 (1): 43-56

[2] Deloitte, 2010, *'Risk Appetite Biggest Challenge for Financial Firms'*, http://www.risk.net/operational-risk-and-regulation/news/1591594/deloitte-risk-appetite-biggest-challenge-financial-firms, as accessed on 13/9/2011

[3] KPMG, 2008, *'Understanding and Articulating Risk Appetite'* http://www.kpmg.com/UK/en/IssuesAndInsights/ArticlesPublications/Documents/PDF/Advisory/193222_Understanding_Risk.pdf, as accessed on 13/9/2011

which they can determine whether a firm is taking on too much risk or how much risk has been taken on by one firm compared to others.

Financial products that contributed significantly to the recent financial crisis are typified by their inherent complexity which is generally a consequence of the multiplicity of operational and financial risks they trigger within the internal operating environment and relative to the external counterparties of the financial institutions that accept them. The effective management of enterprise-wide risk is inhibited by issues concerning the lack of techniques that can be validly applied in the quantification and aggregation of the various risk types (credit, market, liquidity, operational etc.) for pricing and capital allocation purposes. Products such as securitizations of primary assets and liabilities and further securitizations of already securitized asset backed securities such as collateralized debt obligations, credit card receivables et al are designed to distribute risk. It follows that if the risks inherent in these products are improperly calculated leading to the mispricing of risk, then the potential for inter-entity systemic risk contagion is created through the distribution of such products to investors and trading counterparties with embedded, unrealized potential losses.

Accounting practices are aimed at providing investors and other stakeholders with a static representation of an enterprise's financial condition. Thus, accounting has been more concerned with valuation than the prediction of the probability and severity of future losses that are likely to occur as market and macro-economic conditions change. This limits the usefulness of audited financial statements as there is limited assurance that they incorporate the profit and loss implications of accumulating risks. In recent years the accounting profession has attempted to address this situation by introducing accounting practices that recognise, in accounting terms, the loss potential inherent in financial products. For example, in the 1980s banks began to incorporate fair market valuations into their accounting through marking their trading positions to market values ('mark-to-market') and, more recently, marking such positions to financial models ('mark-to-model').

The Questions this Research Addresses

This research sets out to provide empirical evidence that the risk measurement system of risk accounting described in this paper is capable of providing a valuable solution to the problems of quantification, aggregation and measurement of risk exposures. The research aims can be summarised into four related sub-questions;

1. *Following a review of secondary literature regarding current risk quantification and accounting practices, what issues exist within current practices and is there a need for new techniques?*

The literature review used the recent financial crisis as a case study to highlight the importance of effective risk measurement and management. Following this, an analysis of the relevant literature surrounding current risk quantification and accounting techniques was conducted in order to highlight existing issues.

2. *Can the proposed risk accounting technique be used to compute internal and external capital market benchmark data that price risk rationally?*

The capital asset pricing model (CAPM) takes market data as its inputs and applies them to risk measurement and cost of capital formulations for individual firms. In contrast, risk accounting builds risk data from within the firm and computes risk measures based on the fundamental aspects of its activities.

3. *Using the risk accounting framework described in this paper, is it possible to create working software for this method?*

The aim here is to provide proof of concept software in the form of a prototype that validates the interactions between the various inputs and scorecards within the proposed risk measurement system of risk accounting. Although the resulting prototype system will not represent fully functional software the intention is to provide an adequate framework from which informed assessments of the extent to which such software is capable of providing a workable and implementable solution can be made. The prototype should provide a basis on which future research and development can take place.

4. *Does the risk measurement technique of risk accounting and related software provide a sufficient solution to the issues identified within current risk quantification and accounting practices?*

Following the identification of the issues surrounding current risk quantification and associated accounting practices, the extent to which risk accounting and the related software described herein offer a potentially valuable enterprise risk measurement and risk appetite setting and monitoring solution is assessed.

Problems with Current Approaches to Risk Measurement

Risk Quantification – Value-at-Risk

Value at Risk (VaR) has become one of the most prominent risk management techniques following the development of first JP Morgan's RiskMetrics™ and later CreditMetrics™ systems. VaR is a method of managing risk and indicates the degree of losses that can be incurred over a given period of time and for a given level of confidence from the positions held. VaR provides a single statistical measure of the probability of loss rather than an absolute figure, and is affected by the variables of exposure, time, confidence and volatility (Webster, 2006)[4]. VaR can also be calculated for all types of risk making it a preferred risk management tool for managing the risk of disparate market and credit risk portfolios, and for distilling the myriad of financial product risks in the trading book and banking books into one overall metric.

Whereas VaR is widely viewed as an effective risk management technique at the transaction, position or portfolio level, when applied in the determination of minimum capital requirements at the enterprise level it reveals a number of limitations. In its original conceptualization, VaR was not intended to represent a 'maximum loss figure'. Indeed, VaR may be exceeded, potentially on continuous days, a feature that causes it to be inherently

[4] Webster WR, 2006, *'A quick guide to value at risk'*, Barbican Consulting Limited, Financial Markets Training

flawed when used in the determination of minimum capital requirements. This view was confirmed by a recent review of trading book capital requirements conducted by the Basel Committee (2012)[5]. The review identified "material weaknesses" in the prevailing regulatory capital adequacy regime evident in the reviewers' use of expressions such as , "flaws in the overall design of the framework", "both the models-based and the standardized approaches proved wanting", "the models-based capital framework for market risk relied on a bank-specific perspective of risk, which might not be adequate from the perspective of the banking system as a whole", "important shortcomings with the standardized approach" and "a lack of risk sensitivity, a very limited recognition of hedging and diversification benefits and an inability to sufficiently capture risks associated with more complex instruments". Most significantly, the reviewers observed that the prevailing regulatory capital adequacy regime constituted a "provision of incentives for banks to take on tail risk" which is contrary to precisely what a regulatory capital regime is intended to prevent.

As a consequence of its review, the Basel Committee is proposing that VaR be replaced by the Expected Shortfall (ES) methodology for the calibration of regulatory capital requirements. The Committee anticipates that this will increase the sensitivity of the risk regime to accommodate extreme events or "tail risk". By looking through the ES lens beyond the 99th percentile of the extreme expected loss distribution, a broader range of potential outcomes may be observable than those obtained through VaR. Indeed, it could be argued that ES constitutes a formalised incorporation of the stress tests typically applied to VaR outcomes.

It is questionable whether regulatory aims can be successfully achieved by building upon an evidently flawed and overly complex capital adequacy regime in an incremental way. This view found endorsement from an Executive Director at the Bank of England, Haldane (2012)[6], who questioned the role that risk models, such as VaR, play in modern regulation. He cautioned that due to escalating complexity "the Tower of Basel is at risk of over-fitting – and over-balancing" concluding that simpler, more judgment-based approaches to regulation should be considered.

This begs the question as to whether the application of statistical models, such as VaR, constitutes an acceptable approach to the regulatory supervision of banks' capital adequacy. Haldane doesn't appear to have any doubt on the matter as is evident from his observation that the application of such models and approaches gives rise to "startling degrees of complexity and an over-reliance on probably unreliable models.... With thousands of parameters calibrated from short samples, these models are unlikely to be robust for many decades, perhaps centuries to come. It is close to impossible to tell whether results from them are prudent."

Whereas the Basel Committee's trading book review relates to market risk there are similar concerns as to the limitations of risk quantification techniques applied in the calibration of regulatory capital for credit and operational risk. This is evident in Basel III

[5] *Fundamental Review of the Trading Book'*, consultation by the Basel Committee on Banking Supervision, May 2012

[6] *The dog and the Frisbee*, Andrew G Haldane and Vasileios Madouros, presented at the Federal Reserve Bank of Kansas City's 36th economic policy symposium, "The Changing Policy Landscape", Jackson Hole, Wyoming, August 2012

(2011)[7] whereby one of the new devices it introduces is an accounting based leverage ratio to “provide an extra layer of protection against model risk and measurement error”.

In its supervisory guidelines for the advanced measurement approaches (AMA) applied to operational risk, the Basel Committee (2011)[8] makes reference to limitations in such approaches. The guidelines include the observations that the “range of practice continues to be broad, with a diversity of modelling approaches being adopted by AMA banks... (this) clearly affects the AMA methodology of individual banks and, ultimately, the amount of capital resulting from the application of the AMA”, and “While flexibility allows modelling to reflect individual bank risk profiles, it also raises the possibility that banks with similar risk profiles could hold different levels of capital under the AMA if they rely on substantially different modelling approaches and assumptions’.

This begs the question as to whether it is possible to effectively regulate banks with respect to the amount of risk they accept if the models used lack standardisation and consistent application.

Regulatory Capture

The question must be asked, in light of the catastrophic outcome, as to why the Basel Committee agreed to the adoption of banks’ internal risk models in Basel II for calibrating regulatory capital. A possible cause is suggested by Lall (2009)[9] who argues that Basel II’s failure lies in ‘regulatory capture’ which he defines as, “de facto control of the state and its regulatory agencies by the ‘regulated’ interests, enabling these interests to transfer wealth to themselves at the expense of society”. He further argues that “Large international banks were able to systematically manipulate outcomes in Basel II’s regulatory process to their advantage, at the expense of their smaller and emerging market competitors and, above all, systemic financial stability”.

Lall exemplifies regulatory capture through his description of the adoption in Basel II of the internal ratings-based approach to credit risk capital calibration as a consequence of the lobbying by larger, more sophisticated banks and their trade associations for greater recognition of their own internal risk measurement systems. Banks argued that not only were these more risk-sensitive than the arbitrary risk-weights set out in Basel’s first capital accord, but they also had the crucial advantage of being already in use by banks. Regulators were initially sceptical referring to ‘significant hurdles’ to using internal systems to set capital requirements.

Nevertheless, Lall observes that “the (banks and their trade associations) had succeeded in convincing enough of the (Basel) Committee of the merits of an Advanced – Internal Ratings Based (A-IRB) approach to credit risk for some sophisticated banks”.

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[7] *‘Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems’*, Bank for International Settlements, June 2011

[8] *Operational Risk – Supervisory Guidelines for the Advanced Measurement Approaches’*, Bank for International Settlements, June 2011

[9] Lall R., 2009, *Why Basel II Failed and Why Basel III is Doomed*, GEG Working paper 2009/52

Operational Risk Management

Turning to Operational Risk, the Institute of Operational Risk (2010)[10] describes the Risk & Control Self-Assessment (RCSA) as an integral element of a firm's overall operational risk management framework that demonstrates a sound system of internal control and risk management and provides the framework through which the effectiveness of internal controls is reviewed. The Basel Committee (2011)[11] explains that the application of an advanced measurement approach (AMA) for "calculating the operational risk capital charge of a bank requires the use of four data elements which are: (1) internal loss data; (2) external data; (3) scenario analysis, and (4) business environment and internal control factors (BEICFs)". The Risk Management Association (2008)[12] comments that for capital estimation purposes, RCSA results are the most commonly applied BEICF, usually in the form of secondary adjustments to internal and external loss data and scenario analysis. They suggest that "it may well make sense to continue the current practice of the majority of firms and limit their overall effect to an increase or a decrease of some specified amount (of capital) such as 5%, 10%, 20% or 30%". The Basel Committee leaves the impression that BEICFs are primarily of value in the context of capital estimation, whereas "all... member firms believe that the main value of BEICFs is as tools for managing operational risk".

The Institute of Operational Risk (2010)[13] when discussing RCSA comments that "the techniques and disciplines of inherent risk estimation can be extremely subjective and difficult to quantify". They argue that the use of RCSA as a tool that "provides a direct contribution to the evaluation of an operational risk capital charge may be tenuous" and concludes that "operational risk is inherently an empirical rather than a mathematical science". The Basel Committee (2003)[14] implies that the management of operational risk is only achievable through a process of assessment rather than measurement. When providing guidance on sound practices for the management and supervision of operational risk, the Committee considered the management of operational risk to mean the "identification, assessment, monitoring and control / mitigation of risk" which contrasted with their previous risk management papers that referred to the "identification, measurement, monitoring and control of risk". The justification for this change in definition, that is, replacing 'measurement' with 'assessment', was to reflect the "different nature of operational risk". The UK FSA's Operational Risk Governance Expert Group (2005)[15] also addressed the inherent differences that exist between operational risk and other risk types observing that "the direct linkage of measurement to management is difficult", which "is partly due to the inherent difficulties in assessing the operational risk positions that a firm faces and how to measure these…" In

[10] *Sound Practice Guidance - Risk Control Self Assessment*, Institute of Operational Risk, 2010

[11] See footnote 8

[12] *Business Environment & Internal Control Factors (BEICFs),* Industry Position Paper, Risk management Association, December 2008

[13] *'Risk and Control Self Assessment'*, IOR Sound Practice Guidance, Institute of Operational Risk, 2010

[14] *Sound Practices for the Management and Supervision of Operational Risk*, Bank for International Settlements, 2003

[15] UK Financial Services Authority Operational Risk Corporate Governance Expert Group, 2005, *'The "Use Test"'*, http://www.fsa.gov.uk/pubs/international/orsg_use_test.pdf , as accessed on 22/10/11

conclusion the Expert Group commented that operational risk management practices "place less reliance on any risk or capital numbers than in the market or credit risk disciplines".

The Internal Capital Adequacy Assessment Process (ICAAP)

In the second pillar of the Basel II capital accord the Basel Committee (2004)[16] sets out its key principles for a supervisory review process. In particular, the first principle states that "banks should have a process for assessing their overall capital adequacy in relation to their risk profile and a strategy for maintaining their capital levels". The term universally applied to this process is the Internal Capital Adequacy Assessment Process (ICAAP). The ICAAP has been widely adopted by national supervisors as the mechanism through which bank management demonstrates its process for "understanding the nature and level of risk being taken by the bank and how this risk relates to adequate capital levels" and "ensuring that the formality and sophistication of the risk management processes are appropriate in light of the risk profile and business plan".

National supervisors typically require their regulated banks to prepare and submit an ICAAP document. Whereas guidelines may be published for its preparation[17] or a suggested format may be offered[18] it is generally the case that the various forms of supervisory guidance do not constitute a request to submit risk related data and information to regulators in any standardised format. The UK Financial Services Authority, for example, introduces its suggested ICAAP submission format with the words, "firms are not required to adopt this format". The Canadian Office of the Superintendent of Financial Institutions in its ICAAP guideline explains that while such fundamental features of an ICAAP are broadly prescribed, "there is no single 'correct' approach" and it "should be as simple or complex as needed".

In the third pillar (Pillar 3) of Basel II the Basel Committee sets out disclosure requirements which allow market participants to assess key pieces of information on the scope of application, capital, risk exposures, risk assessment processes, and hence the capital adequacy of the institution. Such disclosures should be consistent with how senior management and the board of directors assess and manage the risks of the bank. It follows that there is a good deal of commonality between what banks report in their ICAAPs and related Pillar 3 disclosures.

It is unquestionably the case that ICAAP and Pillar 3 disclosures provide important and valuable information for the board of a bank and its investors and other stakeholders. However, it is also the case that the value of such internal and external reporting mechanisms is inhibited by the absence of a common framework of risk exposure quantification and reporting. Whereas investors and regulators gain important insights into the methods adopted by banks to quantify their risks and how these are related to capital levels, the multiplicity and frequent complexity of such methods result in a limited ability to

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[16] *International Convergence of Capital Measurement and Capital Standards,* Bank for International Settlements, 2004

[17] For example OSFI, 2010, *'Internal Capital Adequacy Assessment Process (ICAAP) for Deposit-Taking Institutions (E-19)*', Office of the Superintendent of Financial Institutions Canada

[18] For example, FSA, 2007, *'ICAAP Submission – Suggested Format (v2.0)'*, UK Financial Services Authority

determine whether a bank is taking on too much risk and a virtual impossibility to compare the risk taken on by one bank compared to others.

Effective bank regulation also suffers from the absence of standardised reporting formats that support the routine, periodic and mechanised receipt of information relating to banks' accumulating risk exposures offered by a common risk quantification and reporting framework.

These problems are becoming increasingly important. Modern financial institutions now reflect the consequences of massive increases in concentrations of risk resulting from: the heightened complexity of financial instruments; the creation of more sophisticated forms of risk intermediation and trading schemes; greater operating density and centralisation through rapidly advancing automation and data management capabilities; and business consolidation through successive mergers and acquisitions. Large scale increases in concentrations of risk mean that changes in the risk profile of a financial institution can occur rapidly and dramatically with material loss implications.

However, such changes in risk profile do not necessarily trigger accounting events and there continues to be no adequate accounting solution as far as the new contagion of systemic risk is concerned. Funding gaps, credit risk concentrations and correlations, unapproved trading positions, poor data, flawed models, the bypassing or overriding of controls... these are all examples of risk conditions or events that do not necessarily translate into accounting events. The evidence of the financial crisis is that life-threatening exposures to risk were accumulating in financial institutions of all sizes whereby such exposures defied identification and quantification and, consequently, were not reported in audited financial statements. Lo (2009)[19] aptly summarised the situation, "Before we can hope to reduce the risks of financial crisis, we must be able to define and measure those (systemic) risks explicitly. Therefore, a pre-requisite for effective financial regulatory reform is to develop dedicated infrastructure for defining, measuring, monitoring and investigating systemic risk on a standardized, on-going and regular basis". This represents both a risk quantification challenge and an accounting challenge. They are inextricably linked.

Accounting for Risk

An important response to perceived weaknesses of VaR based approaches is the call to adapt and reinstate accounting as the foundation on which financial condition and capital adequacy are determined and disclosed. Merton (1995)[20] predicted the likely consequences of systemic risk observing the limitations of conventional accounting practices characterising them as "focused on valuation, which is inherently a static measure of financial conditions". According to Merton, accounting needed to evolve a new branch called 'risk accounting' so that it might become focused on risk exposures and regulation might be made more effective. To do so, it needed inherently dynamic measures of financial condition to indicate the sensitivity of individual balance-sheet values to changes in the underlying financial-

[19] Lo A, 2009, 'The Feasibility of Systemic Risk Measurement', in written testimony prepared for the U.S. House of Representatives Financial Services Committee, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1497682 as accessed on 22/10/11

[20] Merton R, 1995, *Financial Innovation and the Management and Regulation of Financial Institutions*, Journal of Banking and Finance 19 (1995) 461-481

economic environment. Lo (2009)[21] further observed that, with regard to the causes of the financial crisis, “The very fact that so many smart and experienced corporate leaders were all led astray suggests that the crisis can't be blamed on the mistakes of a few greedy CEOs”. He expressed the view that, “...there's something fundamentally wrong with current corporate-governance structures and the language of corporate management. We just don't have the proper lexicon to have a meaningful discussion about the kinds of risks that typical corporations face today, and we need to create a new field of ‘risk accounting’ to address this gap in GAAP (Generally Accepted Accounting Principles)”.

In recent work, Toms (2008, 2010, 2011)[22] developed an accounting based risk measurement system that develops capital asset pricing model (CAPM) style metrics using accounting inputs. In contrast to the traditional CAPM approach, which is top down market driven, the risk accounting method described in this paper uses a bottom up accounting transaction based approach. The utilization of internal data to scale risk, this time in the form of Risk Units (RUs), is an important feature that is applied to the new approach advocated below.

Enterprise Risk Management

The absence of standardised enterprise risk measurement and accounting mechanisms causes operating risk and performance management tools to be dysfunctional. For example where Balanced Scorecards are used they are inconsistent in their structure, devoid of any consistent and comparable basis of measurement and excessively dependent on subjective assessments (Norreklit, 2000, Kasurinen, 2002). RCSAs, as discussed above, share similar limitations. Nevertheless, the literature review revealed a high degree of reliance being placed by financial firms in such management tools to assess and report on the condition of operating performance, risks and controls.

As an illustration, dependence on such dysfunctional management practices could be equated to a hypothetical absence of reliable financial accounting leading to business managers self-assessing their own profitability. In this scenario, the summation of individual business managers’ self-assessed profits would almost certainly exceed the total profitability of the enterprise. In the context of the financial crisis, this is what appears to have been the case, that is, neither the actual level of aggregated risks nor their accumulation was signalled through enterprise-wide self-assessments. It follows that a process of risk accounting must transcend any dependency on risk management tools that are excessively subjective.

Reports originated by such mechanisms typically use an assessment based metric, for example, ‘traffic light’ reports comprising red, amber and green indicators rather than a common and standardised system of value or measurement based metrics. Consequently, such reports are not capable of consolidation and aggregation thereby limiting their comparison, analysis and interpretation across the enterprise. The element of subjectivity

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[21] Lo A, 2009, quoted in *‘Understanding Our Blind Spots’*, Wall Street Journal, March 2009

[22] Toms, S, 2008, *Accounting Based Risk Measurement* CA Magazine, ICAS, January, pp.62-65.

Toms, S, 2010, *Value, profit and risk: accounting and the resource-based view of the firm*, Accounting, Auditing and Accountability Journal, 23(5), pp: 647-670.

Toms S, 2011, *Accounting based risk measurement*, York Management School working paper.

and lack of such consolidation and aggregation invariably inhibits effective management oversight, audit and regulation.

Hughes and Grody (2009)[23] described how an enterprise's operating environment can be deconstructed into a simple model represented by three key operational pillars - people, data, and systems (Figure 1). They further observed that if the interaction of the three operational pillars (manual process, automated process, and data) is assumed to be flawless a theoretical risk free operating environment is the result. Thus, the benchmark for a risk free operating environment can be represented as 100 per cent straight-through-processing (STP) with totally reliable and secure information technology and flawless data. It is evident that this benchmark also represents a transaction processing environment that is operating at or close to optimal efficiency. Thus, it follows that the correlation between risk mitigation effectiveness and operational efficiency is either '1' or close to '1'.

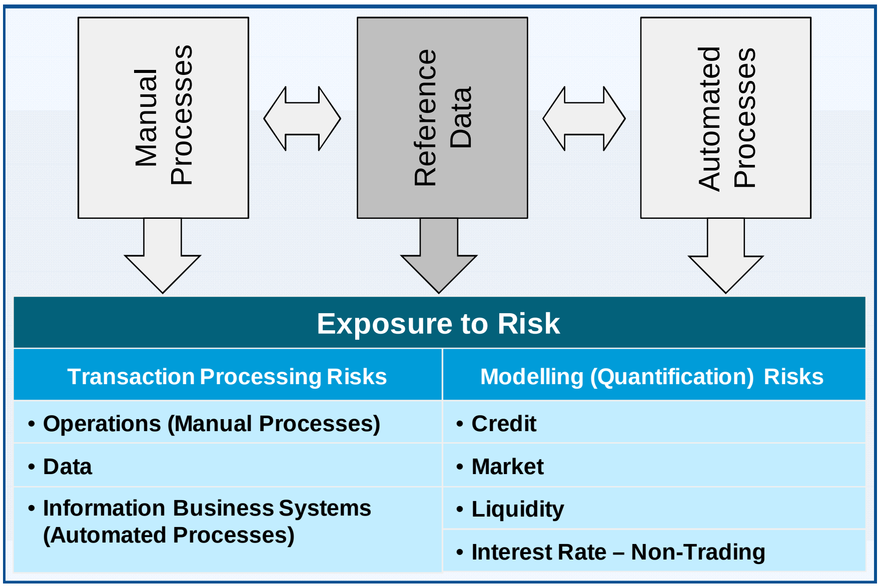

Figure 1 – The Three Pillars of an Operating Environment

It is the presumed close correlation between risk mitigation effectiveness and operational excellence that caused Hughes (2007)[24] to conclude that the risk quantification technique used in risk accounting is potentially valuable when applied to operational transformation programmes, for example, outsourcing and off-shoring, insourcing, business process reengineering, systems implementations and reorganisations. Hughes observed that through the provision of a framework of operating metrics using the method described in this paper, such programmes can be planned and managed with greater security and

[23] Hughes P, Grody AD, 2009, *'Transaction-Based Cross-Enterprise Risk Management'*, Risk Management in Finance – Six Sigma and Other Next-Generation Techniques, John Wiley & Sons, pp 233-256

[24] Hughes P, 2007, *'Operational risk: the direct measurement of exposure and risk in bank operations'*, Journal of Risk Management in Financial Institutions, 1 (1): 25-43

certainty as the ‘as-is’ and ‘to be’ states can be dimensioned in the form of current and target inherent and residual risks and risk mitigation indexes being measures of both risk mitigation and operational efficiency. Through the on-going recalibration of target metrics as the programme progresses and their comparison with original targets, management can obtain dynamic updates on progress towards the ‘to be’ state and the likelihood that predicted programme benefits either will or will not be attained.

Conclusion

In summary, the literature review has produced an overwhelming body of evidence that conventional risk quantification techniques and accounting are, at best, insufficiently granular and, at worst, misleading. It would thus appear that alternative risk management and accounting techniques need to be explored.

The Alternative Risk Accounting Approach

Description and Overview

Hughes et al (2010)[25] proposed a system of risk measurement and accounting that presented an accounting based approach to the capture and reporting of cross-enterprise risk exposures as they accumulate. An overview of the risk measurement and accounting model and system is shown in Figure 2.

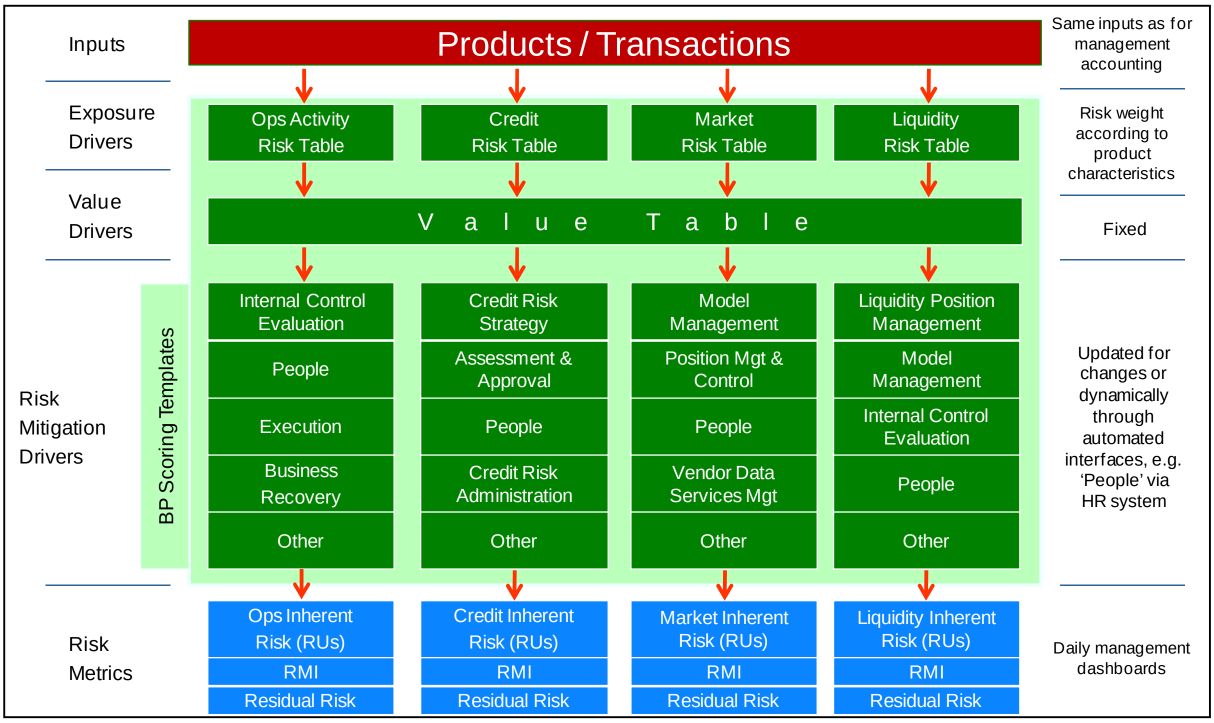

Figure 2 – Overview of the Risk Measurement and Accounting Model and System

[25] See footnote 1

The risk quantification technique involves the production of three core metrics that use a new unitised valuation metric unique to risk accounting, the ‘Risk Unit’ (RU):

Inherent Risk – is the risk-weighted size of a transaction expressed in RUs that represents the transaction’s maximum potential for loss

Risk Mitigation Index (RMI) – is a dynamic measure on a scale of 1 to 100, where 100 is best practice, that represents, in percentage terms, the portion of maximum potential loss that is mitigated through the effective management and control of the firm’s operating environment

Residual Risk – is expressed in RUs and represents the probability of loss being the portion of Inherent Risk not covered by effective risk mitigation as represented by the RMI

The above core metrics are calculated at the transaction level relative to the risk types that are activated and can be one or a combination of operational, credit, market, liquidity and interest rate risks. The metrics can be aggregated by, for example, organization, product, customer, geography and risk type.

Risk types can be ‘external’ or ‘internal’. External risks are accepted by a firm within predetermined risk appetite parameters in the expectation that they will generate a return in the form of revenues or trading gains. Examples of external risks include credit risk and market risk. Internal risks exist as a consequence of the ineffective management and control of a firm’s operating environment and only have downside risk, that is, the existence of internal risks can only lead to losses, not revenues or trading gains. Accordingly, firms structure their operating environments to minimize exposure to internal risks given the absence of an upside revenue or trading gain potential. Examples of internal risks are operational risk and liquidity (funding) risk.

Calculation of External Inherent Risks – Credit and Market Risks

The amount of risk inherent in an approved transaction as reported by the risk accounting system relates to its potential to cause unexpected losses. Risk accounting considers an unexpected loss to be a loss that is capable of prevention through a firm’s effective monitoring and management of the associated risks. Thus, an unexpected loss occurs in circumstances where a firm’s management believes its risk management processes are effective but, in reality, they are not due to failures either in their design or application.

It follows that an unexpected loss does not relate to losses that are the consequence of a firm intentionally taking on a risk for a projected return if the decision to accept such risk is a consequence of the application of effective risk management processes and within predetermined risk appetite parameters.

Risk accounting is designed to identify and quantify external exposures to risk from two perspectives:

1. the amount of new exposures to risk created during a particular day; and
2. the amount of risk inherent in risk positions at a given point in time.

A risk position relative to credit risk relates to amounts due from clients and counterparties relative to products that carry inherent credit risk; and for market risk, it relates to investments and associated hedges that are held by a firm in the expectation that changes in market rates or prices will result in a financial gain.

In risk accounting terms, a combination of high inherent risk measured in RUs and a low Risk Mitigation Index (RMI) leads to high residual risk in RUs which, in turn, denotes a high propensity to unexpected losses. Thus, risk accounting is concerned with computing the amount of residual risk in RUs that is created at the moment transactions are approved and, thereafter, as they are reported as a component of risk positions.

Risk accounting calculates the amount of external risk inherent in a transaction in Risk Units (RUs) by reference to two factors:

1. Exposure Uncertainty Factor (EUF); and
2. Value Band Weighting.

Exposure Uncertainty Factor (EUF)

In quantifying inherent credit or market risk it is assumed that there is a positive correlation between a product's potential to cause unexpected losses and the degree of exposure uncertainty that is likely to exist upon the occurrence of an assumed default (credit risk) or if a trading position were to be unwound on a given day or during an expected liquidation period (market risk). More specifically:

Credit Risk

Exposure uncertainty relative to credit risk is a function of the underlying collateral by reference to its value retention properties and degree of anticipated difficulty in arriving at a liquidation price upon disposal; (a schedule of credit products, their associated types of collateral and assigned EUFs representing their relative inherent credit risk is included in Figure 3).

In determining the EUF for credit risk, reference is made exclusively to the characteristics of the respective credit product and type of collateral rather than the creditworthiness of the obligor. The rationale applied is that credits secured by collateral with a high EUF carry correspondingly high inherent credit risk as they expose a firm to greater probability of unexpected losses. Such losses relate to credits that were deemed secured but have a propensity to become partially or wholly unsecured due to changes in the value of the collateral and difficulty in liquidating the assets. It follows that an unsecured loan has a low EUF and a correspondingly low inherent credit risk as the true exposure at default can be readily determined.

Credit Type	Form of Security / Type of Instrument	EUF
Commercial	Casual Overdraft	2
Commercial	Credit Card	2
Commercial	Unsecured	2
Commercial	Cash	4
Commercial	Cash Like Instruments (Margins, Liquid AAA Collateral)	5
Commercial	Trade Receivables	8
Commercial	Inventory	12
Commercial	Equipment	12
Commercial	Instruments Subject to Mark-to-Market, Mark-to-Model	12
Commercial	Autos	12
Commercial	Personal Guarantee	14
Commercial	Project Financing	16
Commercial	Commercial Real Estate	18
Counterparty	Forward Foreign Exchange	4
Counterparty	Interest Rate Swaps	8
Counterparty	Options	8
Counterparty	Credit Default Swaps	14
Counterparty	Collateralized Debt Obligations and Asset Backed Securities	18
Retail	Casual Overdraft	2
Retail	Credit Card	2
Retail	Unsecured	2
Retail	Autos	12
Retail	Personal Guarantee	14
Retail	Residential Property	16

Source: Financial InterGroup

Figure 3 – Credit Products Exposure Uncertainty Factors (EUFs)

Market Risk

Exposure uncertainty relative to market risk is a function of the manner in which trades are executed and the availability of market prices; (a schedule of the criteria applied in determining the EUFs to be assigned to traded products representing their relative inherent market risk is included in Figure 4).

The rationale applied in determining the EUF for market risk is that trading positions comprised of products and related hedges that have active market prices and are traded by electronic means will have a low inherent market risk as the exposure (the potential gain or loss inherent in the trading position) can be determined instantaneously. Conversely, trading positions comprised of products and related hedges that do not have active market prices and are traded by means other than electronic will have an elevated degree of inherent market risk as the exposure cannot be immediately determined which gives rise to ‘exposure uncertainty’ and heightened probability of unexpected loss.

Risk Criteria	Description	EUF*
Availability and reliability of market prices	Active market prices	2
	Inactive but observable market prices	5
	Unobservable prices that need judgment	8
	No prices but economic or other assumptions (demographic, holistic etc.) are required	10
The manner in which the product is traded	Electronic	2
	Hybrid (electronic + floor / voice-based)	4
	Floor / voice-based	6
	Over-The-Counter (OTC)	10
	Other	10

Source: Financial InterGroup

Figure 4 – Traded Products Exposure Uncertainty Factors (EUFs)

<u>Value Band Weighting</u>

The Value Band weighting is obtained from the Value Table[26] by applying the values and the applicable band weighting in accordance with the criteria set out in Figure 5:

Risk Type	Credit Risk	Market Risk
Daily New Exposures	The amount of new inherent credit risk exposures created on a particular day	The amount of new trading related inherent market risk exposure created on a daily basis determined by calculating the aggregate <u>notional values</u> of the trades (buys, sells and related hedges) relative to a particular trading position that are executed during a given trading day.
Risk Position	The amount of credit risk exposure inherent in outstanding balances at a given point in time	The a-mount of market risk exposure inherent in trading positions determined by calculating the aggregate <u>market values</u>, however derived[27], of the balance of the trading position at a given point in time.

Figure 5 – Value Table Application Criteria

The transactions that comprise 'Daily New Exposures' and 'Risk Position' in Figure 5 are derived from, and are traceable to the firm's general ledger and its associated product sub-ledgers and applications.

[26] A detailed description of the Value Table is provided from page 21
[27] Market values can be determined by various methods including mark-to-market, mark-to-model and the application of fair market values.

The amount of 'Daily New Exposures' relative to credit risk is determined by reference to the total amount of loans disbursed, guarantees approved, etc. by product. Where credit risk is not the result of a loan disbursement, e.g. casual overdrafts, credit card outstandings etc., the net day-to-day increase in total outstandings of the respective portfolio is considered to be the new daily credit exposures.

For market risk 'Daily New Exposures' is the aggregate trades (buys and sells) and related hedges relative to each trading position on the principle that abnormally high trading volume is an indicator of risk and such activities should be reflected in management reports albeit adjusted by the applicable Exposure Uncertainty Factor (EUF) discussed above. Aggregate values are also applied to the products and related hedges that comprise a market risk 'Risk Position' as a high EUF is an indication of a probability that these products and hedges may not be validly combined and netted in a single trading position.

Transaction size is a factor in the calculation of inherent credit and market risk RUs as a transaction's size (value) and the amount of unexpected loss it can potentially create are positively correlated.

In the case of market risk and counterparty credit risk with respect to derivatives, risk accounting considers that the notional values are representative of transaction size as they provide the basis on which future cash flows, mark-to-market and mark-to-model calculations, collateral deposits and related gains and losses are determined. When calculating the exposure in RUs inherent in 'Risk Positions' for both credit and market risk, risk accounting uses the fair values or market values in accordance with accounting principles[28] as these more accurately reflect the outstanding amounts.

Calculation of Internal Inherent Risks – Liquidity (Funding) Risk

Where industry consensus has converged on the relative risk of financial products through the disclosure of product based 'haircuts' and weights applied to asset categories these may be used in the determination of Exposure Uncertainty Factors (EUFs) for risk accounting purposes. For example, the Net Stable Funding Ratio (NSFR) to be introduced by the Basel Committee (2010)[29] within Basel III incorporates a factor that represents the level of stable funding required for certain asset types. A summary extract of the respective table is shown in Figure 6. If it is assumed that such factors represent the Basel Committee's view of the inherent funding liquidity risk inherent in such assets then it is presumed that they may be scaled and adapted for use in the determination of EUFs.

[28] For example, International Financial Reporting Standards (IFRS) or US GAAP

[29] *Basel III: International Framework for Liquidity Risk Measurement, Standards and Monitoring*, Bank for International Settlements, 2010

Item	Required Factor
• Cash • Short-term unsecured actively-traded instruments (< 1 yr) • Securities with exactly offsetting reverse repo • Securities with remaining maturity < 1 yr • Non-renewable loans to financials with remaining maturity < 1 yr	0%
• Debt issued or guaranteed by sovereigns, central banks, BIS, IMF, EC, non-central government, multilateral development banks with a 0% risk weight under Basel II standardised approach	5%
• Unencumbered non-financial senior unsecured corporate bonds and covered bonds rated at least AA-, and debt that is issued by sovereigns, central banks, and PSEs with a risk weighting of 20%; maturity ≥ 1 yr	20%
• Unencumbered listed equity securities or non-financial senior unsecured corporate bonds (or covered bonds) rated from A+ to A-, maturity ≥ 1 yr • Gold • Loans to non-financial corporate clients, sovereigns, central banks, and PSEs with a maturity < 1 yr	50%
• Unencumbered residential mortgages of any maturity and other unencumbered loans, excluding loans to financial institutions with a remaining maturity of one year or greater that would qualify for the 35% or lower risk weight under Basel II standardised approach for credit risk	65%
• Other loans to retail clients and small businesses having a maturity < 1 yr	85%
• All other assets	100%

Figure 6 – Basel III Required Stable Funding Factors

The Value Table

The Value Table (Figure 7) provides an initial scale of transaction values calibrated to value band weightings. The transaction values can be recalibrated and made more granular, adjusted to reflect a higher sensitivity to changes in external price volatility and internal process changes due to stressed environmental factors.

The general structure of the curve derived from the Value Table demonstrates a positive correlation between the exposure to unexpected losses associated with failures of firms to effectively mitigate risk (converted into value band weightings) and daily cumulative transaction values. As a consequence, an increase in transaction values is considered a causal factor that drives increases in risk exposure.

Value Band Reference	Value Band ($)	Value Band Weightings
1	<100,000	10
2	100,000 - 1,000,000	15
3	1,000,000 - 10,000,000	22
4	10,000,000 - 100,000,000	33
5	100,000,000 - 1,000,000,000	50
6	1,000,000,000 - 10,000,000,000	75
7	10,000,000,000 - 100,000,000,000	110
8	> 100,000,000,000	157

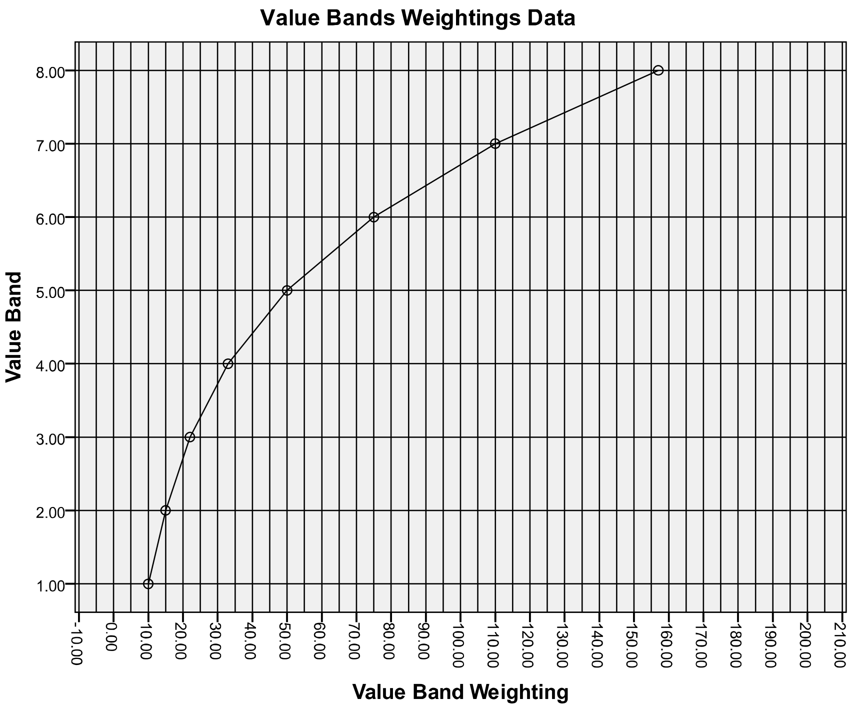

Figure 7 – Value Table

The empirical derivatives of the graph demonstrate that the rate of change of the financial consequences with respect to transaction volumes and values decreases with an increase along the value band spectrum. Hence a change in transaction volumes and values in the lower end of the spectrum will result in a more dramatic change of exposure to unexpected losses, but as the transaction values become more substantial, the same change will result in a proportionally smaller increase in exposure to unexpected losses. This dynamic is attributable to the natural enhancement in operating sophistication that occurs as transaction volumes and values increase primarily through enhanced automation. The net effect is a reduced rate of change in the exposure to risk as transaction volumes and values increase.

This continues to be the case until the curve asymptotically tends towards obtaining a zero derivative where the curve is capped. In this case, any further change in transaction volumes and values will result in a zero rate of change to risk exposure. This is due to the fact that the total amount of capital that the financial services industry and firms themselves hold is also capped. For example, an increase of $1 million in transaction values will have more of an impact if it takes place in an operating environment that processes $2 million worth of transaction values, as opposed to an environment that processes $100 billion.

The fixed points of the curve can be examined in order to determine the structural stability of the risk quantification technique.

Let:

T: transaction volumes (the intervals of which are given by bands).

F: financial consequences of operational failure (denoted by value weightings).

The fixed points of the curve occur when:

$$\frac{dF}{dT} = 0,$$

and from the curve it is observed that these would occur at:

$$(T,F) = (0,0) \text{ and } (T,F) = (\infty, \zeta)$$

where ζ denotes the maximum weighting possible for the exposure to risk.

As the transactions at any given bank will never actually reach ζ the curve can be considered to tend towards this point asymptotically, becoming infinitely close to it. For the purpose of the curve in practical terms, the stable point can be considered to be at a position that is infinitely close to the point (∞, ζ) where the derivative is infinitely close to zero. The analysis shows that the value curve offers reasonable assumptions about the long-term behaviour of the dynamics of the exposure of financial firms to risk resulting from ineffective risk mitigation.

The Calculation of the Risk Mitigation Index and Residual Risk

The method of risk accounting requires first that the operating environment being analysed is deconstructed into business components representing functions that perform transaction processing (operations), risk management, reference data maintenance and business systems (IT) maintenance. The end-to-end operational processes within each business component are documented in the form of process maps. By examining the process maps and in consultation with product and risk management specialists, each product’s risk characteristics are identified and categorised according to the particular type of internal operating and external financial risks they trigger which can be one or a combination of operational, credit, market, liquidity etc.

Best Practice Categories	Weighting	Score
Model Management	10	0 to 100
People	10	0 to 100
Execution	4	0 to 100
Policies & Procedures	2	0 to 100
Control Evaluation	2	0 to 100
Logical Access Management	2	0 to 100
Business Recovery	2	0 to 100
Management Oversight	2	0 to 100

Model Management: relates to the management of the product's models used for risk pricing, valuation, value-at-risk (VaR) calculations and capital adequacy

Best Practice Score = 100

Deduct following scores from Best Practice score if statement does not apply:

- Responsibility assigned to an independent risk control unit (100)
- Daily mark-to-market (100)
- Regular back-testing (80)
- Initial and on-going validation of internal model (80)
- Daily analysis and reports (7)
- Routine and rigorous programme of stress testing (60)
- Risk factors applied consistently in pricing and VaR models (50)
- Regularly reviewed by internal audit (40)
- Daily reports reviewed by senior management (30)
- Well-understood by both traders and senior management (25)

Execution: levels of automation vs. manual workarounds; levels of repair rates; and the stability of core application(s).

Best Practice Score = 100

Level of automation or STP rate:

- 100% score 100 (Best Practice)
- 75% score 75
- 50% score 50
- 25% score 25
- 0% score zero

Average percentage of input rejection / repair:

- 0% score 100 (Best Practice)
- 5% score 75
- 10% score 50
- 25% score 25
- 50% score zero

Number of core system failures in year:

- None score 100 (Best Practice)
- 1 score 75
- 2 score 50
- 4 score 25
- > 12 score zero

Figure 8 – Examples of Best Practice Scoring Templates (Extracts) Relating to Market Risk Management

The risk mitigation effectiveness of the end-to-end operational processes that interact with products on their journey through the operating environment is expressed in the form of a Risk Mitigation Index (RMI). The RMI is derived through mapping the actual status of operational processes to standardised Best Practice Scoring Templates (Figure 8) and extracting the applicable scores which are used in an RMI calculation, prorated on a scale of zero to 100, assigned to each operational process within each business component.

Collateralized Debt Obligations (CDOs)	Inherent Risk (Risk Units)	Risk Mitigation Index (RMI)	Residual Risk (Risk Units)
Processing Risks			
Transaction Processing Risk			
Product & Service Pricing	1,350	63.5	493
Deal Structuring	1,350	55.2	605
Order Management	1,350	68.2	429
Pre-Trade Validation	1,350	62.3	509
Quote Management	1,350	73.4	359
Trade Execution & Capture	1,350	44.9	744
Cash Management	1,350	52.3	644
Trade Confirmation & Matching*	1,350	60.0	540
Position Control & Amendments	1,350	60.2	537
Transaction Reporting	1,350	63.2	497
Credit Limit Monitoring	1,350	45.0	743
Trading Limit Monitoring	1,350	62.4	508
Trade Settlements	1,350	63.4	494
Nostro Reconcilement	1,350	72.8	367
Trading Account Reconciliations	1,350	66.7	450
G/L Proofs & Substantiation	1,350	73.3	360
Management Reporting	1,350	64.2	483
Regulatory & External Reporting	1,350	64.2	483
Control Totals	24,300	62.0	9,245
Transaction Processing Risk	**1,350**	**62.0**	**514**
Data Quality			
Client & Counterparty	1,350	79.2	281
Market Data	1,350	52.9	636
Products & Instruments	1,350	68.2	429
Corporate Events	1,350	43.3	765
Control Totals	5,400	60.9	2,111
Data Quality	**1,350**	**60.9**	**528**
Business Systems (IT) Risk			
Integrated Trading System	1,350	78.9	285
Funds Transfer System	1,350	65.4	467
Global Nostros System	1,350	65.0	473
Global Ledger System	1,350	82.3	239
Funding & Liquidity System	1,350	69.4	413
Control Totals	6,750	72.2	1,877
Business Systems (IT) Risk	**1,350**	**72.2**	**375**
Control Totals	36,450	63.7	13,233
Total Processing Risk	**1,350**	**63.7**	**490**
Model Risk			
Credit Risk	**900**	**65.3**	**312**
Market Risk	**1,350**	**43.9**	**758**
Liquidity Risk	**600**	**55.0**	**270**
Model Risk	**2,850**	**53.0**	**1,340**
Product Risk	**4,200**	**56.4**	**1,830**

Figure 9: Product Risk Report

Best Practice Scoring Templates are comprised of known firm and industry best practices and benchmarks to which risk-weights are assigned according to their relative risk mitigation impact. Industry best practices promulgated by authoritative bodies[30], when available, should be incorporated into Best Practice Scoring Templates.

The inherent risk in RUs and Risk Mitigation Indexes are combined in a calculation of residual risk also denominated in RUs. The calculation of residual risk is made for each business process that is on a product's path through the enterprise's operating environment and each risk management function that is associated with external financial risk.

The calculation of the three core metrics can be represented as follows:

$$RU(I) = PRT_W \times VT_W \qquad (1)$$

Where *RU(I)* = inherent risk units, *VT* = value table outputs, *PRT* = product risk table outputs, with appropriate weightings *W* applied.

$$RMI = [\Sigma(BPST_S \times BPST_W \times RU(I) \times 100] \div [\Sigma(100 \times BPST_W \times RU(I))] \qquad (2)$$

Where RMI = risk mitigation index, *BPST* = best practice scoring templates, with scores, *S*.

$$RU(R) = [(100 - RMI)/100] \times RU(I) \qquad (3)$$

Where *RU(R)* = Residual Risk units.

Risk Appetite is defined in this method as the range of inherent and / or residual risk that a firm accepts in all aspects of the overall business and in specific areas of internal operations and external risk.

Residual risks in RUs and RMIs are aggregated across the enterprise. By reference to organisational, product and customer codes these metrics are applied to processes and products and, in this way, risk reports (Figure 9) are produced that complement the performance and profitability reports produced by management accounting. The resulting metrics, aggregated through the standard measure of RUs, can then be mapped against risk mitigation actions to reduce risk exposure and correlated against loss history data. The data can then be used to iterate the predictive value of these developed risk exposure metrics in RUs so that management can be updated in real-time or near real-time on the status of their exposure to risks and, through disclosure of the process, investors and regulators can be assured of the consistent application of risk measurement methods.

Concept of the Risk Unit (RU) as a Risk Metric

An abstract unit of measure that becomes a monetized equivalent over time as an increasingly robust set of data points evolves is a fundamental principle of risk management. This is found in a FICO score for retail credit measurement - Fair Isaac Corporation (FICO) is the best-known and most widely used retail credit scoring methodology in the USA. It is also applied in credit ratings for determining institutional default probability. Such measurement techniques are already established best practices that can be deployed for new use as a tool for both enterprise risk management and risk appetite measurement.

[30] For example, *Self-Assessment Template – A Supplement to Risk Management Lessons from the Global Banking Crisis of 2008*, Senior Supervisors Group, October 2009

The predictability of a FICO score in determining the probability of loss in a credit card or mortgage portfolio, and the credit rating migration of a reference entity in determining the probability of default of a credit default swap parallels the change in residual risk measured in RUs. Over time, as these RUs are tabulated and aggregated, their intrinsic value in benchmarking both within and across firms will also become correlated with monetary losses and performance measures. Thus, the RU will obtain monetary and predictive attributes and measures associated with it as is the case with FICO scores, credit ratings, scaled indices, rankings, temperature scales and other correlated measurement systems.

The fundamental method of determining RUs is based on an analysis of risk weights performed by using the enterprise's personnel and documentation in a structured process that allows for the understanding of the exposures inherent in the operating environment in which the business exists. It is this knowledge that is translated into risk weights. More importantly, the risk weights are built from the ground up, allowing for the long standing inherent and intuitive intellectual property of operating managements' risk understanding to be embedded in the very fabric of the risk measurement system. Here, a lesson is taken from credit risk modeling.

Credit reporting was born more than a century ago when small retail merchants banded together to trade financial information about their customers. The merchant associations then turned into small credit bureaus, which later consolidated into larger ones with the advent of computerization.

Credit analysis uses a well-defined set of inputs from the historical accumulation of a set of Key Risk Indicators (KRIs) gathered over many years of refining intuition into predictors of loss. KRIs such as payment history, amounts owed, length of credit history, new credits and types of credit are input into credit scores.

Armed with this intelligence, specific credit data are used to calculate individual retail credit scores that, when applied to large and diverse populations can produce categorizations according to risk criteria such as creditworthiness. If we also explore the commercial credit side of credit ratings we get a similar history and methodology, this time not from three major credit bureaus but three major credit rating agencies. Their methods, also refined over a century, categorize credit scores into an A - B - C rating system, each with its own assessment methodology, i.e. KRIs refined over many years through their correlation with actual loss experience.

In similar fashion, institutionalizing long standing corporate awareness of drivers of risk into the risk activity analysis of the risk accounting method creates credibility amongst management as to the intrinsic value of the RU as it is their inputs that are recorded by the method to produce risk weightings. Given the granularity of the analysis and its causal tie back to three levers of change management - people, systems and data - it is also actionable given that credibility and change management are the two most critical components in enabling a risk culture to evolve and continual risk mitigation to be its outcome.

However, while benchmarking across different business silos within a single firm can show biases in the risk weightings within and across departments it still would suffer from ‘culture’ bias if not for benchmarking across firms. Here we look to a metaphor in the way prices trade in surrogate form to its real world company or commodity on exchanges and how they are transformed into an objective measure.

For example, in commodity futures trading buyers and sellers each make their own dynamic and subjective choices as to what will be a fair price now to pay for the commodity in the future when the contract term expires and the seller has to deliver the commodity to the buyer. As the date of delivery approaches, contracts for the commodity are unwound as the remaining futures contract prices diverge to the separately determined physical commodity price, given the available supply, when these futures contracts expire. The ‘benchmark’ physical commodity price keeps all the subjective prices previously agreed in check, much like the benchmarking of RUs would across similar departments and processes and across firms.

Standardised RU values would emerge across firms with each firm understanding and explaining its deviations from norms consistent with its appetite for risk and risk culture biases. This is not unlike the impact different grades and distances from storage facilities have on commodity prices. Over time, as risk mitigation reduces RUs in each firm, a benchmark ‘price’ expressed in RUs and its accepted deviations will emerge. Risk committees will have the ability to analyze and document deviations from the benchmark, both at the firm and individual product levels. Using this awareness firms will adjust plans and projects to add certainty that targeted RU reductions will be achieved.

Regulatory Minimum Capital Requirements

Figure 9 above provides an example of an output of the risk accounting method and system described in this paper relative to the inherent and residual risks of a financial product; in this case, a Collateralized Debt Obligation (CDO). The interpretation placed on this example’s output is that the inherent risk (4,200 RUs) is representative of the maximum potential for loss inherent in the CDOs transacted on a particular day and the residual risk (1,830 RUs) is representative of the respective probability of loss. It is expected that, over time, risk accounting outputs will be correlated with expected and actual losses thereby imparting a monetary value to the RU.

Financial instruments that are outstanding at a given point in time are distilled by a firm’s accounting systems into a balance sheet whereby prevailing accounting principles[31] are oriented towards public disclosure in accordance with the principles of fair value accounting. Such financial instruments comprise risk assets, derivatives and guarantees used in lending, investment, financial risk management or in proprietary trading operations and are categorised as either on or off balance sheet. It is these risk positions that comprise ‘exposure’ for the purposes of determining the leverage ratio proposed in Basel III[32] and, with operational risk, represent the primary focus of minimum capital requirements under Pillar 1 of Basel II[33] (credit, market and interest rate risk).

[31] For example, International Financial Reporting Standards (IFRS)

[32] See footnote 7

[33] *Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework, (Comprehensive Version),* Bank for International Settlements, June 2006

All inputs to risk accounting are derived from and, consequently, are traceable to each firms' accounting records in accordance with new Basel mandates on risk/accounting system reconciliations scheduled for implementation in 2016.[34] This capability applies both to daily new exposures and risk positions. In the case of risk positions accounting fair values or market values are used as input to the Value Table. In this way, outstanding credit balances and trading positions are reported both at fair values in accordance with accounting principles[35] and in Risk Units (RUs) in accordance with risk accounting. In the case of trading risk positions, the aggregated market values of the products and related hedges that comprise the position are used as input to the Value Table.

Given that, in the risk accounting method and system, risk positions are translated into inherent risk RUs on the basis of market values, any reduction in exposures will result in downward pressure on their market values. If, however, a bank chooses to maintain high RU products on its books, and assuming that risk accounting has been incorporated into the determination of regulatory capital requirements and the CAPM, it can be expected that the market value of such portfolios will decline causing a corresponding loss of capital for the banks concerned. It follows that if market values are used as the input to the Value Table the inherent credit and market risk RUs will also decline resulting in a positive correlation between RUs and capital which is precisely the dynamic that should result in better regulation and a safer and more transparent market for investors.

Inasmuch as the risk accounting method quantifies inherent and residual risk in RUs relative to each product transacted by a financial firm and the expectation that the RU will, over time, assume a statistically derived monetary value, and in consideration of the fact that the RU incorporates all the principal risk types (credit, market, operational, liquidity, interest rate etc.) it follows that such information can be validly applied in the calibration of regulatory capital requirements.

For this potential to be realized it is acknowledged that the tables and templates that constitute the risk accounting method will need to be standardized across the industry, not unlike the prescriptive accounting standards disseminated as IFRS that are designed to ensure, amongst other aspects, the comparability of firms' audited financial statements. The benefits are, however, potentially significant for regulators as capital requirements can be the result of explicit measurements of exposure to risk following auditable processes. Investors and other stakeholders will similarly derive benefit as they will acquire the facility to directly compare the level of risk accepted by a firm both absolutely and in comparison to others.

[34] Basel Committee, Principles for effective risk data aggregation and risk reporting, January 2013**, at** http://www.bis.org/publ/bcbs239.pdf

[35] For example, International Financial Reporting Standards (IFRS) or US GAAP

Risk Adjusted Return on Capital (RAROC)

RAROC is widely used to price the use of capital based upon the risk inherent in financial products. RAROC is calculated as:

$$Yield\ (RAROC) = (Inc_A – C_A – EL_A)/EC_A \quad (4)$$

Where Inc_A is revenue, C_A is cost and EC_A is economic capital. The ratio of Bank A RUs to benchmark RUs is then used to calculate expected loss as follows:

$$EL_A = (RU(R)_A/RU(R)_M) \times (PD \times LGD) \quad (5)$$

RU(R) is as defined in *(3)* above, for firm, asset or transaction *A*, and *M* corresponds to the market benchmark. Table 1 shows how the risk management performance of a department dealing with CDO transactions might be evaluated. Risk exposure, mitigation and residual risk data are collected from the outputs of Figure 9 above and compared to suitable benchmark data. Without the adjustment for RUs, EL_A is simply PD x LGD, so that in equation (5) the expected loss is adjusted proportionately to inherent risk and best practice mitigation.

The adjustment for the RUs impacts on yield as a function of the impact on expected loss and the other parameters of the RAROC calculation. As a consequence, the impact of inherent risk or deviation from benchmark best practice can be quantified in % or value terms, and because the number of RUs is known, the value per unit can also be determined. The value of post audit remedial actions can accordingly be quantified, so that, for example, if Bank A were to achieve the 60% Risk Mitigation Index, the effect would be to reduce the expected loss from £32.09m to £16.5m. In this example, operating risk-based RU calculations are used in a hybrid fashion with other current practices of risk quantification.

As the above example demonstrates, the RU has the potential to relate specific departmental level risks to a common standard of measurement across function and enterprise. It also has the potential for use in internal as well as external capital allocation decisions and performance measurement. A firm’s trading positions, on-balance sheet risk assets and off-balance sheet exposures can be processed through the same tables and templates applied in the risk accounting method described above whereby the underlying assumption is that on/off-balance sheet positions are comprised of open transactions that are mapped to the same product structure used in risk accounting. In this way, RUs are calculated that represent the risk exposure of a firm’s on/off-balance sheet positions.

Panel A		
Inputs from dept level risk audit[1]	**Bank A**	**Market or Benchmark**
Inherent risk	4200	4000
Best practice	56.43%	60%
Residual risk	1829.94	1600
Valuation metrics		
$RU(R)_A/RU(R)_M$	1.14	1
Probability of Default (PD)	0.006	0.006
Recovery rate	0.45	0.45
Loss Given Default (LGD)[2]	0.55	0.55
Expected loss	0.0038	0.0033
Panel B		
Bank A balance sheet or transaction reference data	**RU Adjusted £bn**	**Unadjusted £bn**
Loan value	100	100
Revenue	0.7	0.7
Cost	0.1	0.1
Calculated outputs		
Expected loss[3]	0.3774	0.3300
Adjusted income	0.2226	0.2700
Economic capital	2.8	2.8
Yield (RAROC)[4]	**7.949%**	**9.643%**
Yield reduction reflecting higher risk	1.694%	
Value equivalent (£)	£47,425,125	
Value per RU (£)	£25,916	

Notes:
Values taken from CDO product risk report (Figure 9) with fictitious benchmark data
1. Estimates based on rating agency data for a B-/CCC rated CDO
2. Economic capital based on discounted credit risk premium of loan value; revenue and cost based on spread, fee and overhead assumptions
3. Expected loss = PD x LGD x loan value
4. Yield = adjusted income (revenue – cost – expected loss) / economic capital

Table 1: Example RAROC Adjustment and RU Valuation

A Modified Capital Asset Pricing Model (CAPM)

Inasmuch as the RU contains all the principal risk types (credit, market, operational, liquidity, interest rate etc.) it forms the theoretical basis of a global adjustment to the required rate of return. In a universe of risky assets where investors are Markowitz risk/return optimisers and where there is an identifiable risk free asset, capital allocation is optimised for an investor with a given level of risk aversion by some combination of the risk free asset and the market portfolio of risky assets. These are the usual assumptions of the capital asset pricing model. If we can extend these assumptions so that the market portfolio contains the average number of RUs for all traded risky assets, a risk adjustment factor can be computed based on the RUs of any individual asset, a, as the ratio $RU(R)_{aA}/RU(R)_{mM}$. The ratio of individual asset RUs to the RUs for the average market portfolio RUs correspond to the linear adjustment of required return in the standard CAPM formulation:

$$R_A = RF + RU(R)_A / RU(R)_M \, (RM - RF) \qquad (6)$$

In this formulation the ratio $RU(R)_A/RU(R)_M$ substitutes for the CAPM beta. Otherwise the model relies on the other CAPM inputs for the risk free rate and risk premium. In addition to identifying a risk adjusted rate of return, *Ra* can be used as a capitalisation rate for economic income and economic capital calculations.

Equation (6) makes intuitive sense for certain reasons. First, if firm *a* is able to mitigate all its risk, then $RU(R)_A$ is zero and $R_A = RF$. Second, suppose firm *a* fails to adopt sufficient risk mitigation best practice so that $RU(R)_A / RU(R)_M > 1$, even though it has identical products to the market benchmark and therefore the same inherent risk. The required rate of return will be higher and the less than averagely efficient firm will be faced with a higher cost of capital. In an efficient market where RUs are disclosed or otherwise known to investors, required returns will be higher or lower than the market benchmark according to the number of RUs in the individual firm or asset. Unlike beta, which is distorted by stock market random events, the adjustment in *(6)* is determined by auditable internal data.

Against this, defenders of pure CAPM may prefer to argue that RUs can never capture all risk, due to the implied problems of computation and measurement and that the net effect of the unmeasured components of risk are satisfactorily captured in the variation of stock market returns and their covariance with market benchmarks. Accepting that view, a possible variation of (6) is to adjust the beta itself:

$$\beta' = \beta_A \times RU(R)_A / RU(R)_M \qquad (7)$$

Using β′ in (6), such that total risk is broken down into metricated risk and unmetricated residual market risk. To some extent, this decomposition is analogous to the approach used by Hamada (1969, 1972)[36].

An advantage of the method is that systematic risk can be evaluated independently of the distribution, so there is no requirement, as in mean-variance formulations to assume

[36] Hamada, R.S. (1969), ‘Portfolio analysis, market equilibrium and corporation finance’, *Journal of Finance*, pp.13-31.

Hamada, R.S. (1972), ‘The effect of the firm’s capital structure on the systematic risk of common stocks’, *Journal of Finance*, pp.435-452.

normality. In market based formulations of CAPM, including the adjustment proposed in (7), this remains a restrictive assumption that can be overcome by changing estimation methods, for example in the mean-Gini CAPM (Shalit and Yitzhaki, 1984)[37]. The likely distribution of beta computed using $RU(R)_A/RU(R)_M$ is clearly non-normal. More likely, pending further empirical testing, it is reasonable to assume a right skewed distribution with some truncation on the left. Benchmark best practice would tend to create clustering around achievable levels on the left of the distribution. On the right there would be a tail of under-performers in terms of best practice. These are the sorts of distributions tending to occur in quality control settings, for example where there is an upper limit of compliance and defects are below the required standard to varying degrees. (Hosking and Wallis, 1987)[38]. Although such a distribution presents potentially complex modelling issues, managers and regulators can benefit by focusing attention on areas of underperformance and associated risk.

Difficulties that are more problematic are shared with the CAPM, such as various methods for estimating risk premiums, which yield differing estimates ranging from 3% (Claus and Thomas, 2001)[39] to 8.4% (Brearley and Myers, 1996, p.180)[40] and the identification of the risk free asset. As with R*M* in the CAPM, in practice the market benchmark *M* is empirically unobservable and proxies are difficult to compute. Possible solutions to this problem include identifying traded assets with known betas close to 1 and decomposing that asset into component financial products and operations using the RU approach, thereby obtaining an estimated RU score for a beta = 1 asset or group of assets. The asset mix of firm *a* can then be compared using like for like RUs. Another problem that can be dealt with through careful adjustment arises from the summation of RUs across product, function and risk category. Because the market proxy is an average for all risky assets, a scale based adjustment factor is required for the individual firm. This can be done by building a market proxy that reflects the same profile of activities for the individual firm. That proxy in turn can be benchmarked against the beta = 1 asset defined above. A final problem for reconciling the RU approach to economic theory is that the Markowitz efficient frontier encapsulates the effects of diversification across products with differing risk covariances. In determining the RUs in the benchmark therefore, it is important that the effects of diversification are factored into the computation of inherent risk and the average RMI.

Risk Accounting Software

Overview

To achieve successful aggregation, integration and drive the dynamic evolution of internal and external benchmark data, it is necessary to ensure that appropriate software can be

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[37] Shalit, H. and Yitzhaki, S. *(*1984*)* Mean-Gini, Portfolio Theory, and the Pricing of Risky Assets The Journal of Finance 39: 5. 1449-1468

[38] Hosking JRM, Wallis JR, 1987, '*Parameter and Quantile Estimation for the Generalized Pareto Distribution'*, Technometrics, 29 (3): 339-349.

[39] Claus, J. and Thomas, J. 2001, 'Equity Premia as Low as Three Percent? Evidence from Analysts' Earnings Forecasts for Domestic and International Stock Markets', *Journal of Finance*, 55(5): 1629-66.

[40] Brearley, R. and Myers, S. 1996. *Principles of Corporate Finance*, McGraw Hill. 5th Ed.

developed. On the basis of the previous work of Hughes et al (2010)[41], proof-of-concept software was developed and the processing of complex transactions was simulated. The performance of the software and its outputs were assessed to determine whether empirical evidence of a practical and implementable solution existed that supported the theoretical model of a risk measurement system useful for monitoring and measuring enterprise risk and risk appetite. The purpose of the software was to test the method's functional implementation and generate formal outputs that could be assessed to determine whether the software can provide empirical evidence of a workable and implementable solution.

This paper does not comment in detail on the actual development of the software, suffice to say that it was undertaken as a web-based solution with due regard to best practices for the development of such a prototype. While this domain was clearly a complex domain it was agreed that a rapid development environment could be used to demonstrate the feasibility of the methodology (Fernandes, 2012)[42]. The Waterfall Model described by Boehm (1988: 63)[43] for the development of software was applied encompassing the following six stages: Feasibility, Analysis, Design, Implement, Test and Maintain. Importantly, functional and non-functional success criteria were predefined for the software whereby all applicable criteria were satisfactorily achieved.

The method adopted to assess the proposed solution involves, by reference to the literature review, the development of a set of high level requirements and an assessment of the extent to which these requirements are likely to be satisfied by the proposed risk accounting method and system. The assessment was undertaken by reference to the outputs of the prototype software. The requirements by which the system was assessed are as follows:

1. The risk accounting method must be replicable with outputs that are consistent and comparable across and between departments and enterprises, and, as is the case with any accounting system, outputs must be available in a timely, accurate and comprehensive manner.

2. The system of risk accounting must be based on a unitised valuation metric that is truly representative of exposure to the operational and internal and external financial risks of an enterprise that can be applied in enterprise risk measurement and risk appetite setting and monitoring as an extension of financial planning and budgeting. Interpretation of the outputs of the risk accounting system must facilitate an informed view of the maximum loss potential of the enterprise (inherent risk in RUs) and the probability of loss (residual risk in RUs).

3. In addition to the profitability reporting categories typically available in management accounting systems - organisational, business line, customer, product and geographic - risk accounting should additionally produce outputs by key risk category, e.g. internal

[41] See footnote 1

[42] Fernandes K, 2012, 'A Framework for Service Systems Analysis: Theory and Practice', *Production Planning and Control,* DOI: 10.1080/09537287.2011.640035.

[43] Boehm BW, 1988, *'A spiral model of software development and enhancement'*, Computer, 21 (5): 61-72

operating risk sub-divided into the actionable risk mitigating categories of manual processes, automated processes, and data quality and availability; and external risk sub-divided into credit, market, liquidity and interest rate.

4. Risk accounting must be truly measurement based, as opposed to assessment based, applied on an enterprise-wide basis and be capable of effective audit and regulation.

Assessment of Results

It should be noted that the current version of the prototype software only includes the functionality required at this early stage of the research and is also dimensioned according to the particular transaction type selected for simulation. Consequently, it is not presently in an implementable state and further development, research and testing are required. However, earlier versions of the software have been used in live pilots with financial institutions.

1. *Risk accounting must be replicable with outputs that are consistent and comparable across and between departments and enterprises and, as is the case with any accounting system, outputs must be available in a timely, accurate and comprehensive manner.*

The risk accounting method is replicable in any financial operating environment. The consistency and comparability of outputs across and between departments and enterprises can be assured provided the Product Risk Tables, Value Table and Best Practice Scoring Templates are standardised across the population of operating environments that are being evaluated.

In its present form, best practice scoring templates are predominantly manual and require the individual performing the assessment to manually select the benchmark that is most representative of the operating environment's current status (variable benchmark assessment) or indicate whether a particular statement of best practice is being complied with (binary assessment). Consequently, it can be argued that the results provided by the risk accounting software are only as accurate as the information input by the user, thus creating the dilemma of 'garbage in / garbage out'. However, the scoring templates are measurement based; are quite granular so as to mitigate individual errors of judgment while not distorting the overall scores; are intended to be populated initially with responses from at-the-source operating personnel; and, finally overviewed and adjusted first by supervisory personnel and then signed off by operating management. Once coupled with audit, and benchmarked against other departments and firms the reliability of the system's outputs will improve.

It is anticipated that over time the system will progressively incorporate automated interfaces between source systems and the tables and templates of the risk accounting system. In this way, inputs required by the risk measurement system that relate to or indicate the status of operating and risk mitigation practices will be dynamically updated from the operational metrics (Key Risk Indicators [KRIs] and Key Performance Indicators [KPIs]) that are available in, and can be provided by source systems. These metrics can be converted into delineated relative value risk weightings by reference to tables contained in the risk accounting system, and, thereafter, prorated into predefined Best Practice Scoring Templates against fixed intervals between zero and 100 and applied in the calculation of

Risk Mitigation Indexes. The variable notional values can, likewise, be dynamically mapped to the value band weightings and applied to the calculations.

As electronic sources of required metrics are created or identified and their input to the risk measurement system is automated they will progressively displace any manual inputs. This will cause the updating of the risk measurement system to become increasingly dynamic with the ultimate aim of achieving dynamic risk measurements in real-time.

The risk accounting system is designed to share the same general ledger interfaces as management accounting and, consequently, once fully operational will be able to produce outputs in parallel with management accounting with equal timeliness, accuracy and comprehensiveness.

2. *The system of risk accounting must be based on a unitised valuation metric that is truly representative of exposure to the operational and internal and external financial risks of an enterprise that can be applied in the budgeting of risk as an extension of financial budgeting and risk appetite determination. Interpretation of the outputs of the risk accounting system must facilitate an informed view of the maximum loss potential of the enterprise (inherent risk) and the probability of loss (residual risk).*

The RU is a unitised valuation metric that is unique to the risk accounting method and system. Unlike VaR the risk measurement technique contained in risk accounting does not rely on past monetary losses or the probability of future losses. Rather, by reference to a set of standardised tables, it calculates risk weighted transaction values denominated in RUs which are then accounted for.

The question to be addressed is whether inherent risk in RUs, the result of product risk and transaction volume and value weightings, is truly representative of maximum loss potential. There are arguments to suggest this is so given that all the risks triggered by a product and its notional value at the time it was transacted is considered in the calculation.

The difficulty lies in the abstract nature of ‘maximum loss potential’ and the consequent abstract value content of the RU and the need for financial institutions and their stakeholders to accept a valuation metric that is not represented in monetary value. This will be, at least initially, an alien concept. However, this concept is accepted as best practice in such financial activities as calibrating credit scores used as a proxy for creditworthiness and in accepting credit ratings as a proxy for default probabilities.

What can be affirmed at this stage of the research is that:

- The RU is able to function as a unique valuation metric that facilitates the direct comparison of diversified risk exposures in financial firms

- Risk accounting is designed to provide three concise risk metrics (inherent risk, risk mitigation index and residual risk). Case studies indicate that managers intuitively understand and positively respond to reports that use these three risk metrics (Thoresen 2007)[44]

[44] Thoresen T, 2007, ‘*The Marvel of Metrics’*, Inside Reference Data, 2 (8)

- There is a direct and dynamic linkage between changes in causal factors, as represented by the Risk Mitigation Indexes and the residual risk expressed in RUs

- It is possible to assign a monetary value to an RU over time through the statistical correlation of actual loss experience and the prevailing residual risk in RUs of the organisational unit that originated the loss

Budgeting plays an important role within financial and management accounting and 'risk budgeting' has emerged as a concept in the risk literature (Lee & Lam, 2001)[45]. Arnott (2002)[46] and Pearson (2002)[47] both discuss risk budgeting in terms of investment portfolios; however, it would appear that risk accounting transcends this approach by encouraging risk budgeting on an enterprise-wide basis. This offers interesting possibilities for the expression of an enterprise's risk appetite in both quantitative and qualitative terms.

While earlier pilots have found acceptance by management the research is unable to be conclusive at this stage on the acceptability and representativeness of the RU as a universal unit of measure applied to exposure to risk. A body of empirical evidence must be created from which the potential of this new risk measurement technique can be assessed. This work is planned for subsequent phases of the research first using simulations, interviews and surveys and, thereafter, pilots.

3. *In addition to the profitability reporting categories typically available in management accounting systems - organisational, business line, customer, product and geographic - risk accounting should additionally produce outputs by key risk category, e.g. internal operating risk sub-divided into the actionable risk mitigating categories of manual processes, automated processes and data quality and availability; and external risk sub-divided into credit, market, liquidity and interest rate.*

The current version of risk accounting takes into account the following types of risk; operational (sub-divided into manual process, automated process and data), and the internal and external components of credit, market, liquidity and interest rate risk. However this is not an exhaustive list of the risks to which financial institutions are exposed and future developments may consider other risks such as procurement risk, strategic risk, pensions risk, capital risk or compliance risk.

4. *Risk accounting must be truly measurement based, as opposed to assessment based, applied on an enterprise-wide basis and be capable of effective audit and regulation.*

Risk accounting is measurement based, aggregatable and, therefore, able to provide the same scope of reports as management accounting.

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[45] Lee W, Lam DY, 2001, *'Implementing Optimal Risk Budgeting',* Journal of Portfolio Management, 28 (1): 73-80

[46] Arnott RD, 2002, *'Risk Budgeting and Portable Alpha'*, Journal of Investing, 11 (2): 15-23

[47] Pearson ND, 2002, *'Risk Budgeting: Portfolio problem solving with value-at-risk'*, John Wiley and Sons RMA Industry Position Paper, 2008, *'Business Environment and Internal Control Factors (BEICFs)'*, Risk Management Association

A measurement based system such as risk accounting has the potential to revolutionise audit and regulation with respect to certifying and monitoring an institution's level of accepted risk relative to its approved risk appetite. The evidence from the literature review is that minimum capital requirements calculated in accordance with the Basel Committee's capital accords using stochastic techniques such as VaR did little to prevent banks from taking on too much risk. The adoption of the RU would appear to offer a more compelling alternative, perhaps a parallel direction to existing best practices in this regard.

Through the alignment of best practice scoring templates to, for example, sound practices and principles for the management and supervision of risks promulgated by the Basel Committee, Risk Mitigation Indexes can be positioned to reflect the degree of an institution's compliance.

The prototype software provided empirical evidence that the proposed system of risk accounting is both workable and implementable in mechanised form. The simulated processing of complex products provides further evidence of its capability to operate on an enterprise-wide basis. This is further substantiated by the fact that its operation will ultimately be dependent on the same interfaces with the general ledger and other source systems and coding conventions used by management accounting. The expectation is that, once it is fully functioning, risk accounting will replace much of what is currently reported and monitored in risk & control self-assessments, the internal capital adequacy assessment process (ICAAP) and Basel II Pillar 3 disclosures.

Conclusion

The purpose of the research to date is to show that the method of risk accounting, as described herein, is capable of providing a potentially valuable solution to the problems inherent in current risk management, accounting and reporting practices. In particular, three questions needed to be addressed:

1. Following a review of literature regarding current risk quantification and accounting practices, what issues exist within current practices and is there a need for new techniques?

2. Using the risk accounting framework elaborated by Hughes et al, is it possible to create working software for risk accounting?

3. Does the risk measurement technique described herein and related software provides a sufficient solution to issues identified within current risk quantification and accounting practices?

The evidence gathered through the literature review, particularly in light of the recent financial crisis, provides compelling justification in support of research into viable new risk quantification and accounting techniques. Realizing such new methods can potentially provide benefits that are incalculable, perhaps even fulfilling the long held belief that financial institutions and the financial system overall is capable of being measured on a risk adjusted basis thereby causing intuitive risk mitigation to be the natural outcome.

The software that was developed as an integral part of the research has proven that the proposed risk accounting technique is both workable and implementable and represents a potentially valuable alternative to current risk quantification and accounting practices. In particular, it has the ability to transform enterprise-wide risk measurement and reporting into a fully auditable process from which effective, universal risk mitigation and regulation can be applied. It also represents a step forward in addressing the creation of a ‘dedicated infrastructure for defining, measuring, monitoring and investigating systemic risk on a standardized, on-going and regular basis’ (Lo 2009)[48].

Recommendation

The York Management School, University of York and the authors of this paper are pleased to present this research. It is our belief that its potential value for each of the stakeholder communities vested in risk adjusted outcomes and elimination of the global contagion of systemic risk may be significant.

We wish to progress this research to encompass extensions of the software and the gathering and analysis of further empirical evidence in order to more precisely evaluate the proposed methodology. This requires active engagement with market participants through extended simulations of the software in representative operating environments along with interviews and surveys conducted amongst key market participants.

If readers of this paper are interested in participating or collaborating in this important work we request that you make contact with the authors.

[48] See footnote 19

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