



Internal Models Approach (IMA) for Market Risk

July 2010

Overview of IMA Guidelines (RBI Circular)

Internal model and its purpose

▲ What is an internal model?

- “A risk management system developed by the Bank to analyze the overall risk position, to quantify risks and to determine the economic capital required to meet those risks”

▲ What is the purpose of an internal model?

- To fully integrate processes of risk and capital management within the Bank

▲ IMA and VAR?

- Risk Management models in use – far more advanced than rigid rules
- Banks can use their own VaR models as basis for capital requirement for Market Risk
- VaR is a robust Risk Measurement and Management Practice

Steps for migration to IMA

Assess
Preparedness &
then notify RBI

- Assess overall preparedness
- Obtain Board approval of decision to migrate
- Notify RBI of intent to migrate

Formal Application &
obtain approval

- RBI to prescreen and then call for formal application if considered fit

Use of IMA
approach before
formal application

- Used the IMA model parallel to the SMM for a period of at least two calendar Quarters
- Back-tested them for performance during this period

Back – Testing &
Parallel run after RBI
approval

- Back testing for further 2 quarters after RBI nod before IMA use
- Parallel run of MRC for 3 years after approval (Prudential floor of 100%, 90% and 80% in each year).

IMA Scope Overview

Solo vs. Group	Bank				Group
Group Applicability	IMA approach for all group subsidiaries except for Insurance				
SMM or IMA	IMA for Bank				SMM for Group to start with.
Risk Factors	Interest Rate (GRC+SRC)	Equity Price (GRC+SRC)	Exchange Rate Risk	Commodity Price	Interest Rate, Equity, FX, Commodity, Options
Trading or Banking	Trading Book (HFT only)	Trading Book (HFT only)	Trading + Banking	N/A	Trading Book (HFT+AFS)
AFS Portf.	MRC as per SMM and add to HFT VAR				
MRC charge	VAR	VAR	VAR	-	
IMA or SMM	<ul style="list-style-type: none"> •To start with, IMA for GRC and SMM for SRC. •Also, SMM for insignificant portfolio. 				
Risk Factor insignificant	If any risk factor is insignificant, request RBI to permit SMM for that risk factor				
MRC - Total	Simple summation of MRC for each entity. Don't offset long/short positions Bank_IMA + group Subsidiary_SMM+ group Subsidiary_SMM...				

Other Salient Requirements of IMA

▲ IMA applicable on a PER RISK FACTOR

- Banks can apply IMA to one or more risk factors and SMM for the remaining portfolio
- But no cherry picking. Cannot use IMA for IRR for Bank and SMM for IRR for another business unit. Use has to be uniform across risk factor
- Banks using IMA for a risk factor cannot revert and use SMM for it in the future

▲ Daily monitoring of VAR under IMA

- Effective risk management systems to ensure that their intra-day market-risk exposures do not become excessive.

▲ Exemption from insignificant risk factor

- Seek exemption by written application to RBI justifying insignificant portfolio for a risk factor (IRR, Equity or FX)

▲ Notify RBI of breaches in conditions/restriction for grant of IMA

- Draw up action plan to remediate the situation and notify RBI of action plan

▲ Seek approval of RBI before major and significant changes to IMA model.

- Till grant of approval, continue to use old IMA model.

IMA - Qualitative Criteria

- ▲ Board and senior management should be actively involved
 - Daily reports for Risk Unit to be reviewed by Senior Management in order to take appropriate remedial action, if required
- ▲ Documentation of Policies, Procedures and model parameters
 - Bank's risk measurement system must be well documented to describe the basic principles of risk management system and to provide empirical techniques used to measure market risk.
- ▲ Maintenance of Market Risk Model Dossier
 - Ongoing, updated Dossier - to keep a record of the details of the model and of the changes / refinements,
 - Can be built by references and links to other policies, operating manuals
- ▲ Independent Risk Control Unit responsible for design and implementation of Bank's risk management systems
- ▲ Regular Back-Testing and stress testing
- ▲ Initial and on-going Validation of Internal Model
- ▲ Bank's Internal Risk Measurement Model must be integrated into Management decisions
 - Should be used in conjunction with Trading and Exposure Limits.
 - Should be well documented
- ▲ Independent review of risk measurement systems by internal audit

IMA - Quantitative criteria

- ▲ IMA capital a function of
 - Normal VAR
 - Stressed VAR
 - Incremental Risk Charge (IRC) (for positions subject to interest rate specific-risk capital charge)

- ▲ To start with, IMA to be modeled as given below
 - Normal VAR – General market risk
 - Stressed VAR – general market risk
 - Specific Risk Charge as per the Standardized Measurement Method as prescribed in Master Circular on New Capital Adequacy Framework

- ▲ GRC and SRC can be modeled together or separately.
 - However, should be able to enable day to day use and back testing insights.
 - If bank cannot model GRC and SRC separately, still be required to hold SRC as per NCAF SMM. Hence, extra capital

Parameters for normal VAR Computation

- ▲ Computed daily

- ▲ VaR computation be based on following inputs :
 - Horizon of 10 Trading days – Can use daily VAR and scale to 10 days
 - 99% confidence level
 - Observation period – at least 1 year historical data
 - Update data sets at least quarterly
 - Can use any type of model - variance-covariance matrices, historical simulations, or Monte Carlo simulations.

- ▲ Recognize correlation within Categories as well as across categories (FI and FX etc)

Parameters for Stressed VAR computation

- ▲ Intended to replicate a VaR calculation that would be generated on the bank's current portfolio
- ▲ The stressed-VaR should be calculated at least **weekly**
- ▲ The model inputs for the stressed VaR should be calibrated to historical data from a continuous 12-month period of significant financial stress relevant to the bank's **portfolio**
 - Example 2007-2008 period of crisis
- ▲ The said period of stress will be approved by the RBI as part of its approval for the IMA model submitted by the bank and would be regularly reviewed.

Market Risk Charge

$$C = \max \{VaR_{t-1}; (m_c + p_c) * VaR_{avg}\} + \max \{sVaR_{t-1}; (m_s + p_s) * sVaR_{avg}\}$$

where:

m_c and m_s are the multiplication factors to be set by the **RBI** on the basis of their assessment of the quality of the bank's risk management system, subject to absolute minimum of three for both the factors; and

' p_c ' and ' p_s ' is the 'plus' / 'add on' factor, generally ranging from zero to one, to be decided by the bank based on the results of the back testing of its VaR model,

The Multiplication Factor and Plus Factors

	Normal VAR	Stressed VAR
Mc Factor –Range	3 - 4	3-4
Mc –How used	Used to multiply 60 day Average normal VAR	Used to multiply 60 day Average stressed VAR
Mc–Who determines this factor	RBI	RBI
Plus Factor)Pc)– Range	0-1	0-1
Pc– How used.	Added to Mc and used for multiplying 60 days Average normal VAR	Added to Mc and used for multiplying 60 days Average stressed VAR
Pc – Who determines	Banks based on back testing results of NORMAL VAR MODEL and confidence in the model.	Banks based on back testing results of NORMAL VAR MODEL and confidence in the model.

Specification of Market Risk Factors

- ▲ For *interest rates*, there must be a set of risk factors corresponding to interest rates in each currency in which the bank has interest-rate-sensitive on- or off-balance sheet positions
- ▲ The risk measurement system should model the yield curve using one of a number of generally accepted approaches
- ▲ The risk measurement system must incorporate separate risk factors to capture spread risk
- ▲ For *exchange rates* (which may include gold), the risk measurement system should incorporate risk factors corresponding to the individual foreign currencies in which the bank's positions are denominated
- ▲ For *equity prices*, there should be risk factors corresponding to each of the equity markets in which the bank holds significant positions
- ▲ For *commodity prices*, there should be risk factors corresponding to each of the commodity markets in which the bank holds significant positions

Contents of IMA Application to RBI

IMA Approval Criteria and Formal Application Content

RBI approval for IMA based on following elements

- ▲ The assessment of a bank's risk management system
- ▲ Availability of sufficient number of skilled staff in trading, risk control, audit and TBO departments.
- ▲ Proven track record of the bank's models in measuring risk with reasonable accuracy
- ▲ Regular conduct of stress tests
- ▲ A period of initial monitoring and live testing of a bank's internal models, approvals by RBI

Contents of Formal Application to RBI for IMA

- ▲ Request for RBI approval of IMA model
- ▲ Internal audit report of the model
- ▲ **A Market Risk (MR) File - (See detailed slide)**
- ▲ **Market Risk Model Dossier (See detailed slide)**

Market Risk File – Important part of IMA Application

1

Describes the internal model, the risk-management control system and should substantiate the compliance with the quantitative and qualitative requirements of these guidelines.

1. Scope of Application of the Model

- ✓ Precise scope of application
- ✓ Scope should cover all trading activities subject to market risk
- ✓ Explain portfolios excluded from scope

2. Description of the exposures

- ✓ Details of the current exposures by product and risk factor
- ✓ The distribution of risk by business unit with the most detailed breakdown possible should be furnished

3. Estimation of Regulatory capital

- ✓ Estimated regulatory capital for market risk
- ✓ Both by IMA and SMM approach should be included

4. Policies and organisation

- ✓ Market Risk Organisation Chart
- ✓ Details of the responsibilities and functions of each governance component
- ✓ Focus on independence and segregation of roles
- ✓ List of internal manuals of policies, procedures, methodologies, and information systems that shape market-risk management, measurement, control and information.
- ✓ Authorized Products and their trading restrictions

5. Measurement systems

- ✓ Detailed description of the Methodologies of VAR estimates
- ✓ Model input values
- ✓ Market variables captured, with details of the sources and methodology of the secondary calculations
- ✓ Input values and integrity of positions subject to market risk
- ✓ Methodology for product valuation and VaR estimation, with a description of the valuation models used
- ✓ Coverage by model of the specific risk of fixed-income and equities.

6. Stress Analysis Programme

- ✓ Description of the structure of stress analysis programmes
- ✓ definition and selection methodology for scenarios, the periodicity and criteria for their review,
- ✓ Policies for limits on risk assumption in stress situations
- ✓ Information periodically supplied to the directors and senior management

7. Back Testing Programme

- ✓ Results of the previous year's back-testing
- ✓ Explanation of Back testing Exceptions
- ✓ Assessment of effectiveness of model on the basis of hypothetical or “clean” back-testing
- ✓ Details of additional tests performed at disaggregated levels

8. Technological Environment and Information Integrity Controls

- ✓ Description of the technological environment
- ✓ diagram explaining the systems involved in the process of measurement and control of market risk and information flows between systems
- ✓ Processes to reconcile positions between the trading-room, accounting and risk systems.
- ✓ Procedures to identify the boundaries of the portfolios included in the model.
- ✓ Procedures for the daily analysis of risk exposures.
- ✓ Procedures for validating the sources of market prices, their volatilities and correlations.

9. Structure of Limits

- ✓ Risk Limit definition, the hierarchical structure and the procedures established for their approval, modification, control and monitoring, and notification of excesses over such limits
- ✓ Use tests available to ensure the efficacy of the approved limits

10. Information Systems

- ✓ Details of the different regular or ad hoc reports, to notify the risks assumed
- ✓ Relevant information that ensures the effectiveness of the communication systems established for taking decisions
- ✓ Minutes of business and risk committees, the management of possible excesses over risk limits etc

11. Databases of relevant Information for MRM

- ✓ Daily VaR series, correlated at the overall and disaggregated levels, with the highest degree of detail available.
- ✓ Series of profits and losses used in back-tests, with the highest level of disaggregation available.
- ✓ Daily series of the various risk factors (interest rates, exchange rates, equity prices, implied volatilities in options, etc.) used in VaR estimates

12. Details of Tables of Applications to Calculate Market Risk

- ✓ Functional application manuals of the VaR calculation
- ✓ Tables of model input values (positions and market factors)

13. Future Developments and Implementation Schedule

- ✓ Any planned changes or future plans that have a bearing on the systems
- ✓ Incorporation of any units or portfolios subject to market risk initially excluded

14. Other Independent Assessments

- ✓ Copy of the internal audit reports should be submitted
- ✓ Reports of any external audits
- ✓ Tests performed to review the risk control systems
- ✓ The procedures implemented to measure and verify precisely and rigorously the position input values

Market Risk Model Dossier

▲ Elements to be covered

- Full technical specifications of the model;
- RBI approval for the model and for subsequent changes, if any, made to the model along with the conditions of approval
- Complete details and record of subsequent changes, revision of sources of external data, modifications in the applications, organizational changes, etc.) in the operation of the approved model.

▲ Suggested Format

- Authors responsible for the contents, date updated
- Description of the scope of application of the model
- Risk exposures and levels
- Policies and organisation
- Risk measurement system
- Stress analysis programme and results of the tests
- Back-testing programme and the results of the tests
- Uses to which the VaR is put within the bank
- Technological environment and information integrity controls
- Independent assessments of the model
- Weaknesses identified in the model and future developments planned

Organisation of Market Risk Function

- ▲ Front Office/Trading unit:
- ▲ Middle Office/Risk Control Unit:
 - Responsible for the design and implementation of the bank's market risk management system.
 - Analyze daily reports on the output of the bank's risk measurement model, including an evaluation of the relationship between measures of risk exposure and trading limits
 - Conduct a regular back-testing programme
 - Conduct the initial and on-going validation of the internal
 - Responsible for performing stress tests on the market risk exposures of the bank. model.
- ▲ Model Construction Unit – if built in-house
- ▲ Model Validation Unit
- ▲ Back Office
- ▲ Internal Audit

Model Validation

Internal Model Validation

Model Validation Objectives

- Review the logical and conceptual soundness;
- Compare the model against an identical model constructed by staff independent of those who constructed the first-mentioned model or another model chosen as a benchmark; and
- Review the back-testing done on the model, where back-testing is an appropriate validation process.

Three components of the model validation

- Model inputs component, which delivers data and assumptions to the Model
- Model processing component, which encompasses the theoretical model and the computer codes which transform the model inputs into mathematical estimates
- Reporting component, which translates the mathematical estimates into useful business information.

External Validation

Validation of models' accuracy by external auditors and/or supervisory authorities should at a minimum include

- Verifying the internal validation processes
- Formulae used in the calculation process as well as for the pricing of options and other complex instruments are validated by a qualified unit - independent from the trading area
- Structure of internal models is adequate with respect to the bank's activities and geographical coverage
- Results of the banks' back-testing of its internal measurement system
- Data flows and processes associated with the risk measurement system are transparent and accessible

Model Validation by RBI

- ▲ Assessment and adequacy of documentation
- ▲ Assessment of scope of the model
- ▲ Qualitative review
 - *Assessment of policies on risk management, organisation and procedures*
 - *Assessment of organizational structure*
 - *Assessment of uses of the model and of its integration in risk management*
 - *Analysis of internal audit reports*
- ▲ Assessment of technological environment and of information integrity
- ▲ Quantitative review
 - *Assessment of measurement system*
 - *Review of the essential features of the model methodology*
 - *Analysis of model accuracy (back-testing)*
 - *Assessment of stress-testing programme*
- ▲ Model Monitoring

Model Prerequisites

	Interest Rate	Equity	FX Risk	Commodities
Risk Factors	at least 6 factors for yield curve risk + separate risk factors to model spread risk	at least consist of beta mapping on an index, a more detailed approach could consist in adding industry factors, as well as individual risk factor modeling		the model should account for movements in the spot plus convenient yields
Options with each risk factors	Bank should also capture the non linear price characteristics of options (gamma, vega , ...)			

Stress Testing Programme

Stress Testing

- ▲ Stress testing to identify events or influences that could greatly impact banks is a key component of a bank's assessment of its capital position
- ▲ Stress scenarios need to cover a range of factors that can create extraordinary losses or gains in trading portfolios, or make the control of risk in those portfolios very difficult
- ▲ Stress tests should be both of a quantitative and qualitative nature, incorporating both market risk and liquidity aspects of market disturbances
- ▲ Banks should combine the use of supervisory stress scenarios with stress tests developed by banks themselves to reflect their specific risk characteristics
- ▲ Stress tests results should be reviewed periodically by senior management and should be reflected in the policies and limits set by management and the board of directors

Stress Testing - Scenarios Analysis

- Evaluating the portfolios under various states of the world
- Evaluating the impact
- Changing evaluation models
- Volatilities and correlations
- Scenarios requiring no simulations
- Analyzing large past losses
- Scenarios requiring simulations
- Running simulations of the current portfolio subject to large historical shocks e.g. 1987 crash, etc ...
- Bank specific scenario driven by the current position of the bank rather than historical simulation
- Much more subjective than VAR
- Can help to identify undetected weakness in the bank's portfolio

Back Testing Programme

Back Testing

Statistical testing that consist of checking whether actual trading losses are in line with the VAR forecasts

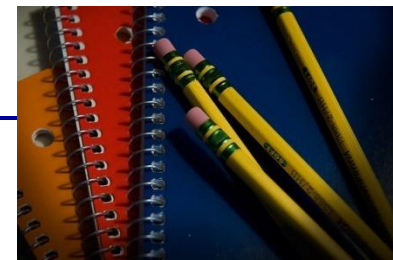
- The Basel back testing framework consists in recording daily exception of the 99% VAR over the last year
- Even though capital requirements are based on 10 days VAR, back testing uses a daily interval, which entails more observations
- A bank should also report to the RBI the results of their back-testing exercise every quarter before the last day of the month. In addition to exceptions, report to include:
 - Classification of exceptions and proposed investigations.
 - Action already taken or proposed to be taken for model improvement.
 - Number of exceptions observed during each of the last three back-testing results.
- Too many exceptions indicate that
 - The bank's systems are not simply capturing the risk of the positions themselves.
 - Model volatilities and/or correlations were calculated incorrectly
 - Models accuracy could be improved
 - Bad Luck or market moved in unanticipated manner
 - Loss due to intra-day trading

Back testing

Zone	Number of Exceptions	Increase in multiplication factor
Green Zone	0	0.00
	1	0.00
	2	0.00
	3	0.00
	4	0.00
Yellow Zone	5	0.40
	6	0.50
	7	0.65
	8	0.75
	9	0.85
Red Zone	10 or more	1.00

RISKPRO INTRODUCTION

Background and overview



▲ About Us

- Enterprise Risk Professionals LLP is registered in India in 2009
- 4 Founding Partners
- 3-4 anchor member firms associated and respected in their areas of business
- It is managed by experienced professionals with experiences spanning various industries.

▲ Mission & Objectives

- Provide integrated consulting services to mid-large sized corporates /banks in India
- Be the preferred service provider for Risk Management projects

▲ Value Proposition

- You get quality advisory, normally delivered by large consulting firms, at fee levels charged by independent & small consulting firms
- Timely complex of any task that we undertake. We achieve this by tapping into our talent pool, resources of our strategic alliances and if needed looping in third party

Risk Management Advisory Services

Basel II Advisory

- Market Risk
- Credit Risk
- Operational Risk
- ICAAP

Corporate Risks

- Enterprise Risk Assessment
- Fraud Risk
- Internal Audit
- Operations Risk

Information Security

- IT Audits
- Information Security

Operational Risk

- Process reviews
- Policy/ Process Review
- Process Improvement
- Environmental Risk
- Health & Safety Risk
- Product Risks

Governance

- Corporate Governance
- Business Strategic risk
- Fraud Risk

Other Risks

- Business/Strategic Risk
- Reputation Risk
- Outsourcing Risk
- Contractual Risk
- Physical Security Risk

Training

- Customized Training
- Regular Risk Management Training
- Online Training material
- Workshops

Recruitment

- Virtual Risk Managers
- Full Time Risk Professionals
- Part time Risk Professionals
- Risk Managers on call – free

RESUMES - MANAGEMENT

Manoj Jain

- ▲ **Founder - Enterprise Risk Professionals LLP**
- ▲ CA, CPA, MBA-Finance (USA), FRM (GARP)
- ▲ Over 10 years international experience – 6 years in Bahrain and 4 years USA
- ▲ 15 years exp in risk consulting and internal audits
- ▲ Most recent Sox Compliance project for Fannie Mae, USA
 - \$900+ Billion Mortgage Company
- ▲ Specialization in Internal Controls, Sox and Control design
- ▲ Led medium to large engagement teams

Piyush Kumar

- ▲ **Co-founder- Enterprise Risk Professionals LLP**
- ▲ Founder of PMG, a TQM Consulting Co in Delhi
- ▲ Mechanical Engineer
- ▲ Black Belt – Lean Six Sigma
- ▲ 20 years in TQM concepts.
- ▲ Strong skill set in various productivity & quality improvement projects including Six Sigma offerings
- ▲ Past experience includes projects initiated by reputed organizations like Andersen Consulting, Eicher Consulting & Nathan & Nathan consultants

Contacts

Mumbai

Manoj Jain

Director

Manoj.jain@riskpro.in

Delhi

Piyush Kumar

Director

Piyush.kumar@riskpro.in

Phone : +91 98337 67114

Email : info@riskpro.in



Web: www.riskpro.in



THANKS