

Market Risk Management

FRTB Imperatives & Implementation Challenges

Fundamental Review of Trading Book (FRTB) – An initiative from the Basel Committee on Banking Supervision (BCBS) aims at bringing in robust standards for managing Market Risk and to overhaul the current measures under Basel 2.5. FRTB addresses the current weakness in the computation of Minimum capital requirements for Market Risk as well as brings significant changes in Standardized approach & Internal Model approach, Approval process for Internal Models, Revised Data requirements and Front Office / Risk infrastructure of banks. This white paper provides an overview of main components of the change and the Implementation challenges faced by banks.

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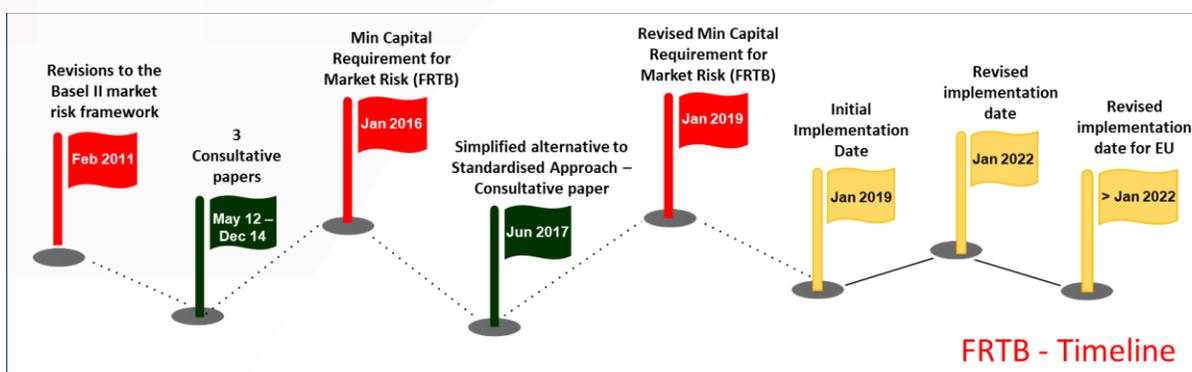
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1. EXECUTIVE SUMMARY

During the financial crisis of 2007-08, many firms were found to be under-capitalized in their trading book exposure, which was attributed to weaknesses in the prevalent Market Risk Capital framework. In response to this, the Banking Committee on Banking Supervision (BCBS) initiated the Fundamental Review of the Trading book (FRTB) to address structural flaws in the Market Risk Framework and introduced revisions on top of the 2009 Basel 2.5 market risk framework.

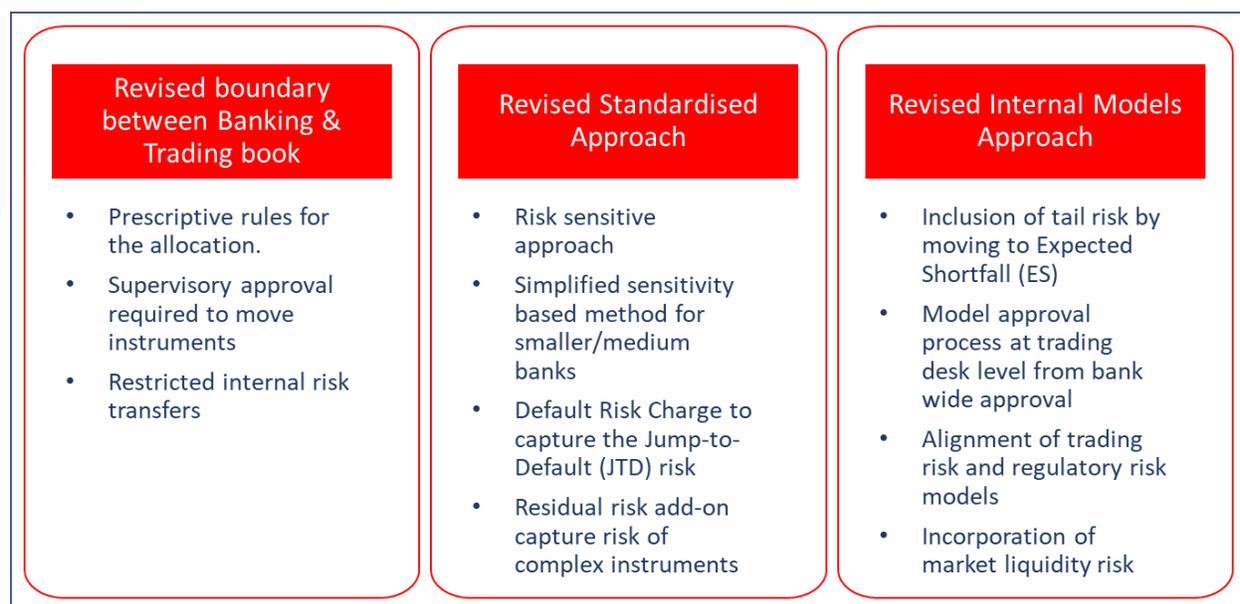
BCBS published Minimum Capital Requirement for Market Risk (FRTB) standards in Jan 2016 taking in to consideration the reviews and suggestions received on the consultative document published in May 2012, Oct 2013 and Dec 2014. The latest consultative document has been published in Mar 2018, proposing changes in areas like standardized approach, simplified alternative to standardized approach and risk factor identification. EU is planning to delay the actual implementation of the FRTB beyond Jan 2022 and the initial FRTB compliance mandate will have only reporting requirements.

This document focuses on FRTB requirements and attempts to identify the aspects that will significantly impact the traditional risk management methods of capital market players.



2. KEY FEATURES OF FRTB

Significant features and prescriptions / rules of FRTB are: Revised boundary between trading and banking books, Revised Standardised Approach, Revised Internal Models Approach and incorporation of market liquidity.



A. Revised boundary between the Trading Book and Banking Book

Banking Book positions which are carried at amortized cost and are subject to pillar 2 requirements, does not attract capital charge whereas Trading Book positions are subject to pillar 1 capital charge and are marked to market, attracting higher market risk capital charges. This led to the practice of indulging in regulatory arbitrage by firms to reduce capital charge by moving positions between Banking and Trading book.

FRTB has revised the guidelines for allocation of positions between Banking and Trading Book. It introduced 'the intent (of trading) rule' for definition of instrument & differentiation and prescriptive rules for the 'allocation'.

In general, positions which must be classified under Trading Book are the ones which are held with the intention of:

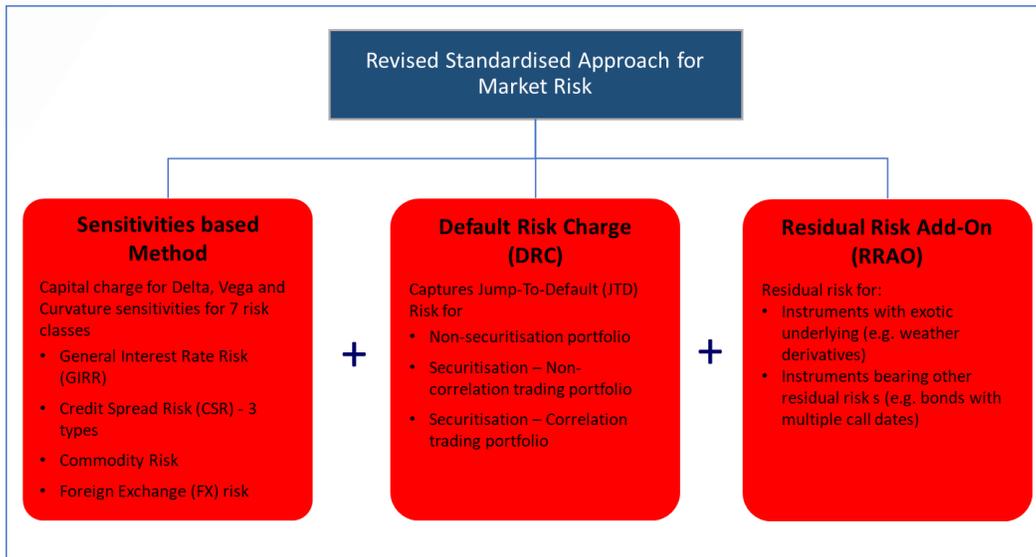
- a. Short-term resale
- b. Profit expectation arising out of short-term price fluctuations
- c. Generating arbitrage profits
- d. Hedging risk on any of the positions above or for hedging risk

Positions like unlisted equities, real estate holdings, hedge funds and any other position other than the prescribed trading Book instruments must be classified under Banking Book. Deviation from these rules will require significant reasoning from the bank and approval from regulator is required. After initial allocation, movement of positions between Banking and Trading book is allowed only in exceptional circumstances.

B. Revised Standardised Approach for Market Risk

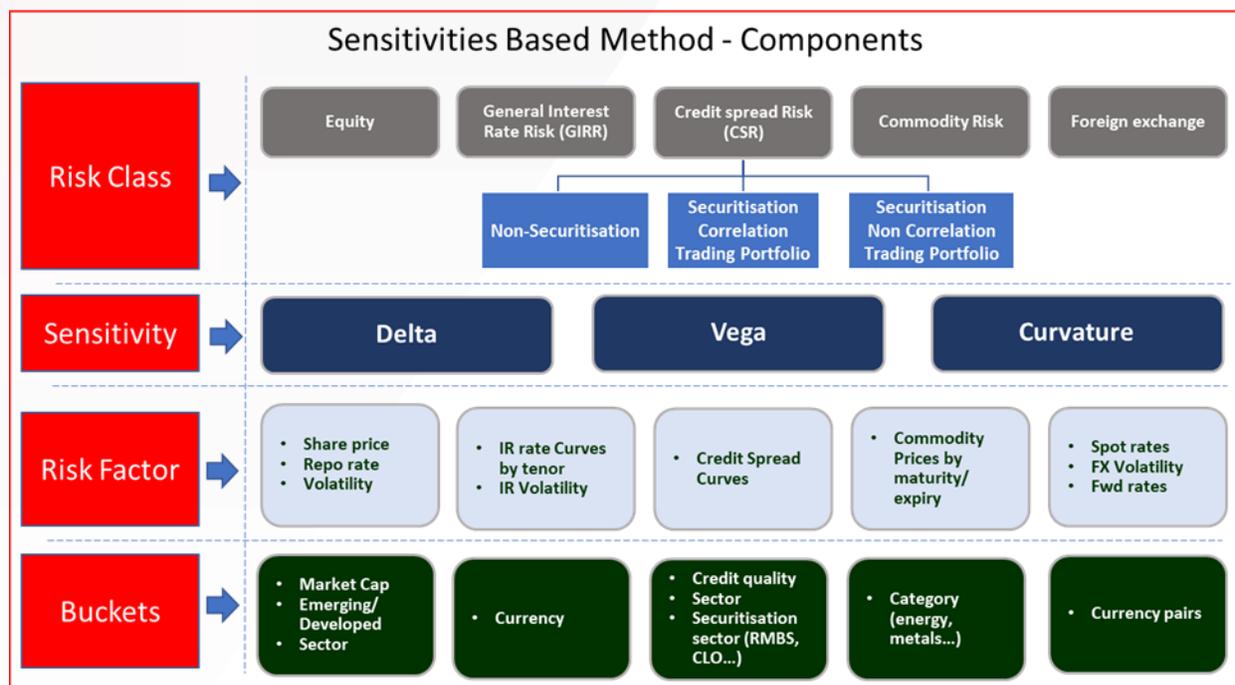
Several shortcomings were identified in the Standardised approach like lack of risk sensitivity, unlimited recognition of hedging & diversification benefits and inefficient capture of risk in complex instruments. The Revised Standardised Approach tries to address these shortcomings.

One of the notable changes is the use of sensitivities for the capital risk charge calculations and closer calibration with Internal Model Approach (IMA) by including risk weights of risk class and the varying liquidity horizon similar to IMA. The capital charge under Revised Standardised Approach is the simple sum of capital charge calculated under the Sensitivities-based Method (SbM), the Default Risk Charge (DRC) and the Residual Risk Add-On (RRAO).



I. SENSITIVITIES-BASED METHOD (SbM)

The use of sensitivity is already present in existing Standardised method but the revised one extends this to wide range of risk factors. Under Sensitivities-based method, seven risk classes (e.g. Equity, Credit spread) have been defined and within each risk class, three sensitivities - Delta, Vega and Curvature have to be calculated, if applicable. Sensitivity is a risk measure which captures how 'sensitive' is a position/asset with respect to a variable in the pricing/valuation model. These variables are called risk factors i.e. factors on which the risk of position/asset is dependent upon. Some of the examples of risk factors could be an equity index price which impacts the price of an equity or a 10Y interest rate which impacts the value of a long-term bond.



Delta measures the change in price of the asset/position due to change in price of the relevant risk factor while Vega measures the change in price due to change in volatility of relevant risk factor. Curvature sensitivity captures the additional risk due to changes in price which is not captured by delta risk for non-linear instruments. When curvature risk is managed holistically across instruments with optionality and without optionality, the instruments without optionality can also be included for curvature risk.

After calculation of Delta, Vega & Curvature sensitivities by risk classes, sensitivities are multiplied by prescribed weights and aggregated across & within buckets using regulator prescribed correlations to arrive at the overall market risk capital charge.

Summary of the Capital Charge under SbM method is as follows:

- Position to Risk Class Mapping:** In the new method, asset/positions are grouped in to one or more of the seven risk classes according to their risk characteristics. For example, a local currency equity option position might be mapped to only equity risk class whereas a corporate bond position could be under both General Interest Rate risk (GIRR) & Credit spread risk (CSR) since it is exposed to both this risk.
- Identification of Risk Factors:** Risk factors are market variables that impact the value of the positions and the risk factors applicable to specific positions are identified. This is generally done using product to risk factor mapping. Risk factors are mapped to a risk class.
- Calculation of Sensitivities:** Under each risk class, three sensitivities - Delta, Vega and Curvature must be calculated at position level using pricing models/libraries. Sensitivities measure the change in value of the position with respect to changes in the underlying risk factors like interest rate. For example, under General Interest Rate risk (GIRR), IR Delta measure the impact of change in risk free rate on the value of the position. Note that Vega and Curvature sensitivities are applicable only for assets with optionality.

- d. **Calculation of Weighted Sensitivity:** The calculated sensitivities are multiplied with prescribed weights to arrive at 'weighted sensitivities'. For assigning weights and correlations, BCBS has defined 'buckets' which differ by risk class.

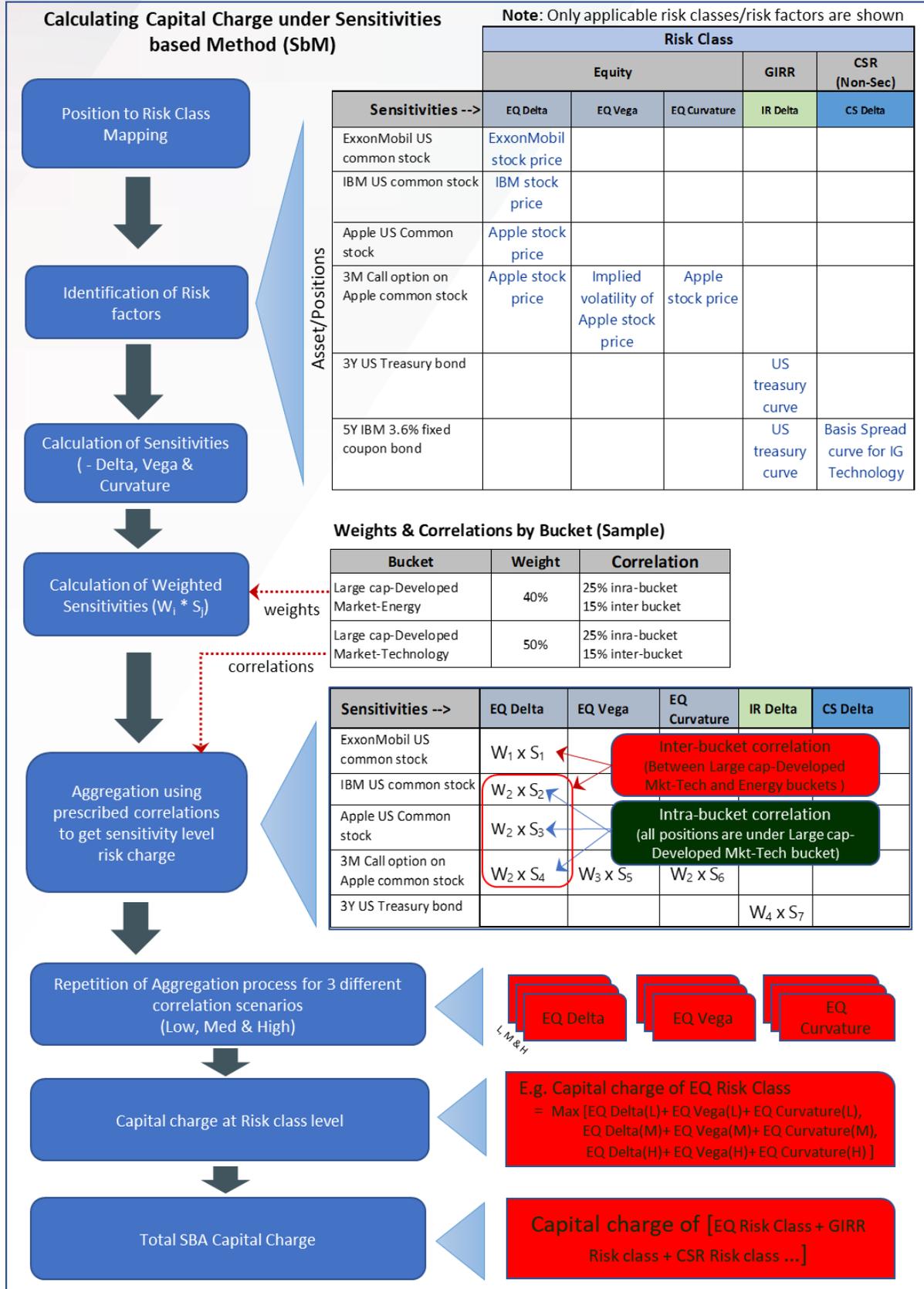
For example, under equity risk class, buckets are defined by market cap, economy (emerging or developing) & sector whereas under Credit Spread Risk (CSR), buckets are defined by currency, credit quality and sector (sovereign, finance, consumer goods). For example, 55% is the risk weight for a large cap, emerging market consumer goods share in the equity risk calculation.

- e. **Sensitivity level Risk Charge:** The weighted sensitivities are then aggregated within and across buckets using prescribed correlation and aggregation formulae to arrive at sensitivity level capital charge e.g. EQ Delta capital charge under Equity risk class.
- f. **Sensitivity level – Different Scenarios:** To cater to varying correlations during financial stress, 3 correlation scenarios – low, medium and high are defined and the sensitivity level calculations are repeated to arrive at capital charge for each of this scenario e.g. EQ Delta (Low), EQ Delta (Medium) and EQ Delta (High).
- g. **Risk Class Level Risk Charge:** The risk class level capital charge is then calculated as the maximum of the simple sum of capital charge of Delta, Vega and Curvature sensitivities for the 3 correlation scenarios.

$$\text{E.g. Capital Charge for EQ Risk class} = \text{Max} [\text{EQ Delta(L)} + \text{EQ Vega(L)} + \text{EQ Curvature(L)}, \\ \text{EQ Delta(M)} + \text{EQ Vega(M)} + \text{EQ Curvature(M)}, \\ \text{EQ Delta(H)} + \text{EQ Vega(H)} + \text{EQ Curvature(H)}]$$

where L, M, H refers to Low, Medium and High respectively

- h. **Total Capital Charge:** The total market risk capital charge is the simple sum of risk charge across risk classes i.e. there are no diversification benefits recognized between risk classes.



To facilitate adoption of FRTB by banks other than large and systematically important banks, an alternative (simplified) Standardised approach has been proposed. Under this approach, banks can use a simplified version of the Sensitivities based Method (SbM). This simplified SbM requires only Delta risk charges (no Vega and Curvature risk) along with simplified basis risk calculation and reduced risk factor granularity & correlation scenarios. There are no changes to DRC and residual risk add-on components under this approach i.e. alternative Standardised approach = Simplified SbM + DRC + Residual add-on.

II. STANDARDISED DEFAULT RISK CHARGE (DRC)

The use of sensitivity is already present in existing Standardised method but the revised one extends this to wide range of risk factors. Under Sensitivities-based method, seven risk classes (e.g. Equity, Credit spread) have been defined and within each risk class, three sensitivities - Delta, Vega and Curvature have to be calculated, if applicable. Sensitivity is a risk measure which captures how 'sensitive' is a position/asset with respect to a variable in the pricing/valuation model. These variables are called risk factors i.e. factors on which the risk of position/asset is dependent upon. Some of the examples of risk factors could be an equity index price which impacts the price of an equity or a 10Y interest rate which impacts the value of a long-term bond.

III. RESIDUAL RISK ADD-ON (RRAO)

This captures any other risks not captured under the sensitivities-based method or Standardised DRC method and is applicable for complex instruments. This provides a simple and conservative method of capital calculation - simple sum of gross notional amounts of the instruments having residual risks multiplied by a risk weight of 1.0% for instruments with exotic underlying and a risk weight of 0.1% for other non-exotic instruments.

The total market risk capital is sum of Risk capital from Sensitivity Based Method, Default Risk Charge (DRC) and Residual risk add-on (RRAO).

C. Revised Internal Models Approach (IMA) for Market Risk

Firms prefer to use Internal Model Approach since the standard approach do not accurately assess the capital charge on complex instruments and resulted in higher capital requirements. But IMA had inherent weaknesses, which the revised IMA is trying to address with enhancements like replacing VaR with Stressed Expected Shortfall (SES), Enhanced model approval process and limited recognition of diversification benefits.

I. EXPECTED SHORTFALL (ES)

Under revised IMA, Expected Shortfall (ES) method need to be used as risk of measure instead of Value-at-Risk (VaR) because ES considers both size and likelihood of losses beyond a certain confidence level but VaR measures only the minimum loss that can be expected & not the size of the loss beyond the confidence level. Therefore, ES ensures that tail risk is also captured. The stressed ES which is the ES calculated over a period of severe economic distress needs to be calculated for non-modellable risk factors.

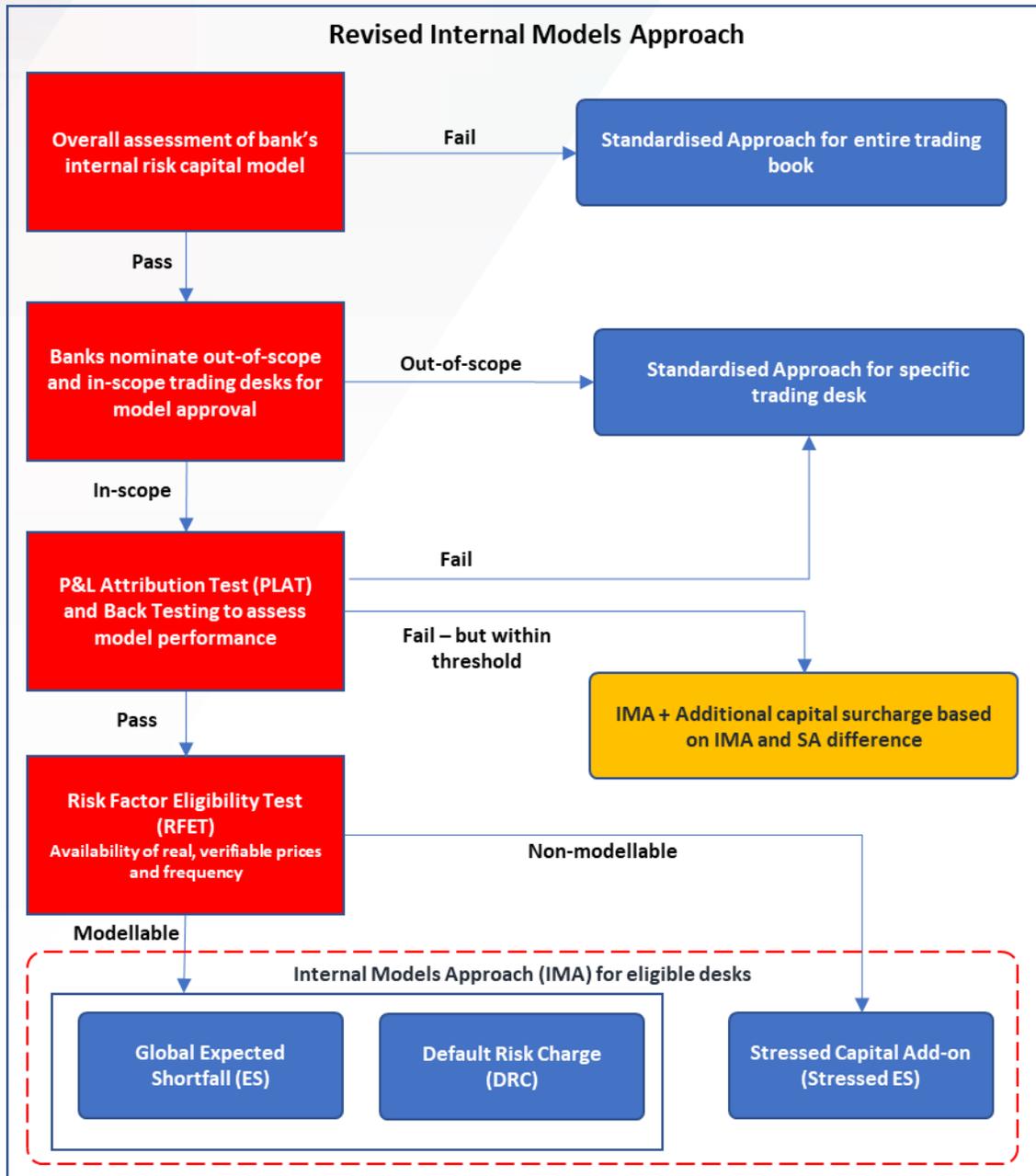
II. ENHANCED MODEL APPROVAL PROCESS

Internal models of risk management did not accurately reflect the risk of the underlying positions and firms experienced losses far more than what the models predicted. BCBS intends to fix this shortcoming by aligning the models with the actual profit or loss incurred in the position through quantitative tests and model approval process at the trading desk level.

IMA model approval for each trading desk is dependent on two quantitative validation criteria - Profit and loss Attribution Test (PLAT) and Back-testing.

The Back-testing requirements are similar to the earlier guidelines, but the PLAT offers challenges in adopting IMA. PLAT test tries to determine whether the P&L calculated using the front office trading risk management model (called Hypothetical P&L) matches with the P&L calculated by regulatory risk models (called Risk Theoretical P&L). Previously, P&L attribution test involved calculation of 2 metrics - a mean and a variance ratio which has been replaced with a correlation (Spearman) test and a Kolmogrov Smirnov or a Chi-Squared Test.

BCBS has introduced an amber zone wherein firms failing the PLAT need not have to fall back to SA directly but must include additional capital charges to the IMA capital charges. This is to avoid cliff-effect and facilitate smoother transition.



III. MODELLABLE AND NON-MODELLABLE RISK FACTORS

Once a desk qualifies for IMA, risk factors must further undergo Risk Factor Eligibility Test (RFET) to be eligible for modellable capital calculation (ES and default risk). Under this test, Banks must demonstrate that data getting in to models are from actual transactions or committed quotes and have at least 24 real price observations over a 12-month period with a minimum of four data points in a 90-day period. Alternatively, at least 100 data points over previous 12-month period is required. Additionally, for the eligible risk factors, banks must apply a set of principles to the data points used. Risk factors failing this test will be deemed Non-Modellable Risk Factor (NMRF) and will incur additional capital add-on.

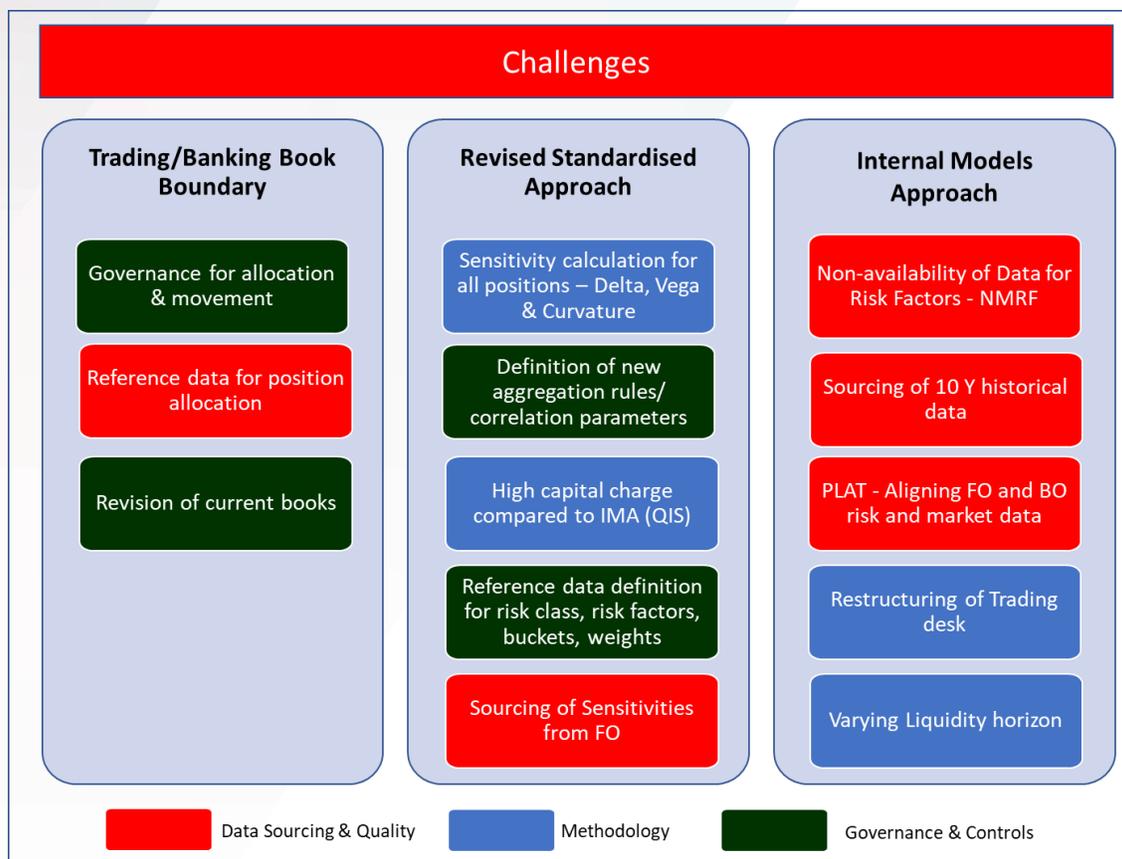
D. Incorporation of the Market Liquidity Risk

Under Basel II, it was assumed that banks can exit or hedge their trading positions over a 10-day period which turned out to be incorrect during the crisis wherein even perfectly liquid positions turned illiquid. To overcome this limitation, a varying liquidity measure has been introduced. Under IMA of FRTB, Banks' risk factors will be assigned to five liquidity horizon categories, ranging from 10 days to 120 days. Firms must calculate ES at base liquidity horizon of 10 days and scale up to the required liquidity horizon as per prescribed scaling formula. This will result in higher capital charge since liquidity horizon for illiquid assets can be as high as 120 days compared to the current approach of using 10 days across all asset class/risk.

		Liquidity Horizon (LH) under Revised IMA				
		10	20	40	60	120
Risk Factor Category	Equity	Price (Large cap)	Price (Small cap) Volatility (Large cap)	None	Volatility (Small cap) Other Risk factors	None
	Interest Rate	EUR, USD, GBP, AUD, JPY, SEK, CAD Domestic currency of bank	Currencies not specified under LH=10	None	Volatility Other Risk factors	None
	Credit spread	None	Sovereign (IG)	Sovereign (HY) Corporate (IG)	Corporate (HY)	Volatility Other Risk factors
	Foreign exchange	Rate for specified currency pairs	All other currency pairs not specified under LH = 10	Volatility Other Risk factors	None	None
	Commodity	None	Price: <ul style="list-style-type: none"> Energy and carbon emissions trading Precious metals and non-ferrous metals 	None	Price: Other commodities Volatility: <ul style="list-style-type: none"> Energy and carbon emissions trading Precious metals and non-ferrous metals 	Volatility: Other commodities Other Risk factors

3. CHALLENGES

Implementation of FRTB involves significant changes in business processes, technology and data across the entire market risk management landscape covering both the capital requirements and the front office risk management activities. Let us look at some of the challenges of FRTB.



A. Data sourcing and Quality

FRTB puts more emphasis on data sourcing and its quality – banks need to source sensitivities, market and reference data from Front office and third-party vendors and in parallel should ensure data is of sufficient quality irrespective of the methodology chosen – Revised SA or IMA. Under IMA, data for risk factors pertaining to complex embedded instruments will be scarce and getting real quotes will be challenging rendering the risk factor as non-modellable. Data vendors like HIS Markit, DTCC are in the process of building global data pools and Nordic banks are planning for local data pools to address these data challenges but still traceability and security concerns remain.

Risk and market data must be aligned between front and back office to ensure qualification under PLAT test. Therefore, huge volumes of data across asset classes have to be migrated from front to back office. For Revised SA as well, front office already has most of the sensitivities and therefore these have to be sourced in to risk systems for capital calculation.

B. Methodology

Quantitative Impact Studies (QIS) have shown that firms will incur significant increase in capital charges in both Revised SA and IMA methods. All firms will now have to calculate capital based on Revised SA to be used as fall back method in case IMA firms fail the quarterly qualification criteria. Firms might implement Revised SA for all trading desk and slowly move to IMA weighing the capital charge implications.

Ten years of historical market data need to be maintained for IMA which poses challenges in data volumes, generating analytical insights and data availability.

The varying liquidity horizon by asset class along with the prescribed correlation and aggregation rules make the methodology more complex.

C. Governance & Controls

Deviation from trading and banking book allocation rules needs substantial reasoning and regulatory approval. Movement of positions can be done only in exceptional cases and also without any gain in capital charge. Policies and procedures governing the movement of positions will play a vital role in adhering to regulatory mandate.

Eligibility tests for IMA qualification will involve maintenance of models across desks & asset classes, assessment, approval of results, data lineage and reporting capabilities.

4. CONCLUSION

FRTB brings in complete overhaul of the market risk capital framework and the implementation will involve teams across risk, finance, front office and IT divisions. Although the core components of the regulatory mandate have been finalized, the final rules are yet to be published because of which firms have to be flexible in their implementation approach. Firms will be able to manage Trading & Banking book boundary requirements through a long term or tactical solution. For the methodology changes, IMA firms might go forward with Revised SA approach for their trading desks and then switching on to IMA on a desk-by-desk basis and firms following Standardised approach might consider leveraging the front office risk management capabilities. Some of the open items like NMRF data, amber zone parameter calibration, effectiveness and coverage of reduced SbM methods will evolve and get finalized over a period.

One important outcome for the FRTB regulation is the realization of a greater need to align the market data sources, valuation models between Risk and Front office to clear the P&L Attribution tests. This means FRTB implementation may require not just an overhaul of risk infrastructure but also trading infrastructures for better alignment. In response to the needs of FRTB, there are multiple platform and data vendors providing solutions for various components like NMRF price feed, Risk Aggregation engines, reporting engines etc. Many Banks prefer flexibility as well as competitive advantage by building in-house tools, however as the needs getting more standardized the option to buy a vended solution is becoming more attractive.

Finally, the vital cog in successfully completing the journey is acquiring the talent to implement the solution. As the regulatory compliance list grows, it means higher demand of quality people who bring in to the table the relevant knowledge as well the holistic view on the regulatory impact. It is obvious that the entire talent pool cannot be sourced in-house and banks needs to select the right partners (vendors and FinTech's) who not only bring in the technical skills but also bring domain knowledge that is required for the job.

5. GLOSSARY

TERM	DESCRIPTION
ABS	Asset Backed Securities
BCBS	Banking Committee on Banking Supervision. It is the primary global standard setter for the prudential regulation of banks and provides a forum for regular cooperation on banking supervisory matters. It consists of 45 members who are central banks and bank supervisors from 28 jurisdictions
Buckets	Categorization of positions for market risk capital calculation. For e.g. equities are grouped in to Large cap and Small cap categories.
CDS	Credit Default Swap
CLO	Collateralized Loan Obligation
Curvature	Risk measure which captures the incremental risk not captured by the delta risk of price changes and is measured as the worst loss among two stress scenarios - upward shock and downward shock.
CVaR	Conditional Value at Risk. Another name for Expected Shortfall.
Delta	Sensitivity of a position with respect to underlying price of the risk factor
DRC	Default Risk Charge. Market risk capital calculation which captures Jump-to-Default risk.
DTCC	Depository Trust and Clearing Corporation. An American post-trade financial services company providing clearing and settlement services to the financial markets. They also provide data/information required for financial institutions.
ES	Expected Shortfall. A measure of risk of a position or a portfolio which quantifies the tail risk. It is defined as the average of all losses which are greater or equal than VaR.
EU	European Union. Political and economic union of 28-member countries in the European region.
FRTB	Fundamental Review of Banking Book. Set of regulatory proposals by BCBS to revise the market risk regulatory capital rules after Basel 2.5 reforms.
Hypothetical P&L	Profit or Loss of a position/asset calculated using the front office trading risk management models.
IHS Markit	London-based global data/information provider
IMA	Internal Model Approach. One of the methods of calculating market risk capital which uses bank's own internal models.
Jump-to-Default Risk	Jump to default risk for an instrument is the loss that will be suffered by the holder of the instrument because of default by the issuer of the instrument. This is captured by the default risk charge in FRTB
LGD	Loss Given Default (LGD) is the share of the loan/asset lost when the borrower defaults
Liquidity horizon	The time required to extinguish/close/sell/hedge a position/asset without materially affecting market prices in stressed market conditions.

TERM	DESCRIPTION
Market risk	The risk of loss in a position/asset/portfolio due to movement in market risk factors like price, volatility.
MBS	Mortgage Backed Securities
NMRF	Non-Modellable Risk Factor. Risk factors which are deemed non-measurable using models.
PLAT	Profit & Loss Attribution Test. A test under FRTB to measure how good the risk calculated for regulatory purposes (Risk Theoretical P&L) match with the risk calculated at front office (Hypothetical P&L).
QIS	Quantitative Impact Study. Studies conducted to analyze the impact of new regulations.
Reduced SbM	Reduced Sensitivities based method. Applicable only for a subset of banks which are not large and systematically important banks.
Risk Class	Categorization of risk
Risk factor	Factors on which the risk/value of a position/asset is based upon. E.g. the value of an equity option position depends on the price and volatility of the underlying equity. Price and volatility are called risk factors here.
RFET	Risk Factor Eligibility Test – the eligibility test for risk factors for the purpose of classifying them as modellable.
Risk Theoretical P&L	Profit or Loss of a position/asset calculated by regulatory risk models
SA	Standardised Approach. One of the methods of calculating market risk capital where banks use the method defined by regulator/supervisor.
SbM	Sensitivities based method. One of the methods under Revised Standardised Approach where in sensitivities with respect to risk factors are used for calculating market risk capital
Securitisation Correlation Trading Portfolio	Portfolio consisting of securitisation positions and nth-to-default credit derivatives that meet the following criteria: <ul style="list-style-type: none"> • Securitisation positions - ABS, MBS securities, CLO, referenced single named CDS, nth to default CDS (referenced on a nth entity). • Any derivatives used to hedge the positions within this securitisation portfolio is allowed to be considered. • Options on Securitization (Example TBA) are not allowed to be part of correlation trading portfolio
Securitisation Non-Correlation Trading Portfolio	Securitisation positions which does not fall under the definition of Securitisation Correlation Trading Portfolio
Sensitivity	A measure of risk which captures how 'sensitive' is a position/asset with respect to a risk factor. Example Delta is a sensitivity which measures how the value of a position/asset varies when the price of the asset varies.
Stress VaR	VaR calculated over a period of severe economic distress.
TBA	To Be Announced (TBA) securities are forward settling mortgage-backed securities (MBS) issued by Freddie Mac, Fannie Mae and Ginnie Mae in the TBA market. The name 'To Be Announced' is due to the fact that the actual MBS that will be delivered to fulfill a TBA trade is not designated at the time of the trade and is agreed upon later.

TERM	DESCRIPTION
VaR	Value at Risk. It is a measure of risk of a position or a portfolio. It is the estimate of what is the minimum loss expected (with a given probability) within a set time period such as a day.
Vega	Sensitivity of a position with respect to volatility of the underlying risk factor

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