



**WHITE PAPER**

# **FRTB—BEYOND COMPLIANCE**

**How trading infrastructure  
can become more flexible  
and cost-efficient**

**( THE FUTURE OF  
FINANCE IS OPEN**

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# EXECUTIVE SUMMARY

**The Fundamental Review of the Trading Book (FRTB) is indeed fundamental in the impact it will have on both the market risk capital charge and front office and risk management technology. The regulation is scheduled to replace the current Basel 2.5 Standardized Approach (SA) and Internal Model Approach (IMA) for capital charges in January 2020, with banks performing parallel runs during 2019.**

FRTB gives banks the flexibility to apply for IMA on a desk-by-desk basis. However, IMA implementation is extremely complex, entailing at least an order of magnitude increase in valuations and aggregation load compared with traditional historical Value-at-Risk (VaR). In deciding between IMA and SA for a desk, banks will need to weigh technology costs and project risk against the cost of the additional capital charge.

Banks that opt for the simpler SA across all desks, accepting the steep increase in capital charges, will want a cost-effective way to comply, taking into account the prescribed need to extract new sets of sensitivities from all the front offices<sup>1</sup>.

They will also want a solution that gives them the option to upgrade at least some desks to IMA over time—in terms of investigating and optimizing capital charge under the SA regime, tools to decide if and which desks to migrate, and the technology to extend the solution to IMA.

Banks that intend to upgrade to or re-apply for IMA for some or all desks face a technology investment that is far too significant to be simply treated as a compliance cost. The substantial increase in calculations and the need to align trading and risk management valuations that FRTB demands will push banks towards single valuation services shared by front, risk and middle office and powered by advanced analytics.

<sup>1</sup> Paragraph 49: “A key assumption of the Standardized Approach for market risk is that a bank’s pricing model used in actual profit and reporting provides an appropriate basis for the determination of regulatory capital requirements for all market risks”. In other words, while the prescribed SA sensitivities are new, and not calculated today in any system, the bank still needs to calculate them in the same mechanism used today for official P&L. In the IMA case, the requirement is not explicit. However, banks that use a separate risk framework to calculate the PVs feeding the expected shortfall are taking the risk of not passing the IMA test and hence falling back to SA.



**A technology solution must balance the need for compliance on time and at low risk, preferably leveraging existing technology, with using FRTB investment to achieve incremental and ongoing advances in technology infrastructure flexibility and efficiency while reducing overall costs.”**

The magnitude of an FRTB project will force banks to review and reduce their dependency on trading and Enterprise Risk Management (ERM) systems that are monolithic, where functions are woven in with each other rather than architecturally separate, and inflexible. In particular, FRTB reintroduces trading to risk, and, hence, reinforces the importance of advanced trading system capabilities and the trading systems’ agility in introducing them. Architectures that separate functions into defined components that allow new functionality to be added easily will facilitate change to help banks achieve compliance under tight budget constraints.

And, the sensitivity of the FRTB capital charge to desk structure and trading book composition will drive banks to seek mass-aggregation technology that allows for ongoing capital charge analysis and optimization. A technology solution for FRTB must balance the need for compliance on time and at low risk, preferably leveraging existing technology, with using FRTB investment to achieve incremental and ongoing advances in technology infrastructure flexibility and efficiency while reducing overall costs.

An open component-based solution can offer modules for FRTB-specific functionality while integrating with existing in-house or third-party systems infrastructure to suit an individual bank’s circumstances. Banks opting for SA can benefit from a pre-packaged configuration of FRTB components that integrate easily with front office systems. Banks opting for IMA for some or all desks will want a flexible solution that fits with their current technology infrastructure and planned strategic development while maximizing the long-term business benefits of FRTB investment.

# Sweeping Changes Ahead

The Fundamental Review of the Trading Book (FRTB) radically changes the calculation methodologies for both SA and IMA in a manner that will make banks reassess business models, trading desk structures and desk viability, as well as their underlying technology.

Capital charges for SA and IMA will vary enormously according to a bank's trading and banking book structure, but on average they will increase significantly. The SA charge is expected to be a multiple of the current charge in some cases, making it prohibitively expensive to continue with certain desks. Furthermore, some trade types (e.g. FX and commodities) that could be capitalized under the banking book will now be liable for FRTB.

Both SA and IMA require a review of existing capital calculation processes. All banks need to comply with the new SA for all the desks, and those that had approval to use the IMA under the previous regime need to reapply for FRTB IMA on a desk-by-desk basis. The main challenge for many banks will be to align FRTB risk calculations with front office market data and models. Without such alignment, IMA desks could fail the prescribed compliance tests and have to revert to SA. SA also needs to be calculated with the front office models.

### IMA or SA?

FRTB gives banks the flexibility to apply for IMA on a desk-by-desk basis. However, IMA implementation is hugely complex, entailing at least an order of magnitude increase in valuations and aggregation load compared with traditional historical Value-at-Risk (VaR). In deciding between IMA and SA for a desk, banks will need to weigh technology costs and project risk against the cost of the additional capital charge. Even if they opt for SA, banks will need to consider the likelihood of having to comply with IMA in the future, as well as find a path to compliance that does not restrict future business growth or technology consolidation. There are other alternatives to IMA for reducing capital charges, but they typically involve changes in business practices, such as lowering limits for overnight risk.



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Banks that opt for the simpler SA across all desks, accepting the steep increase in capital charges, will want a cost-effective way to comply, taking into account the prescribed need to extract new sets of sensitivities from all the front offices. They will also want a solution that gives them the option to upgrade at least some desks to IMA over time—in terms of investigating and optimizing capital charges under the SA regime, tools to decide if and which desks to migrate, and the technology to extend the solution to IMA. There are several possible technology approaches, which will differ in the cost of integrating front office and risk systems, in the ability to upgrade to IMA, and in the ability to adapt to evolving risk practices (such as calculating capital charges pre-trade and enforcing enterprise limits).

Banks that intend to upgrade to or reapply for IMA for some or all desks face a technology investment that is far too significant to be simply treated as a compliance cost. FRTB IMA will carry large ongoing technology and operational costs beyond the compliance date. Therefore, it will be essential to define an efficient target architecture and take continuous steps towards it to avoid mounting costs that negate the capital charge reductions that are the *raison d'être* of IMA. Banks should look for flexible IMA solutions that allow them to reuse existing technology assets where possible with investment in new elements to meet FRTB requirements. Key ingredients of a successful solution are likely to include shared analytics services, component-based architectures and capital charge optimization.

The vast increase in calculations and the need to align trading and risk management valuations that FRTB demands will push banks towards single valuation services shared by front, risk and middle office and powered by advanced analytics. The magnitude of an FRTB project will force banks to review and reduce their dependency on trading and ERM systems that are monolithic, where functions are woven in with each other rather than architecturally separate, and inflexible. Architectures that separate functions into defined components that allow new functionality to be added easily will facilitate change to help banks achieve compliance under tight budget constraints. And, the sensitivity of the FRTB capital charge to desk structure and trading book composition will drive banks to seek mass-aggregation technology that allows for ongoing capital charge analysis and optimization.

# Wide-Ranging Decisions

**FRTB requires banks to make early and far-reaching decisions regarding implementation. Banks need to finalize their trading and banking book boundaries, and complete their impact studies to understand the new trade categorization and capitalization methods and the impact FRTB will have on their capital charge and desk organization.**

Banks will need to reassess their trading and banking books under the new regime. Some trade types (e.g. FX and commodities) that could be capitalized under the banking book will now be liable for FRTB. Trades that are eligible for internal risk transfer, such as asset and liability management hedges, are not capitalized under FRTB.

Because of the significant time, project risk and investment required to achieve IMA approval, banks will have to carefully assess each desk covered by FRTB. Will the initial and ongoing investment in IMA outweigh the reduction in capital charge compared with SA? If so, banks will have to adopt SA or, in extreme cases, close the desk. Where IMA is viable, banks will also need to assess whether they can implement it on time. To meet the deadline, they are likely to need to optimize desk organization, market data management, project risk and technology costs. Potential benefits beyond pure compliance should also be considered where possible. Some banks may decide to start with SA for some desks, with the option of upgrading to IMA at a later date.

Both IMA and SA are significantly more conservative than Basel 2.5. IMA approval is by desk and risk factor and not bank-wide, as under the previous regime, and is much harder and more costly to obtain. Approval is based on stringent quantitative metrics—in particular, P&L attribution and back-testing. Data quality criteria are more rigorous, requiring banks to demonstrate that the data going into models is from real transactions, with minimum frequencies for observations of risk factors.

All desks must calculate the revised SA, irrespective of whether they have IMA approval. Any failure in back-testing or P&L attribution means banks must automatically revert to SA.

“  
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### Changes from Basel 2.5 and their Impact

Compared with Basel 2.5, the capital charge under FRTB for both SA and IMA is highly dependent on risk factors and the range of instruments traded by each desk, and typically requires simulations to assess the exact impact. Industry impact studies have produced a wide range of results, from as few as tens of percent to several hundreds of percent increases in the charge. The SA charge could be a multiple of the IMA charge. The IMA charge is sensitive to Non-Modellable Risk Factors (NMRFs), which are dependent on high-quality data and, therefore, good market data maintenance. As a consequence, banks must carefully weigh the high technology cost of IMA against the high capital charge of SA.

Under the current Basel 2.5 regime, IMA eligibility is not determined by prescriptive tests. Rather, the regulator judges each bank individually and by desk, and a back-testing failure results in a charge multiplier. Under FRTB, IMA eligibility is by desk and based on explicit tests (back-test and P&L attribution), where failure requires reverting to the SA charge. However, banks can choose to invest in IMA for only a subset of desks.

SA calculations under FRTB are more complex than under Basel 2.5. The sensitivity-based approach requires extraction of delta and vega sensitivities for trades, as well as a curvature stress test from the front office. Multiple weighted aggregations must then be applied across different risk factors and buckets. FRTB's default risk charge and residual risk add-on require the classification of trades and must be applied to rules on present value (PV), notional value and jump-to-default. This requires the extraction of new measures from the front office, and a move from approximations to full valuation of trades. Also, banks must implement multi-level aggregation rules. Front office and risk management integration will help facilitate this.

IMA calculations under FRTB are also more complex and are resource-intensive, particularly those involving multi-level weighted expected shortfall of modellable factors. Less resource-intensive are the calculations for the NMRF charge, default risk charge, P&L attribution and back-testing, but still entail new formulas.

This demands highly complex front office and risk integration, with a massive increase in analytical capability to support typically tenfold or more of the number of calculations compared to a standard one year HVaR<sup>2</sup> (compared with the one year historical VaR of Basel 2.5).

### Standardized Approach Considerations

SA is mandatory for all banks with desks falling under FRTB—either as the only method applied across some or all desks or as the fall-back charge for desks that fail the IMA back-testing and P&L attribution criteria.

The FRTB SBA component of the SA capital charge is calculated using a prescriptive aggregation of bucketed sensitivities and parallel shifts. The current SA regime does not require sensitivities as inputs. Furthermore, the regulator requires these measures to be consistent with the sensitivities used for front office risk management and official front office P&L. Note that FRTB is not a ‘second line of defence’ regulation, but rather a capital charge against the risk taken by the bank and its behavior in worst-case scenarios. Hence, the FRTB calculations should be consistent with the trades, market data and models used by the front office for daily active risk management and official front office P&L.

For banks that opt for IMA, SA implementation considerations will form only a small subset of the overall IMA considerations, yet they should not be underestimated. For banks that go for SA across the board, the main considerations are project cost, and the auditability and extensibility (including for IMA) of the proposed solution.

Potential SA solutions will differ in their integration costs. For most banks, FRTB SA will require more than re-aggregation of existing information and calculations already done in enterprise market risk applications. New information is needed, and a significant portion of project costs will be related to integrating with and extracting raw input from one or more front office systems. In terms of aggregation engine capabilities, SA, while not as calculation-intensive as IMA, nevertheless requires complex aggregation logic (across buckets, assets, multiple correlation cases and desks), as well as traceability of results, and the ability to understand attribution of inputs. Banks will need to look at extending front office or ERM systems, or the use of in-house and third-party modules.

A front office system that holds a significant proportion of the trading book could offer an efficient option for SA since it will already have trades, market data and models, plus the ability to configure reports with the required measures. An extension module for the selected front office system should be able to handle SA calculations for all positions held in the selected front office, with a simple interface for sensitivities and parallel shifts for the remainder of the positions outside this system.

ERM systems typically consolidate all trades and market data from front office systems, but are unlikely to have all the new required sensitivities or all the front office pricing models. If the ERM lacks the front office pricing models, an SA extension module would likely involve significant re-integration of all front office systems and the re-configuration of reports.

Opting for other in-house or third-party modules for SA will have similar integration overheads as for a front office system extension, as well as maintenance overheads if the module adds to an already fragmented technology infrastructure. FRTB figures must be calculated daily and reported monthly, and must be auditable. The SA solution should allow for easy tracking of calculations and drill down to intermediate results at any aggregation level or consolidation of data sources. The conditions that determine the choice of SA or IMA may change over time, so banks will need to continuously assess the viability of SA at desk and product levels.

The FRTB capital charge is the latest in a growing list of measures that banks must check before a trade is done, including total cost of doing a trade, various value adjustments (XVA), and internal compliance and credit risk measures, and will force banks to review their enterprise compliance limit frameworks. Although SA banks are likely to focus first on mandatory compliance issues, they will need to extend the FRTB solution in the future to support pre-deal capital charge checks and the impact of limits. This is in addition to the requirements they must meet for the Basel III Standardized Approach for Counterparty Credit Risk (SA-CCR) and enterprise limits in general. Such extensibility will be easier to achieve if the front office systems have open limits architectures.

Forward-looking banks would also want to future-proof their SA capital charge solutions to enable them to switch desks to IMA within a reasonable timeline and cost.



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<sup>2</sup> The calculation load depends on the books’ composition and on the depth of historical market data per desk. Desks that depend on a small number of modellable risk factors that are spread across a small portion of the full range of liquidity horizons will require fewer calculations. Typically banks should run expected shortfall (ES) on 3 periods—“stressed historical period on a reduced set of risk factors”, “recent period on the full set of risk factors”, “recent period on a reduced set of risk factors”. For each of the 3 periods, the bank needs to calculate ES on up to 21 sets of historical shocks scenarios: Each of the 5 asset classes has to be shocked independently of the others (i.e. shocked while factors from other assets are frozen). FX, IR, EQ and CMD are shocked across up to 3 liquidity horizons, CRD across 4. Then all assets are shifted together across all 5 horizons (3+3+3+3+4+5 = 21). Shifting across horizon n, means freezing all factors in horizons < n, and shocking the rest.

### Internal Model Approach Considerations

FRTB functional requirements are prescriptive, and all IMA solutions will need to provide all the necessary functionality. Solutions will differ in project methodology and technology architecture, with implications in terms of project risk and cost and ongoing running costs, as well as the ability to obtain value from the solution beyond compliance. The main factors to consider when choosing a solution for IMA are market data, pricing, aggregation, and the impact on current and planned IT infrastructure.

Under IMA, banks will have to gather and maintain ten years of historical market data that complies with modellable risk factor rules to maximize the trades which are eligible for the expected shortfall-based charge, and to be able to adjust the stress period used in the expected shortfall calculations.

Banks will have to obtain raw pricing (PV vectors for expected shortfall of modellable risk factors, stress test results for NMRFs, and sensitivities for SA) from all desks. This information must be sufficiently consistent with the front office to pass the P&L attribution test, and will require a huge increase in calculation resources.

Banks will have to orchestrate the entire IMA process, including enabling SA for all desks, with the calculation of scenarios for pricing, aggregation of pricing vectors for multiple expected shortfall calculations, and calculation of add-on charges (NMRF and default risk charge). In addition, the solution should be able to perform back-testing and P&L attribution tests, and adjustment of the monthly stress period. This will require high performance mass-aggregation technology, which must also provide granular audit trails for regulatory monitoring and tools for ongoing capital charge optimization (e.g. simulations of alternative desks structures and granular charge attribution).

An IMA project will impact both front office and enterprise risk technology for many months and is likely to coincide with other regulatory projects and ongoing initiatives aimed at system simplification and cost reduction. As a result, there will often be trade-offs between meeting regulatory deadlines and leveraging FRTB projects for business benefits.



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# When Consistency is Key

**Historically, market risk departments could gain internal model approval by using different models from those used in the front office. As a result, there is often only partial modeling consistency between the front office and risk.**

While FRTB does not mandate using the same pricing models as those used for official front office P&L, not doing so is likely to result in failing the P&L attribution test and consequent reversion to the SA charge. Therefore, most banks will look to use front office pricing models for FRTB IMA. There are three main alternative approaches banks could take to achieving this front-to-risk consistency.

Banks could extract raw calculations from their front office systems and load them into their chosen FRTB aggregation engine. This is a relatively straightforward, low-risk approach, as most front office systems should be able to batch-generate the required PV vector reports and sensitivities for the SA calculations. The latter may involve some adjustments or upgrades to cater for the prescriptive formulas in the regulation, but typically requires the least changes to systems. However, this approach is also likely to require significant expansion of front office hardware that has no further value beyond compliance. In extreme cases, the additional servers will be prohibitively expensive or pose a risk to timely overnight completion of calculations.



**The alternative approach is replacing the separate front office and risk management pricing models with a shared pricing service and market data components.”**

Another approach is to license an end-to-end FRTB extension module for a front office system that is responsible for a significant portion of desks, possibly combined with the extraction approach for desks not covered by the chosen front office system. Alternatively, banks could choose to extend their ERM system by 'hard-wiring' front office pricing models to it. Both options typically involve long and complex upgrades. Furthermore, these approaches bind the FRTB compliance project tightly in with any capital markets or ERM systems simplification or improvement project that the bank might have under way, posing a risk to both endeavors. In addition, the monolithic nature of such a systems infrastructure means that any investment in hardware and model improvements will be locked into the infrastructure and not accessible for other purposes.

The alternative approach is replacing the separate front office and risk management pricing models with a shared pricing service and market data components. Many banks are already in the process of moving from pricing libraries that are embedded into individual front office and risk systems to an architecture where valuation and analytics are provided as a shared service. FRTB can be an additional driver and source of funding for such projects, which will bring a range of benefits.

FRTB requires investment in hardware for mass batch calculations—a shared pricing service will maximize access to these resources. Quants will be more productive because of improvements in development operations, testing, validation and roll-out practices that come with a shared pricing service. Many banks are already looking to move from conventional CPU-based computing grids to grids incorporating Graphics Processing Units (GPUs) for higher performance. However, this requires rewriting model code to run on GPUs. The increase in calculations required by FRTB will likely push many conventional grids beyond financial viability, thereby adding to the business case for re-coding models for GPUs. A pricing service will also allow banks to create a common 'data lake' (database) for trades and market data, which will not only benefit FRTB calculations, but could also become a base for consolidated cross-asset reporting for customers, sales and regulations.

# Simplicity and Efficiency Through Compliance

Over time, banks have tended to build up highly complex, fragmented capital markets and ERM systems infrastructure, typically comprising one or more core trading systems, one or more ERM systems, and a multitude of satellite systems.

Most banks are in various stages of transforming this unsustainable and inflexible infrastructure into one that is simpler, more agile, and drastically cheaper to run.

Achieving IMA approval for FRTB poses a dilemma for banks because the project, with its compressed timeline and complexity, will inevitably come into competition with infrastructure transformation initiatives. Banks will, therefore, need to consider one of the following alternatives to standalone FRTB IMA projects.

Banks could achieve compliance by adding FRTB components to existing infrastructure and tools. This approach is the least risky, as it maximizes the reuse of existing technology and does not interfere with infrastructure transformation projects. However, it will increase the infrastructure complexity and costs that transformation projects are attempting to address.

Banks could license a module to add FRTB capabilities to their existing monolithic trading and ERM systems. In such cases, banks are also likely to look at consolidating other technology assets into such an architecture to meet simplification objectives. The downside is that FRTB will then be dependent on a lengthy and complex upgrade, at the end of which the bank may have fewer systems, but higher project risk, and the same rigidity of architecture and spiraling costs as before.



Alternatively, banks could leverage the investment they will have to make for FRTB to build an agile architecture that has the flexibility to meet current and future demands. Increasingly, banks realize that the key to long-term technology and operational efficiency lies in a combination of critical measures.”

Alternatively, banks could leverage the investment they will have to make for FRTB to build an agile architecture that has the flexibility to meet current and future demands. Increasingly, banks realize that the key to long-term technology and operational efficiency lies in a combination of critical measures.

The first is investment in core capabilities, such as the ability to get a single view of all interactions with a customer. This should be accompanied by a move to commoditized (standard, off-the-shelf) technology wherever possible, including for functions such as post-trade processing and regulatory trade reporting.

The second is a move to common shared services for business operations—for example, exception handling processes in the back office that can be applied to all asset classes. This should also help reduce the number of integration points (e.g. with trade, market and static data sources) and should make it easier to adhere to evolving market best practices for things like enterprise limits, pre-trade compliance and collateral management.

Third is the use of internet-based technologies, such as data lakes, mass aggregation and analytics technologies.

And fourth is the adoption of an infrastructure transformation program that brings quick intermediate results, and delivers flexibility and agility, thereby allowing banks to change course as markets and business models evolve without the need for major systems upgrades. The mandatory investment that FRTB requires is an opportunity for banks to bring additional funding to such programs.

# Capital Charge and Associated Costs

The cost of complying with FRTB and maintaining IMA approval will be an ongoing consideration going beyond the compliance date. Many moving parts impact the capital charge and among those banks will have to pay particular attention to market data management, desk optimization, pre-trade capital charge analysis and aggregation technology.

The IMA charge is highly sensitive to NMRFs. These do not meet the required observation frequency and the capital charge for trades exposed to these factors is calculated using a higher-charge stress test approach. Minimizing the impact of NMRFs requires the ability to build and continuously maintain ten years of historical data. In addition, raw market data used for scenario generation should be identical to that used by the front office for official P&L generation. Furthermore, the scenario definition mechanism should be sufficiently flexible to define and maintain a large number of scenario types, potentially from multiple sources.

The IMA capital charge is also highly dependent on the composition of trading books and which desks implement IMA. Some international banks are reported to be trying to reduce capital charges by optimizing certain desks according to specific national requirements. In addition, there is always the risk of failing backtesting and P&L attribution tests and having to revert to SA. Therefore, the FRTB aggregation engine should not only be able to calculate the regulatory charge based on the current desk structure, but also be able to investigate contribution to the charge by product, book and desk, as well as perform back-testing and attribution tests. Furthermore, it will be imperative to be able to simulate different combinations of books and instruments by desks and geographies to continuously assess and optimize capital usage.

Understanding the IMA capital charge pre-deal is likely to become increasingly important. Banks are unlikely to invest in pre-trade charge calculation from day one, but would want aggregation technology that allows them to extend to pre-trade limits checks in the future. This implies the ability to incrementally calculate expected shortfalls on new trades, and to integrate this with limits mechanisms. The FRTB capital charge is only one of the increasing number of factors affecting pre-trade decisions.

The functional requirements of calculating and optimizing the IMA capital charge pose significant challenges for the aggregation engine. The technology must support flexible management of scenarios, mass aggregation of huge amounts of raw data (for PV calculations and stress tests cubes), and quick re-aggregation (by instruments, desks, books, etc.) for investigation of capital charge attribution.

In addition, the engine should be able to support 'what-if' analysis of desk structure and pre-trade checks. Also important are decision support tools, including heatmaps and other data visualization tools, and adequate technology for data persistence (storage) and retrieval, and the re-aggregation of past results for audit and business investigation purposes.



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## CONCLUSION

**A technology solution for FRTB must balance the need for compliance on time and at low risk, preferably leveraging existing technology, with using FRTB investment to achieve incremental and ongoing advances in technology infrastructure flexibility and efficiency while reducing overall costs.**

An open and flexible solution can offer components for FRTB-specific functionality while integrating with existing in-house or third-party systems infrastructure to suit an individual bank's circumstances. Banks opting for SA can benefit from a pre-packaged configuration of FRTB components that integrate easily with front office systems. Banks opting for IMA for some or all desks will want a flexible solution that fits with their current technology infrastructure and planned strategic development while maximizing the long-term business benefits of the FRTB investment.

## ABOUT THE AUTHOR



### **Sadiq Javeri**

Head of Product Strategy,  
Capital Markets and  
Enterprise Risk

Sadiq is responsible for the medium to long term direction of Capital Markets and Risk businesses at Finastra. He is mainly focused on understanding how industry and regulatory trends are evolving, and in developing plans for Finastra to continue to serve these changing requirements.

Sadiq joined Finastra from Oliver Wyman where he advised Capital Markets institutions on business strategy, regulatory response and risk management engagements. Prior to joining Oliver Wyman, he worked for Deutsche Bank in their Global Markets division in both sales and trading roles. Sadiq holds a Bachelor's degree in Engineering from Imperial College London and a Masters in Finance from the University of Cambridge.





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## Corporate headquarters

One Kingdom Street  
Paddington  
London W2 6BL  
United Kingdom  
T +44 20 3320 5000

