



A State Street Company

Charles River IMS Middle Office

crd.com

The Charles River Middle Office



Position Management (IBOR)

- Work from an accurate, real-time and consolidated view of positions and cash
- Generate “as-of” position views to enable faster response to compliance/regulatory inquiries
- Manage tax lot tagging for multi-sleeve/multi-strategy products such as unified managed accounts

Collateral Management

- Manage collateral selection, pledging and tracking
- Expedite margin recording, reconciliation, dispute resolution, collateral selection and tracking
- Verify Credit Support Annex is in place for allocation funds

Performance & Attribution

- Help ensure GIPS compliance
- Provide verified account performance to front-office
- Manage composites for performance result validation

Post-Trade Processing

- Help reduce failed trades with automated matching and confirmation of blocks and allocations
- Satisfy regulatory mandates with OTC clearing workflows and end-to-end audit trails

Settlements & SWIFT Connectivity

- Direct connectivity and bidirectional communication with SWIFT destinations lets firms:
 - Send trade notifications to custodians
 - Receive trade confirmations and settlement status
 - Obtain position and trade reconciliations

Middle Office Challenges

Investment managers face several challenges related to their middle office. Reliance on back office accounting systems and custodians results in out-of-date and incomplete views of account positions. Manual post-trade processing introduces settlement process errors, and multiple asset class-specific performance and attribution systems create integration bottlenecks with portfolio management and risk systems. Regulations have saddled firms with new compliance obligations for OTC derivatives, requiring advanced collateral and margin management capabilities to remain compliant.

To address these challenges, many firms are re-evaluating their middle office and considering out-sourced solutions. This introduces new costs, operational risk and integration challenges.

Charles River IMS: A Front and Middle Office Solution

The Charles River Investment Management Solution (Charles River IMS) provides a viable alternative to middle office outsourcing with a complete set of capabilities to manage institutional accounts, from decision support to trading, and position management to post-trade processing. This gives the front and middle office a shared and consistent view of positions, risk exposures and collateral.

Middle Office capabilities include:

- Position & cash management via the Investment Book of Record
- Collateral and margin management
- PMA and GIPS composite management
- Post-trade processing
- SaaS based deployment and SWIFT messaging

Incorporating these capabilities into a unified front and middle office platform helps investment firms address their middle office challenges without the cost, risk and complexity of outsourcing.

- Helps reduce reliance on back office accounting systems and custodial position reporting
- Aims to eliminate the need for asset class-specific performance and attribution systems
- Designed to deliver timely, consistent and transparent information across the enterprise
- Automates the entire post-trade life cycle with faster processing and high volume scalability
- Enables better compliance with regulations (Dodd-Frank, MiFID) and industry standards (GIPS)

“The biggest immediate value Asset Managers see in automation comes from removing cost from the middle office, where there is the most low-hanging fruit.”

**Wholesale Banks
& Asset Managers:
Winning Under Pressure
Morgan Stanley /
Oliver Wyman Bluepaper**

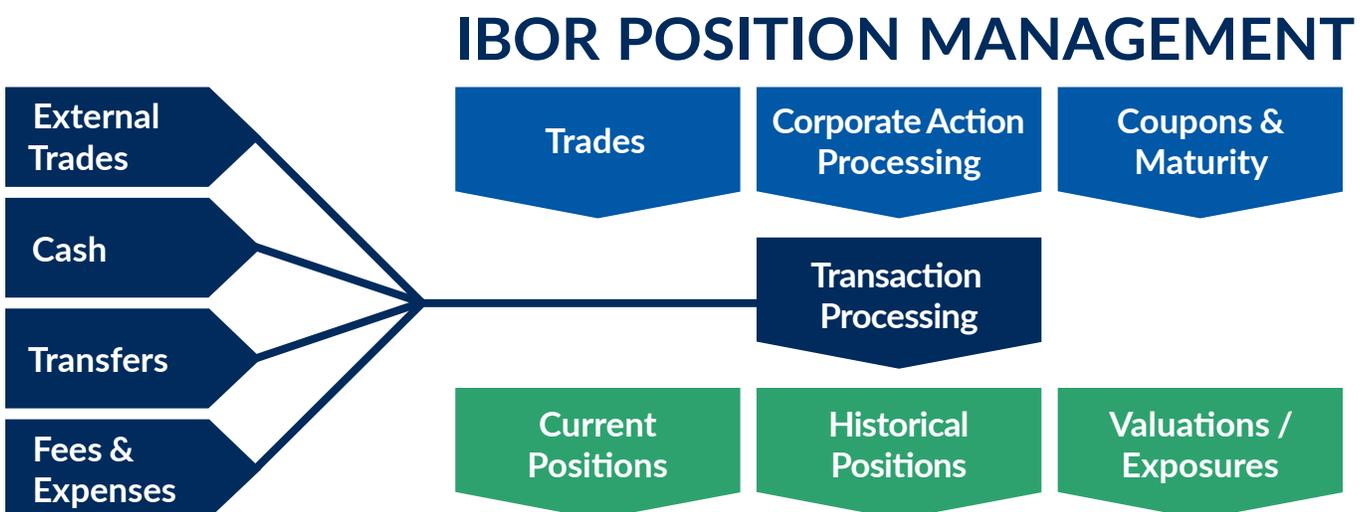
Position Management

Charles River's Investment Book of Record (IBOR) automates position management across all asset classes. This provides the front office with a single source of accurate real-time positions and cash, and supports the retrieval and reconstruction of historic positions to help answer inquiries from portfolio managers, traders, and compliance officers. As an independent source of start-of-day positions, IBOR decouples the front office from the back office, enabling consistent and real-time management of position data on a single platform. By establishing a "single and current version of the truth", IBOR instills greater confidence in investment decisions.

IBOR feeds the Charles River IMS with beginning-of-day positions and can distribute position keeping data to ancillary front and middle office systems. Unlike competing offerings, Charles River's IBOR is built on an open architecture, enabling it to accept trades from external systems. By eliminating dependency on daily feeds from back-office systems for investment operations and consolidating multiple sources of position-related data onto one platform, clients can eliminate position errors, streamline operations, and reduce costs.

Charles River's IBOR:

- Helps ensure that investment managers are trading on timely, accurate and complete information, reducing the possibility of oversold positions, compliance violations, fines and losses
- Streamlines operations through self-sufficient position management workflows
- Aims to eliminate the need for multiple front office systems by supporting all asset classes and instruments, including derivatives
- Maintains an independent and auditable view of position data, critical for firms with outsourced back office services
- Seeks to reduce end-of-day processing time by eliminating dependency on back-office data
- Supports faster implementation and deployment of new product offerings



Collateral Management

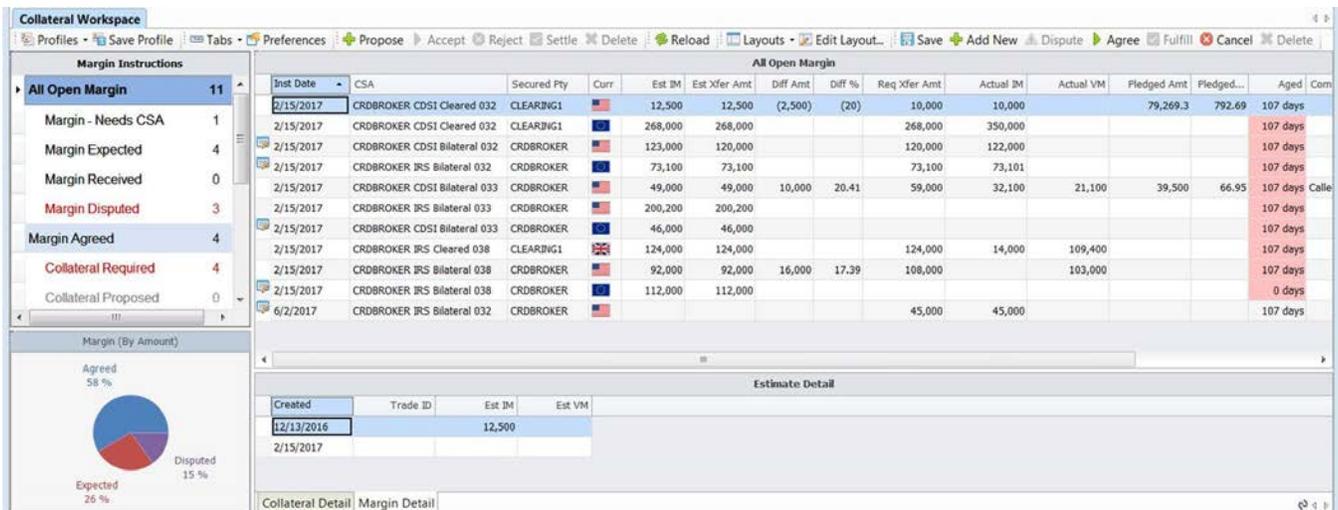
Collateral and Margin Management capabilities help investment managers comply with new regulatory requirements and industry best practices. An increasing number of firms must post collateral for bilateral (uncleared) swaps, to settle collateral on T+1, and to maintain separate legal documentation arrangements for initial and cleared variation margin. By embedding collateral and margin management in the Charles River IMS, firms can eliminate the need for third party systems.

Charles River supports both front and middle office margin requirements, from pre-trade decision support through to management of margin calls and collateral posting. Managers gain visibility into the initial margin estimate based on regulatory guidelines and can readily establish whether required collateral agreements are in place. Real-time updates of the trading book eliminate over/under pledging. Firms can streamline operations by centralizing the identification of eligible collateral with recording, reconciliation, selection and tracking tasks. Charles River IMS displays the status of margin instructions and linked collateral to expedite margin workflows.

“We estimate 40% of processing and administration costs are personnel, despite the high potential for automation. The battle is on to develop the winning proposition, with the goal to deliver a more robust, scalable technology driven solution.”

Wholesale Banks & Asset Managers: Winning Under Pressure

Morgan Stanley / Oliver Wyman Bluepaper



Charles River IMS provides end-to-end collateral management workflows

Performance & Attribution

Charles River IMS enables firms to view historical account performance across any timeframe and understand the portfolio construction and asset selection decisions responsible for that performance. Analysts can change performance or attribution settings on the fly and run different analyses for the same account across asset types, down to the individual security level. Performance results can be converted to any currency and custom benchmarks can be created by importing and blending category- or constituent-level indices.

Portfolio managers and analysts can:

- Measure performance using either true time-weighted or modified Dietz methodologies, configurable at the account level
- Utilize several fixed income attribution methods including van Breukelen and Tim Lord-styled breakdowns (income, roll, duration, convexity, spread allocation and selection, currency)
- Calculate multiple return types, including capital, income, base, local, currency, gross and net
- Roll up performance to any level, including multiple nested classifications, total portfolio/benchmark, account groups and composites

Attribution Methodologies and Capabilities:

- Daily attribution by asset style, including currency, fixed income roll, duration, convexity and spread effects
- Choice of attribution methodology to best support a portfolio manager's investment objectives, configurable at global system, account or report levels
- Attribute roll-up to multiple classification levels for each security, including domicile (region, country, currency) and sector (industry or sub-sector)

Charles River also supports attribution analysis based on third party factor models. Firms can assess the contribution impact in their portfolios from active exposure to each factor. The factor-level analysis can be combined with return-based analysis to provide a comprehensive view of the sources of portfolio's active return.

Post-Trade, Settlements & SWIFT Connectivity

By automating the post-trade process and providing centralized confirmation, trade matching and settlement instruction workflows, Charles River IMS helps firms reduce clearing-related risk. Dealers and traders, portfolio managers, compliance, and operations personnel have the same real-time view of all post-trade processing activity and data for each transaction. The resulting low-touch settlement process aims to minimize manual steps and reduces operational bottlenecks.

End-to-end confirmation, reconciliation, and settlement workflows: Bidirectional message support and connectivity with SWIFT networks expedite routing of individual trades and allocations to help ensure same-day matching and confirmation

Reduce failed trades: Automated matching and confirmation of blocks and allocations help eliminate error-prone manual workflows

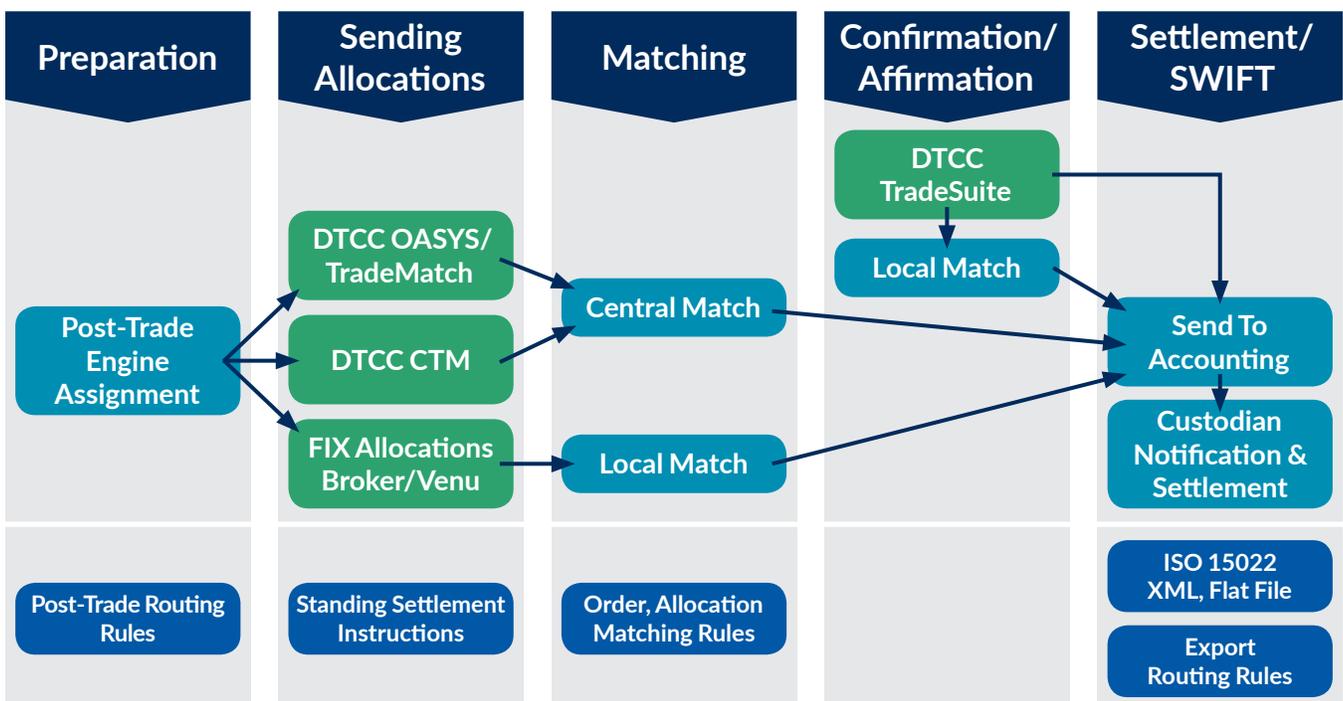
Automate trade confirmation across multiple asset classes: Charles River IMS integrates DTCC Central Trade Manager (DTCC CTM) for central matching of cross-border and domestic transactions

Support local trade matching: Standing settlement instructions and configurable, rule-based tolerance matching enable match/affirm with any local destination

Manage “by exception”: Personalized views and alerts can save time and speed up corrective intervention

Satisfy regulatory mandates: OTC clearing workflows and audit trails help ensure adherence to the latest regulations

Consolidate post-execution operations: Centralization of all reference data and settlement instructions helps reduce cost and complexity



SaaS-based Deployment

Charles River IMS is deployed via Software as a Service (SaaS). This helps simplify client operations, improves data quality and investment professional productivity, manages risk and lowers technology costs.

Up-to-Date Capabilities: Charles River's operations specialists provide software upgrades and other updates in a timely manner, and helps ensure that new instrument support and other improvements are made available to meet client needs. End users can leverage the latest capabilities, and firms avoid the risks associated with outdated software. Charles River can also introduce incremental enhancements more frequently in response to client, regulatory and market requirements.

Managed Data Services: The Charles River Data Service alleviates many of the complexities and costs of data management by integrating multiple data sources designed to provide complete, accurate and timely data to the Charles River IMS.

Charles River's Data Management Service helps ensure that high quality security master data is made available to the front office before each trading day. In a typical client scenario, foundational security data from the Charles River Data Service or Bloomberg is blended with other data sources and brought directly into the Charles River IMS. The Data Management Service evaluates and resolves all data exceptions related to reference data, pricing, analytics and benchmarks. By performing proactive data validation, Charles River's global data team can identify and rectify issues before they impact front office activities.

Private Cloud-based Delivery: ISO certification of our private cloud environment helps ensure that the Charles River IMS is running on the latest infrastructure, security protocols and operating systems. SaaS deployment provides a more predictable cost structure and better application performance and reliability than firms can maintain internally.



FIX Connectivity: A certified global FIX network is administered by an internal support team that manages, tests and certifies broker connectivity, striving to ensure seamless, reliable electronic trading.

SWIFT Connectivity: Direct connectivity to SWIFT destinations allows firms to send trade notifications to custodians, receive trade confirmations and settlement status, and obtain position and trade reconciliations.



A State Street Company

CHARLES RIVER DEVELOPMENT, A STATE STREET COMPANY

Investment firms, asset owners, wealth managers, hedge funds and insurers in more than 30 countries rely on Charles River's front and middle office investment management platform to manage more than US\$30 Trillion in assets. Together with State Street's middle and back office capabilities, Charles River's software technology forms the foundation of State Street AlphaSM. The Charles River Investment Management Solution (Charles River IMS) is designed to automate and simplify the institutional investment process across asset classes, from portfolio management and risk analytics through trading and post-trade settlement, with integrated compliance and managed data throughout. Charles River's growing partner ecosystem enables clients to seamlessly access external data and analytics, applications and liquidity venues that support the unique demands of their product and asset class mix. Headquartered in Burlington, Massachusetts, we serve clients globally with more than 975 employees in 12 regional offices. (Statistics as of October 2019)

WWW.CRD.COM

Charles River Development - A State Street Company is a wholly owned business of State Street Corporation (incorporated in Massachusetts).

This document and information herein (together, the "Content") is subject to change without notice based on market and other conditions and may not reflect the views of State Street Corporation and its subsidiaries and affiliates ("State Street"). The Content is provided only for general informational, illustrative, and/or marketing purposes, or in connection with exploratory conversations; it does not take into account any client or prospects particular investment or other financial objectives or strategies, nor any client's legal, regulatory, tax or accounting status, nor does it purport to be comprehensive or intended to replace the exercise of a client or prospects own careful independent review regarding any corresponding investment or other financial decision. The Content does not constitute investment research or legal, regulatory, investment, tax or accounting advice and is not an offer or solicitation to buy or sell securities or any other product, nor is it intended to constitute any binding contractual arrangement or commitment by State Street of any kind. The Content provided was prepared and obtained from sources believed to be reliable at the time of preparation, however it is provided "as-is" and State Street makes no guarantee, representation, or warranty of any kind including, without limitation, as to its accuracy, suitability, timeliness, merchantability, fitness for a particular purpose, non-infringement of third-party rights, or otherwise. State Street disclaims all liability, whether arising in contract, tort or otherwise, for any claims, losses, liabilities, damages (including direct, indirect, special or consequential), expenses or costs arising from or connected with the Content. The Content is not intended for retail clients or for distribution to, and may not be relied upon by, any person or entity in any jurisdiction or country where such distribution or use would be contrary to applicable law or regulation. The Content provided may contain certain statements that could be deemed forward-looking statements; any such statements or forecasted information are not guarantees or reliable indicators for future performance and actual results or developments may differ materially from those depicted or projected. Past performance is no guarantee of future results. No permission is granted to reprint, sell, copy, distribute, or modify the Content in any form or by any means without the prior written consent of State Street.

The offer or sale of any of these products and services in your jurisdiction is subject to the receipt by State Street of such internal and external approvals as it deems necessary in its sole discretion. Please contact your sales representative for further information.

©2019 STATE STREET CORPORATION