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# Charles River IMS Performance Testing

Charles River's institutional and wealth customers continue to grow in size and sophistication. Increased trade volumes, more complex financial products and heightened user expectations require Charles River IMS to be consistently performant under any market or operational scenario.

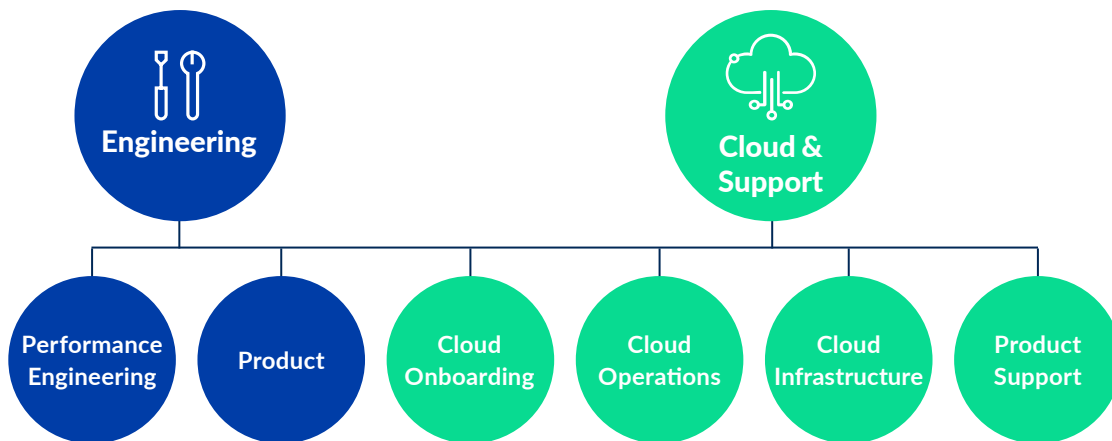
Performance Engineering (PE) is a crucial step in software development. Our engineering and product teams conduct extensive unit tests during the development of new capabilities. Each release of Charles River IMS undergoes database load testing to measure I/O throughput, chaos testing to model random user workflow impacts, and scripted testing cycles that replicate known workflows on the system. These results are measured and benchmarked for each release.

However, performance engineering tests are just the first step. Achieving a consistently performant solution also requires testing that takes into account different production environments, data loads and use cases.

For new customers implementing, or existing customers upgrading Charles River IMS on Microsoft® Azure, Charles River supports the ability to run Performance Testing (PT) aligned with their different requirements and operating environments. Leveraging a common testing framework, PT helps ensure that customers have a performant, scalable and reliable operating environment before final user acceptance testing (UAT) begins. PT is an iterative process that runs in parallel with the implementation of Charles River IMS, on a dedicated performance environment within each customer's Azure Spoke. This process replicates the operating environment to accurately and realistically simulate/stress-test potential operational scenarios.

# Roles and Responsibilities

## Charles River Performance Team Organization



PT is a cross-functional service delivered by Charles River's Engineering, Product, Cloud and Delivery teams. Charles River's Performance Team works closely with clients to define and validate performance objectives for Charles River IMS and components deployed in the Azure cloud.

The team also drives performance improvements in Charles River IMS, working with development and operations to incorporate feedback gained through monitoring and testing of client environments.

Charles River's evolving PT process employs increased tooling and methodology refinements to span the entire software delivery process, from engineering and product management to services and operations.

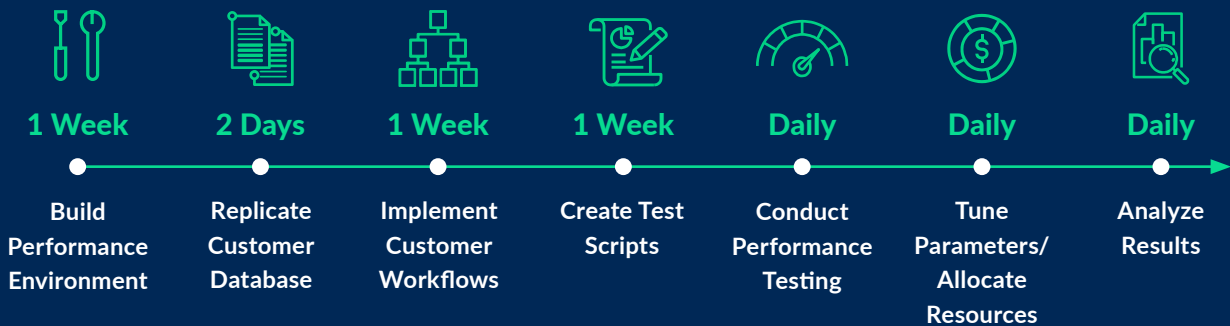
# Performance Testing Methodology

Charles River PT leverages open source and proprietary testing tools to measure processor performance for computationally intensive calculations, and database throughput for I/O-centric components such as the Investment Book of Record. These tools also generate readily comparable Transaction Processing Performance Council (TPC) benchmarks. Automated testing helps implementation teams isolate problems and identify necessary tuning steps quickly.

PT begins with configuration of a performance environment that shadows the customer production environment and database. PT engineers work with customers and their Implementation team to understand project scope, performance goals, requirements, time line and exit criteria. Customer use cases are then generated, incorporating realistic processing and data loads, and the ability to stress test the environment for peak trading volumes, liquidity events and other scenarios. Based on this analysis, customer-specific test scripts are generated, either as Java API tests for Charles River user workflows or load scenarios using Apache JMeter, and executed on the client's environment.

Performance monitoring and analysis identifies bottleneck, enabling engineers to diagnose performance issues. Customers are provided with detailed performance reports, including tuning and resource recommendations. By flagging data I/O bottlenecks and other performance shortfalls early, implementation teams can tune server and system parameters, allocate additional hardware resources, validate and repeat, until customer-specified performance requirements are met. Azure provides significant flexibility that helps teams quickly change configuration parameters and allocate processing power, memory, disk space and other resources to determine performance impact.

## Charles River Performance Testing Process Flow



# Automated Regression Testing

To expedite adoption of Charles River IMS upgrades and patches, automated regression testing is now available. This service aims to deliver improved testing while reducing disruption to project and operations teams. Regression testing leverages an established Charles River test automation toolkit designed for, and integrated to, the Charles River IMS user interface. Charles River provides test services at implementation, upgrade, patch and major functional rollouts, collaborating with customers to define workflows and/ test scenarios.



## Efficiency and Assurance

- Automated Test Scripts
- Client specific test library
- Leverage Charles River IMS specific
- Professional Test Team



## Reduce Time to Market

- Faster regression cycle
- Internal teams focus on requirements and decisions



## Upgrades and Patches

- Automated Assurance strives to reduce risk of patches
- Help enable more frequent upgrades



## Reduce Impact on BAU and End Users

- Offload heavy lifting of bulk testing to Service
- Focus resources on edge cases, new workflow, and exceptions

# Performance Testing Tools

Charles River employs a number of open source and proprietary tools to test and validate performance across the software development and deployment life cycle:

**Apache JMeter** is used to simulate heavy loads on a server, group of servers, network or object to test its strength and to analyze overall performance under different load scenarios.

The Windows Performance Monitor (**Perfmon**) and **Dynatrace** monitoring tool capture servers' CPU, memory, and network health metrics down to the process level.

**ELK** (Elasticsearch, Logstash, and Kibana) helps engineers aggregate, analyze and visualize Azure log diagnostics data in real time.

**Solarwinds Database Performance Analyzer** (DPC) for SQL Server monitoring and tuning.

**GCViewer, Memory Analyzer,** and **Thread Dump Analyzer** for Java Virtual Machine (JVM) tuning.

**LoadRunner** tool to support Charles River IMS fat client and next-gen web client scenarios.

Azure's suite of monitoring tools, including **Azure Monitor, App Insight** and **Log Analyzer**.

## Future-proofing Charles River IMS on Azure

Working closely with our customers to understand their use cases and the different demands of their investment process and operating environment is key to delivering a consistent and performant user experience. Having a thoroughly tested environment that scales to meet business requirements and proactively maintains the capabilities and performance required by the customer is a critical enabler for success as clients grow larger and operations become more complex.

# 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 cloud-deployed software technology forms the foundation of State Street Alpha<sup>SM</sup>. 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 demands of their product and asset class mix. Headquartered in Burlington, Massachusetts, we serve clients globally with more than 1,000 employees in 11 regional offices.

(Statistics as of Q1 2021)

Learn more at [crd.com/azure](https://crd.com/azure)

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