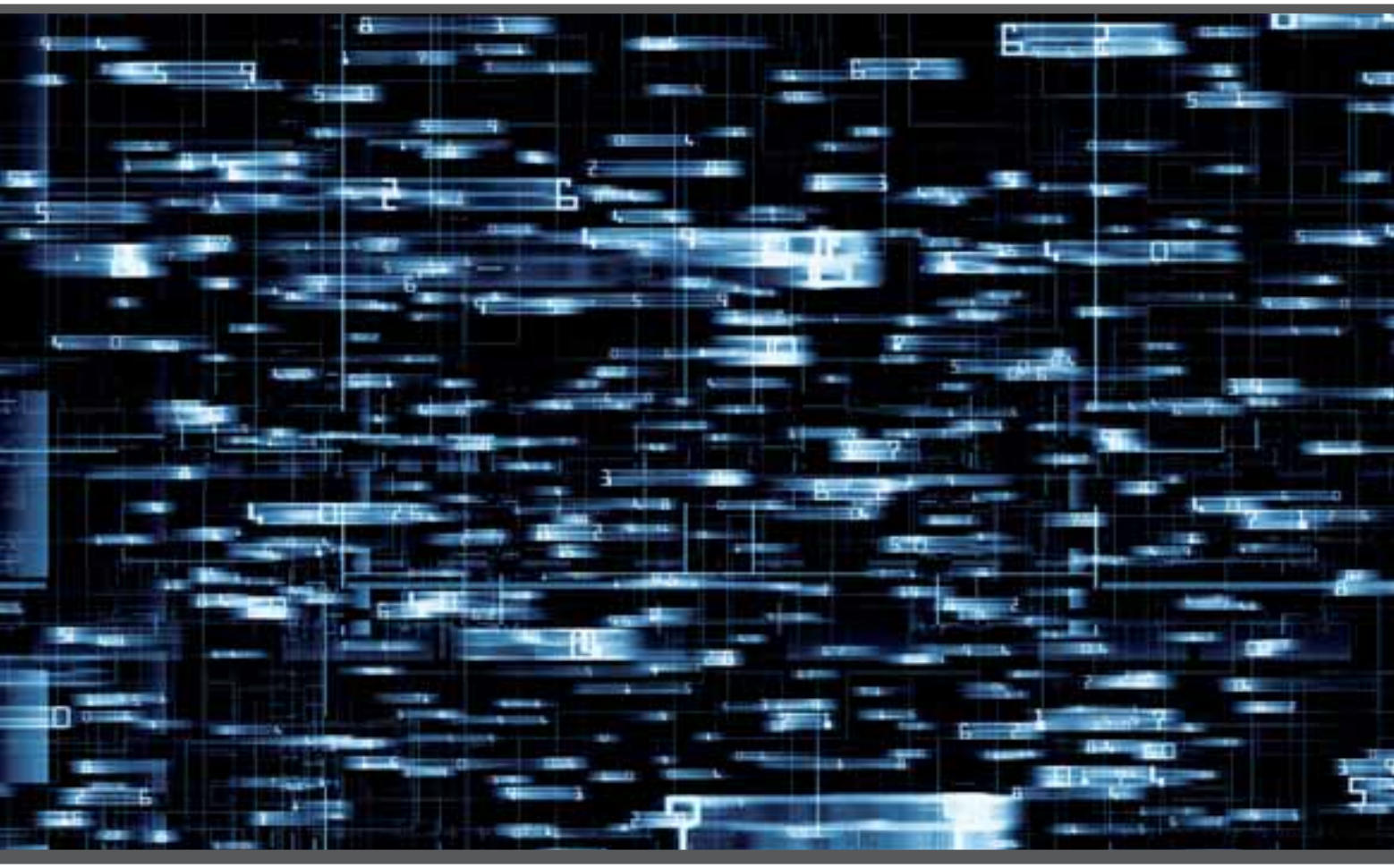
waters
trading technologies for financial-market professionals

Complex-Event Processing

Special Report



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Waters (ISSN 1068-5863) is published monthly (12 times a year) by Incisive Media. Printed in the UK by Wyndeham Grange, Southwick, West Sussex.

Too Much of a Good Thing

In the capital markets, data is the blood that moves the body. It's essential for the healthy functioning of the markets. Remove data and everything dies.

But whereas humans have kidneys that regulate the amount of blood in the body, financial services firms generate and receive ever-increasing data volumes as a way of driving the business. However, as with all things in life, too much of a good thing isn't such a good thing.

Capital markets firms have been grappling with the surge in data volumes and varieties—and crucially, the velocity at which that data is generated and transmitted—for a number of years now. While storing massive data volumes is no walk in the park, it is the most straightforward big-data related task. What's far more challenging is mining that data—making sense of what it all means and deriving critical analysis from it, which, in turn helps to put firms in a position where they can make more judicious business decisions. Nowhere is this more useful than in the mission-critical realms of trading-related decision support and risk management, which increasingly has come to include various compliance and surveillance functions in addition to extrapolating traditional market and credit risk measures.

But help is at hand in the form of complex-event processing (CEP) technology, the first products of which emerged around a decade ago, designed specifically to allow capital markets participants to analyze large volumes of fast-moving data across multiple streams and formats.

In the Q&A section of this special report on page six, we look at the specific business applications of CEP technology across the front and middle offices, delve into the attributes of the ideal CEP framework, and address a number of the pitfalls awaiting unsuspecting capital markets firms taking their first tentative steps down the CEP path. On page 10, James Rundle looks back at two Apama-sponsored CEP webcasts, and focuses on how capital markets firms are being forced to administer their risk management disciplines and techniques in ever-decreasing timeframes in order to stay current with algorithmic and high-frequency trading strategies, now an integral part of many buy-side and sell-side firms. Finally, on page five, Apama's Theo Hildyard looks at the build-versus-buy trade-off in the CEP realm, arguing that any CEP platform worth its salt consists of significantly more than merely a high-performance CEP engine—speed-to-market and the vendor's track record in terms of understanding the nature of its clients' business and delivering effective and user-friendly technologies to underpin those businesses, should never be overlooked. ■

Victor Anderson
Editor-in-Chief

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Lime Squeezes International Flavor from Data to Meet Risk Demand

Lime Brokerage, Wedbush Securities' New York-based agency broker business, is seeking to capture market data feeds from international and emerging markets to support an effort to market its low-latency risk management tools outside the US, officials say.

Currently, the broker provides two hardware-enabled risk solutions—LimeDirect, which performs pre-trade risk checks with latency of around 200 nanoseconds, and LimeInside, which also performs pre-trade risk, though with slightly higher latency—both of which were developed entirely in-house by the firm.

"We are interested in developing our risk systems for more international markets, and in having our technology lead us into other markets," says Lime CEO Jeff Bell. "But to do that, we need international market data," to support development of the tools to work with data feeds from other markets, he adds.


Jeff Bell
Lime Brokerage

Initially, Lime is seeing demand from US clients for access to markets in Europe, Brazil and Asia-Pacific, and is working toward making initial sales of the risk tools for foreign markets, Bell says.

LimeDirect and LimeInside are both compliant with the Securities and Exchange Commission's (SEC's) Rule 15c3-5 Market Access Rule, though Bell says that if a particular market or region does not require the same level of pre-trade checks—for example, if it does not require the system to maintain and check trades against a restricted securities list—then Lime could strip out some of the products' capabilities to make them run even faster.

Panopticon Adds HTML5 Support, Visualization Tools with Update

Data analysis vendor Panopticon has announced the 6.2.2 release of its flagship software, including enhanced visualization tools and deployment methods that include HTML5 publishing capabilities suitable for mobile devices.

The new release has the ability to visualize real-time streaming data from complex-event processing (CEP) engines, including vendor products such as OneTick, Thomson Reuters and SAP, as well as other feeds and historical datastores. The HTML5 capabilities center on functionality for clients to publish mobile-suitable dashboards, and incorporate Panopticon's dashboards into their own platforms. The release supports Windows and Java IT environments as standard.

"We have invested a lot of research and development time into improving the underlying architecture of the system, in order to speed things up for users as well as make new data connectivity possible," says Ludvig Sandman, chief architect at Panopticon. "As always, we also added several important new features in the 6.2.2 release, including new real-time streaming functions for clients who wish to embed our visual analysis tools into their own Java applications."

ConvergeEx Upgrades Pre-Trade Risk Controls for ConnEx

Agency broker ConvergEx Group has upgraded the pre-trade risk management system of its outsourced hosted connectivity infrastructure business, ConnEx.

According to the New-York-based broker, ConnEx will provide additional risk checks with reduced latency and an improved user interface to help its clients manage their internal market access risk strategy.

"There have been a number of recent market events and new regulations that have highlighted why risk management continues to be a very important and ever-evolving topic in our industry," says George Rosenberger, who heads ConnEx.

According to ConvergEx, the new interface helps users to create customized client groups. This will allow them to create a set of risk parameters or build a customized risk profile on a client-by-client basis. Users can also assign buying power, as well as credit and risk checks for their underlying clients.

Nasdaq OMX Unveils Pre-Trade Risk Management Service for Commodities

Nasdaq OMX has rolled out a new pre-trade risk management service geared toward the commodities market, dubbed Genium Inet PRM.

Nasdaq first launched Genium Inet PRM to its Nordic equity derivatives customers earlier this year before a soft launch for commodities in early June.

Genium Inet PRM provides a "complete and continuous overview of trading activities and the controls needed to act immediately," according to officials from the exchange operator. While it was "tailored for general clearing members' needs, the service meets the needs for improving pre-trade protection for any member."

PRM was developed by FTEN, a risk management solutions provider that was acquired by Nasdaq in 2010.

FPL Releases HFT-Specific FIX Working Document

FIX Protocol Ltd. (FPL) has announced a new version of the FIX language specific to high-frequency trading (HFT). The industry cooperative has its member organizations to participate in a working document review.

The new version uses a streamlined programming method known as Simple Binary Encoding (SBE). Given the latency requirements of HFT operations, using a truncated, or less verbose, programming language will introduce an alternative to expensive proprietary protocols for connecting to exchanges. FIX is widely seen as an industry standard for messaging within the financial industry, and has seen an increased take-up recently.

As well as developing SBE, FPL is also including guides for mapping FIX to Google's Protocol Buffer and Abstract Syntax Notation (ASN) standards.

Equinix Builds RF Data Support at Co-Lo Sites

Datacenter provider Equinix is increasing the amount of space available on the rooftops of a number of its buildings in the UK and North America for equipment to support wireless radio frequency data transmission, to cater to high-frequency traders, and trading firms and service providers that are looking to build low-latency microwave connectivity to and from its sites.

Equinix is currently building a new standalone microwave data tower at its LD4 co-location facility in Slough, outside central London, which it aims to complete in early July, to provide line-of-sight connectivity between LD4 and locations in central London, where the London Stock Exchange and Bats Chi-X Europe host their datacenters, and to NYSE Euronext's co-location facility in Basildon, Essex, on the opposite side of London.

Meanwhile, in the US, the vendor plans to expand the rooftop capacity of its NY5 co-location facility in Secaucus, NJ, later this year, pending planning permission for the required extensions, says Allan Graham, director of financial product management at Equinix.

Tibco Acquires StreamBase Systems

Infrastructure software provider Tibco has announced the acquisition of complex-event processing (CEP) vendor StreamBase Systems. Terms of the deal were not disclosed.

Tibco focuses on low-latency messaging, and the acquisition of StreamBase and its CEP technology, gives it access to algorithmic trading support and big data technologies pertinent to real-time processing.

"Tibco sets the standard in low-latency messaging, enterprise integration and visual and computational analytics. Now with streaming event processing and real-time analytics from StreamBase, Tibco's big data platform is the most capable in the industry," says Mark Palmer, CEO of StreamBase Systems. "StreamBase has revolutionized how organizations use real-time data by speeding application development to enable companies to analyze data and take immediate action."

RTS Realtime Systems Advances China Move

RTS Realtime Systems Group, a Frankfurt-based trading solutions provider, has established a Shanghai office and has initiated plans to move its datacenter to the Hong Kong Exchange (HKEx) co-location facility by the end of the year.

RTS will develop low-latency gateways to capitalize on HKEx's new Orion initiatives and connect to the exchange's equities and derivatives platform.

"We continue to believe that greater China presents a significant strategic growth opportunity for RTS and that our broad offering of hosting, risk management, trading and connectivity solutions can play an important role in fostering the growth of locally based brokerages and trading firms," says CEO Steffen Gemuenden. "To that end, we've made additional key investments recently in our technology, infrastructure and human resources in Mainland China and Hong Kong."

There has been demand from Chinese and Hong Kong brokers for global connectivity, direct market access (DMA), and algorithmic trading solutions, according to the CEO.

RTS opened a datacenter in Shanghai last year.

DataArt, 10gen Partner for Data Aggregation, Opera Reporting

Software provider DataArt is teaming up with 10gen, which develops the MongoDB NoSQL open-source database, to tackle challenges related to big data and the aggregation of data. The first result of this pairing is a reporting solution for the proposed Open Protocol Enabling Risk Aggregation (Opera) industry standard.

DataArt will pair its big data and data visualization competence center with 10gen's MongoDB to tackle risk and position aggregation in near-real time, says Alexei Miller, executive vice president at DataArt.

"We're showing how you can deploy open-source, big data technology—MongoDB in this case—and apply it creatively to some of the more technically complicated development tasks that trading and portfolio management shops are facing," Miller says.

Alexei Miller
DataArt

The first solution to be rolled out is a risk reporting suite for Opera, which will be made available for free to clients.

SunGard Extends FoxRiver Suite to Japanese Equities

SunGard has extended the international reach of its Fox River algorithmic suite to support trading in the Japanese equities market.

The vendor claims Fox River's advanced technology helps reduce overall latency in reaching external venues, enabling traders from outside Japan to improve fill rates and execution prices.

According to SunGard, Fox River's algo suite, from smart order routing to intelligent liquidity trading, including passive and aggressive types, imitates the behavior, logic and knowledge of a human trader and differs from traditional algorithms by focusing on picking the right price and time to trade under current market conditions rather than benchmarks.

The Case for CEP Deployment

There are recurring themes in most discussions around complex-event processing (CEP), including the extent to which CEP has become an enterprise tool and whether it is suitable for re-use across the organization; how to measure the performance of different CEP engines and compare them with native C/C++ or Java; and quantifying the value of CEP, a technology platform at heart, versus buying a packaged application or building from the ground up. By Theo Hildyard

CEP—The Enterprise Tool

Complex-event processing (CEP) became commercially available in 2003 when Apama signed its first customer. Since then, CEP has moved from an edge tool for algorithmic trading to an indispensable platform. No longer a niche product, it is now used across the capital markets to power event-driven real-time applications in the front and middle office.

Capital markets applications from across the front and middle office make some use of CEP:

Front Office: Market data aggregators, algorithms, smart order routers, order management, execution management, matching engines, pre-trade risk, pricing, client analytics, and algorithm back-testing.

Middle Office: Real-time and post-trade risk management, position keeping, real-time profit-and-loss calculations, fraud detection, surveillance, and anti-money laundering (AML).

CEP is useful in applications that make decisions and take action based on the analysis of large volumes of fast-moving data. There may be multiple streams and types of data. Volume, velocity, variety and speed of correlation are all parts of the equation. Essentially, CEP is perfectly suited to handling and acting on big data in motion from across the enterprise.

Performance and Development Languages

A CEP performance discussion often includes a comparison of the languages used to program the engine and the trade-off between proprietary language-based CEP engines, Java-based CEP engines, and custom-built C/C++ or Java applications. If we give Java-based CEP engines the benefit of the doubt and assume they can perform as well as custom-built Java, we are actually discussing specialist proprietary languages versus C/C++ versus Java. When C/C++ or Java programs are compiled for general distribution, they typically target the lowest common denominator CPU architecture. However, modern CPU microarchitectures have optimized instruction sets, and an application compiled to run on all architectures will not be able to take advantage of this characteristic of modern CPUs.

A proprietary language combined with a Low Level Virtual Machine (http://llvm.org) compiler can dynamically (on every start-up) compile its code to native machine code that is optimized for the exact microarchitecture it is running on, thereby ensuring greater performance than general-purpose C/C++ or Java compilations.

Options exist to compile C/C++ code using LLVM, but the developer would also need to compile special versions of any required standard or mathematics/analytics libraries for each target CPU architecture. This is certainly possible, though not portable to other CPU architectures, and is therefore costly and time-consuming to maintain.

Options also exist to run Java code inside a high-performance Java Virtual Machine, but that could involve additional vendors, additional cost, and maintenance complications.

Getting Value from CEP

The key to deriving value from CEP is to accept that CEP offers a hybrid of buy and build—it might not be appropriate for all data-in-motion challenges, although it excels in IT programs that deliver a thin but critical layer of intellectual property on top of a baseline architecture of common reusable components. With respect to buying versus building, a buy strategy offers reduced delivery risk and faster time-to-market, but it will likely offer a rigid application unsuitable for bespoke or evolving requirements. Furthermore, packaged software offers little room for creating competitive advantage.

A build strategy allows for the development of differentiated intellectual property and total control over features and functionality. But it is expensive, risky and time-consuming.

A CEP platform can offer a hybrid approach that frees IT programs from developing everything from the ground up, but retains the ability to build truly differentiated intellectual property. Furthermore, the platform is, by its nature, a flexible technology that lends itself to reuse and brings reductions in total cost of ownership and increases in software quality—a win–win.

Born Equally?

Not all CEP engines are born equal, and to truly realize this value, firms should look for vendors to:

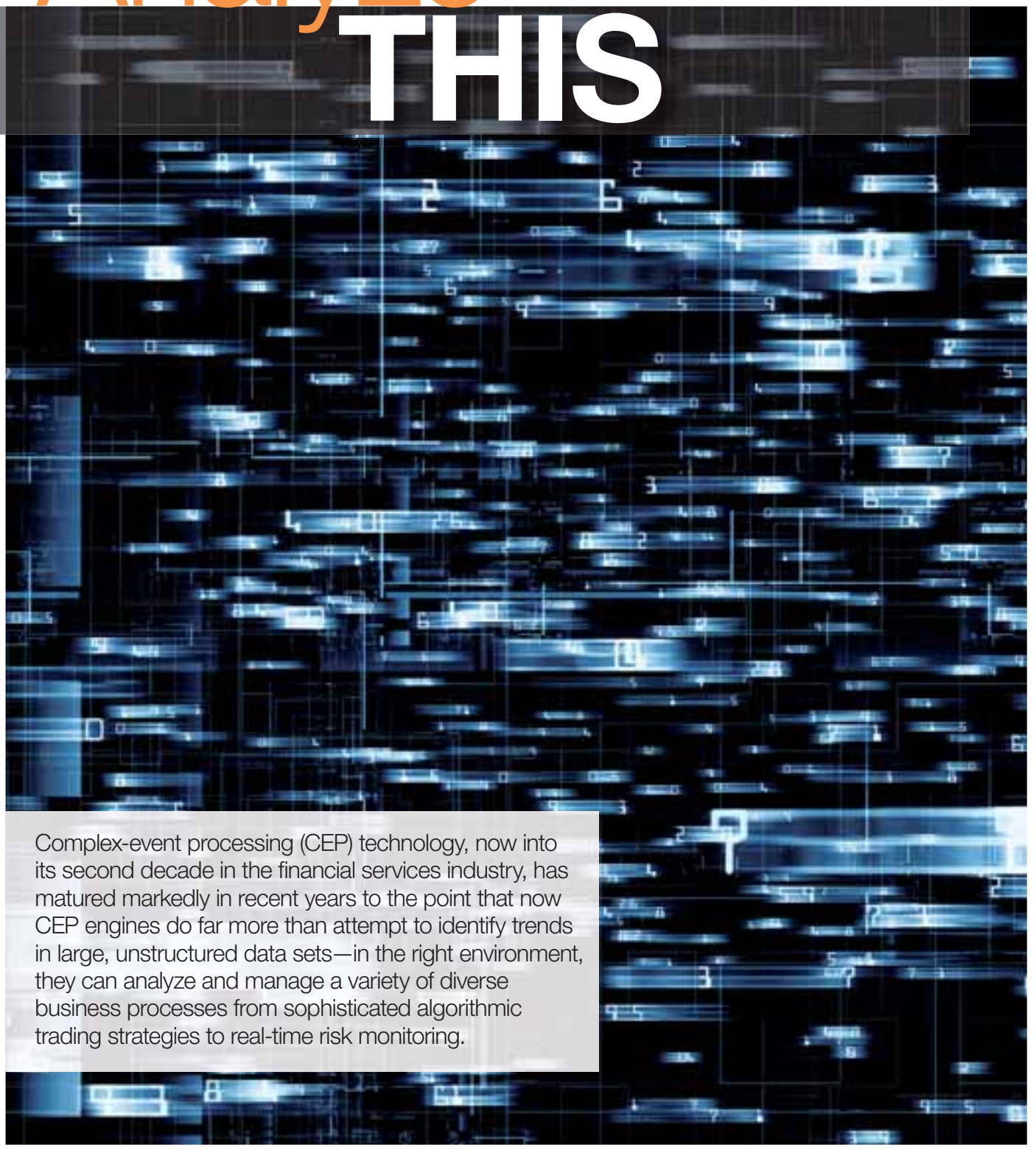
Demonstrate latency and throughput in real-world benchmark tests (e.g. option pricing calculation, portfolio valuation, and so on) as well as demonstrate how performance degrades as throughput increases.

Supply pre-packaged application components that save development teams having to rebuild commodity services.

Prove consistent investment in research and development (R&D) and a future roadmap that instills confidence in the vendor as a viable long-term partner. ■

Theo Hildyard is product manager, capital markets software solutions, at Apama.

Analyze THIS



Complex-event processing (CEP) technology, now into its second decade in the financial services industry, has matured markedly in recent years to the point that now CEP engines do far more than attempt to identify trends in large, unstructured data sets—in the right environment, they can analyze and manage a variety of diverse business processes from sophisticated algorithmic trading strategies to real-time risk monitoring.

Q How can CEP technologies be used to help trading firms identify investment opportunities and act on those opportunities faster than their competitors?

Theo Hildyard, product manager, capital markets software solutions, Apama: CEP is often divided into alpha-seeking algorithms—where the analysis of the investment opportunity and the decision to trade is automated—and execution algorithms that focus on managing the trade execution once the investment decision has been made. An important part of improving alpha-seeking algos is tuning the algo with current market intelligence. The more up-to-date an algo's view of the market, the more informed the investment decision will be.

CEP can add additional value by analyzing standard measures, such as pricing and depth-of-book, as well as complex measures, such as volatility of the instrument, and related instruments; collateral adjustments; and credit charges associated with the trade and news. CEP can build intelligent analysis of the current market, as well as the consequences of making the trade, into the pre-trade decision-making process. Many of the techniques above apply to execution algos as well—i.e., intelligent analysis of market data to achieve better execution. However, Apama enables clients to extend this idea and allows firms to run multiple variants of execution algos with only a few live at any one time. Based on intelligent analysis of market data, the algos can then be dynamically and seamlessly swapped in and out on an intra-day basis to deliver better performance.

Zak Martin, head of risk technology and change, markets and international banking, Royal Bank of Scotland: Pre-deal impact analysis is becoming more important in a capital-constrained environment. Those firms that can evaluate the complete impact of a proposed transaction will gain the edge on those who can only evaluate capital impact infrequently and on a portfolio basis. I want to qualify this answer by saying that I am not convinced that CEP is the answer to the pre-deal problem, although it could be a solution. I have no visibility of it being used in this space.

Paul Rowady, senior analyst, Tabb Group: The sky is the limit. Only the boundaries of creativity will define how CEP will be used going forward to identify trading decisions. Two drivers set this stage: First, CEP will eventually become a part of what will be known as "big memory"—used to combat critical needs for big data. CEP and high-performance and high-capacity solid-state—i.e., flash or dynamic random-access memory—storage will converge, allowing never-before-conceived computational workloads to be executed at ultra-low latencies. Second, more of the global capital markets will be available in a highly automated framework, mainly due to the unprecedented transformation occurring in fixed income and over-the-counter (OTC) derivatives markets. Eventually, CEP will be used to harvest theoretical alpha embedded in the cross-asset mispricings of equity and fixed income securities, and their respective derivatives.

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Theo Hildyard

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Q What are the attributes of an ideal CEP platform, and how specifically does the technology help firms make more judicious decisions in ever-shrinking timeframes?

David Tsui, director of markets and trading surveillance, Citigroup: CEP platforms provide flexibility and scalability, and are uniquely qualified to address problems that are event driven. Trading decisions and market surveillance are mostly event driven (e.g., when there is a large customer order—an event—they monitor if a firm order is placed ahead of the customer order). CEP could monitor events and associated activities that should occur or should be monitored in real time.

It can also be scaled depending on the problem—e.g., for surveillance purposes, listed stocks and related products, as well as all transactions and market prices could be scaled by security symbol in time order. This provides scalability and flexibility that cannot be achieved by set-based processing for large volumes of data and problems that are event driven in nature.

For instance, the problem of monitoring listed options execution is both "event" and "time" driven, and the daily market data volume in the US is about 20 billion records. A set-based approach will make it extremely difficult to monitor execution obligations for listed options. As such, a CEP platform with a built in layer for scalability will be very beneficial. For instance, have a load-balancing layer to distribute data based on a pre-defined set of criteria instead of custom built.

It is the nature of CEP to look for events and most CEP platforms are not very good at providing meaning errors or exception handling. As CEP is expanded to provide enterprise solutions and handle big data, error logging and exception handling will be essential.

Rowady: The ideal CEP platform is, one, pre-integrated with the widest spectrum of market data feeds and other relevant catalytic data feeds; two, highly "parameterizable," such that end-users are not hamstrung in their level of creativity and exploration; and, three, has a well-designed visual interface such that the broadest spectrum of skill sets can contribute to the design of strategies.

Zak Martin
RBS

Martin: It is important that any solution can differentiate with respect to the timeliness considerations for a given calculation. In many cases, an approximation will suffice. Furthermore, the technology framework and rule-set construction must have a sensible set of fallback rules for "failure" situations. If you stop trading unnecessarily, you will not be popular for very long.

Similar to my previous answer, I want to qualify this response by saying that I am not convinced that CEP is the answer to the pre-deal problem, although it could be a solution. I have no visibility of it being used in this space.

Hildyard: A CEP engine does very little on its own. CEP, as an event-processing tool, delivers value though:

- Connectivity to various and disparate data sources
- High-performance correlation and analytics
- Development and testing tools

However, even with these tools, users of CEP will still need to build the typical software components associated with capital-markets applications, such as position/profit-and-loss (P&L) services, order management services, order routers, market data management, and so on. Having to build these standard components from scratch increases project cost and risks. An ideal CEP platform, therefore, includes a high-performance CEP engine, a comprehensive data integration suite, development and testing tools, as well as a rich library of software services to reduce time-to-market and development costs. Equipped with this ideal CEP platform, firms can make more timely decisions by rapid analysis of fast-moving data, using business rules that are quick to update and evolve as market conditions change.

Q What other areas of the business—risk management and surveillance, for example—are ripe for the adoption of CEP technology?

Martin: In this environment of increased regulatory scrutiny, trade surveillance is an ideal opportunity for CEP technology and I see this as a growth area for those companies who want to lead the field in compliance risk. But the technology also needs to be supported by a program of cultural change.

Hildyard: Two stand-out opportunities exist for CEP right now:

Front-office trading of asset classes that are moving up the automation curve—e.g., fixed income and OTC swaps

The risk and compliance functions within the middle office

The front office can realize substantial cost-savings by re-purposing mature CEP-based automated trading applications including order management, liquidity management, price aggregation, smart order routing, execution algorithms, and so on. Obviously, there are differences in trading dynamics across asset classes, but a good CEP platform has customization and extensibility wired into its DNA. Within risk, pre-trade monitoring of automated trading can identify and block erroneous orders, and maybe even shut down offending algos, and is an obvious candidate for CEP. Within compliance, a range of behavioral monitoring, from detecting market abuse to rogue trading, can be thought of as detecting patterns from streaming data, and is, therefore, suitable for CEP.

Rowady: Yes, yes, yes, and all of the above. The use cases are limitless. Risk measurement, surveillance/fraud detection are clearly near-term targets for CEP usage. Other operational, technical infrastructure, and other system monitoring will eventually be added to the list. Harvesting signals for the growing body of social media is also a category ripe for CEP.

Tsui: I see CEP adoption being most useful for compliance-related issues, especially for surveillance. It's useful for compliance in terms of connecting activities across business lines, regions and entities.

Q Are there parts of the business that might stand to benefit from CEP technology over the next 18 to 24 months?

Hildyard: The OTC swaps market faces changes that are relevant to CEP. European Market Infrastructure Regulation (EMIR) and Dodd–Frank will drive OTC swaps onto trading venues, which could in turn lead to a plethora of swap execution facilities (SEFs), or the futurization of these instruments. CEP has a role to play in both eventualities. A SEF-led market will have similarities to the foreign exchange (FX) market in which multiple liquidity sources will require firms to have aggregation, order management, auto-hedging and other services currently delivered using CEP. A futurized market will attract increased liquidity and speculation. Automated trading firms will step in, meaning buy-side, alpha-seeking algos and sell-side execution algos will participate in this market in much the same way as with other exchange-traded derivatives.

Martin: Banks can build on the capital-calculation frameworks that have been built to meet the regulatory challenges of Basel III. With only minor modifications, these systems can be adopted to generate some direct business benefits for those businesses that wish to utilize capital more effectively.

Rowady: In capital markets, trading strategy research/development/implementation, risk discovery/measurement/monitoring, and operational integrity—including compliance, fraud detection,

and so on—are the primary targets. For large sell-side firms, CEP may be useful to crowd-source behaviour patterns. Basically, CEP could be useful to detect short-term shifts in crowd—e.g., customer—behavior for just about anything.

Paul Rowady
Tabb Group

Q How has CEP technology changed over the past two years and what is the killer functionality that proves compelling to end-users?

Rowady: CEP has certainly become more mature, more robust as a tool: more data integration, easier to use—via improved user experience design—and improved governance when toggling algorithms from development into production. Also, the spectrum of use cases has clearly begun to expand. This is largely due to vendor marketing, as the community of early adopters for trade execution has reached its limits. For the most part, CEP is becoming more commoditized, which is why we've had two key acquisitions in the past few weeks. CEP is itself killer functionality, but becoming more difficult to distinguish between vendors. It is itself compelling to end users when they wake up to the spectrum of possibilities of its use for low latency decision support.

> "CEP can add additional value by analyzing standard measures, such as pricing and depth-of-book, as well as complex measures, such as volatility of the instrument (and related instruments), collateral adjustments and credit charges associated with the trade and news."
> **Theo Hildyard, Apama**

Tsui: It is now being used to create built-in adaptors to connect activities across different communication channels. For instance, surveillance, such as insider trading, should connect trading activities, emails, instant messaging, Facebook, Twitter, voicemail, proximity, and so on. On top of the built-in adaptors, it can be used to create certain functions that could facilitate business activities such as surveillance. For instance, "functions" for surveillance could be security symbol, account ID, activities for a certain period, phrases with multiple key words, and so forth. The same approach could also be beneficial for marketing to consumers and clients.

Hildyard: The past two years have seen a number of CEP vendors augment their baseline event-processing capability with additional functionality. Some vendors seek to pre-package algorithms, some include a tick database, some focus on performance. For Apama, the focus is very much on performance and, to be clear, the high-performance execution of computationally intensive tasks. Furthermore, the performance of any IT system will degrade as load increases, but key to the performance of CEP is as little degradation as possible—e.g., reliable performance at scale. These two areas of functionality are, in our view, the most compelling areas for end-users—a good old fashioned straight-line speed advantage when performing complex real-world tasks.

Q What are the common pitfalls made by end-users when it comes to designing and implementing CEP platforms?

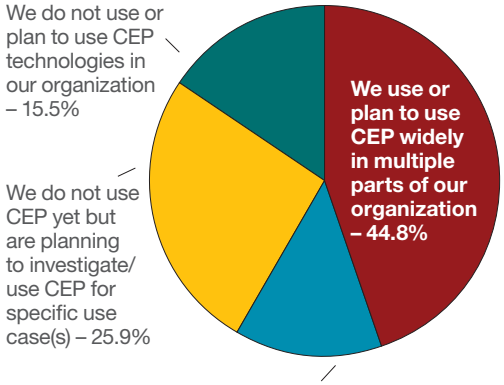
Hildyard: A CEP platform offers a middle ground on the continuum between buying rigid applications and building bespoke applications from the ground up. A common pitfall from the buy end of the continuum is to underestimate the effort involved in taking the hybrid approach. The hybrid approach allows for customized software to be built on top of a tried-and-tested platform—cost-effective yet differentiated intellectual property essentially—but there is still development involved. A common pitfall from the build end is to suffer from the "not-invented-here" syndrome and think that everything must be built from the ground-up. In truth, capital markets applications often make use of common software services like position keeping, margin calculations, order management, and so on. These services are not themselves differentiators and firms could save precious time and budget by buying them as part of a CEP platform.

Tsui: CEP has been used for a lot of real-time applications. There is a tendency to design the application to have all of the necessary information—such as product and account reference—in memory. As CEP is expanded to handle enterprise data or big data across platforms, I do not think this is a valid assumption going forward. The application platform/framework should have the functionality to "fetch" reference or other data as needed. CEP also requires a different kind of thinking in designing an application. Most developers are used to the set-based/database approach. Substantial training and time are required to build a development and support team that can handle CEP development and realize the benefits of the approach.

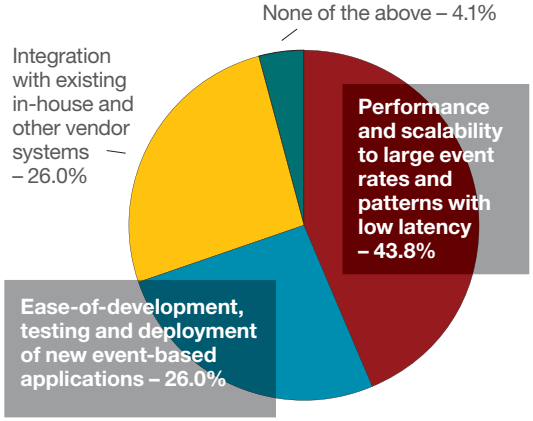
Rowady: The most common pitfall is over-complication; asking the tool to do too much, too soon, before vetting new routines. This is a common problem in trading shops in general. Simpler is better. Start simple and small. Verify and validate. Build from there; methodically and with a highly disciplined process. Eventually the routines will become quite complex, but only when assessed in totality. At the foundation, CEP is ideal for making a nested series of very small decisions, extremely fast. ■

Measurement, Management and Monitoring

AUDIENCE POLL 1: Do you use CEP technologies in your organization?



AUDIENCE POLL 2: What are the most important criteria you consider when selecting CEP technologies?



Moving beyond its traditional role in algorithmic trading, complex-event processing (CEP) technology is evolving to become a key part of a firm's infrastructure across the trade lifecycle. *Waters* recently gathered experts for two webcasts to discuss the uses of CEP in risk, compliance, and across the enterprise. By James Rundle

As CEP has matured over the years, it has become more endemic in the technology ecosystems of financial services firms for an increasing variety of applications. These range from pre-trade risk management to effective surveillance operations that are increasingly requiring pattern-recognition and analysis capabilities. Coupled with in-memory analytic technologies, CEP has become a key weapon in the big data arsenal as well.

"We've seen a move beyond algorithmic trading use-cases for CEP for a while now," says Richard Bentley, vice president, capital markets at Apama. "There are a couple of areas, such as real-time risk analytics with enterprise views, which are of increasing importance. Particularly within that are the regulatory drivers that call for more real-time, intra-day views of collateral and margin assessments for pre-trade decision making."

High to Low

One of the key points from both webcasts was the distinction between risk measurement and risk management. Automation is suitable for the former, which is heavily reliant on data crunched by technologies such as CEP engines, but the latter has a human influence where meaningful decisions are determined by that output.

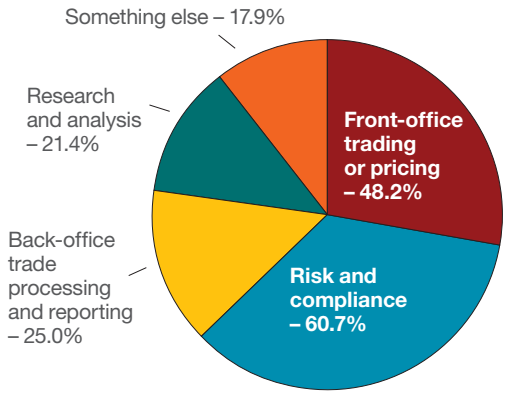
In the pre-trade arena, though, particularly as trading strategies diversify, the technology is becoming essential when it comes to pulling data from systems that have been traditionally isolated.

"As the buy-side opportunities for alpha have dried up, people have to look further afield by incorporating different asset classes and geographies, different time zones and settlement procedures, and all of this is rolling up into a greater level of analysis," says Rebecca Healey, senior analyst at Tabb Group. "Unless you have a CEP-type system in place, it's going to be very difficult to get siloed, legacy systems to effectively talk to each other, to ensure that you're fully compliant."

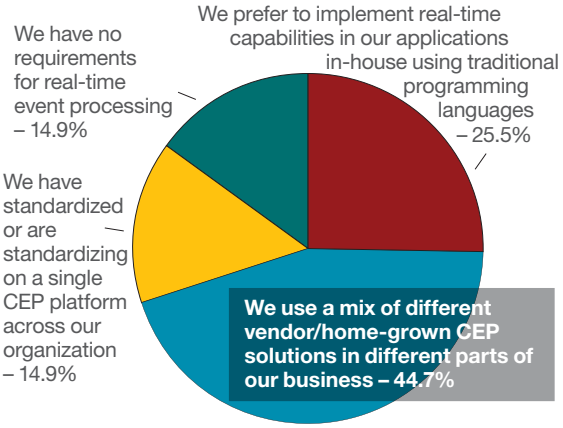
Expanding on this idea, and acknowledging that regulation is pushing more instruments to a flow model with straight-through workflows as opposed to high-touch processes, other panelists say the addition of more risk management points of control are necessitating further use of CEP and intelligent software, that can create actionable information based on data.

"Consider that in high-touch transactions, the systems built around that are not real time, and they're very heavily based on an artificial batch cycle," says Jaime Mantilla, vice president of solutions architecture for trading technology at Deutsche Bank. "As you move the trading and the execution workflow to a real-time basis, then correspondingly you have to move your risk analytics to that speed, and remove the artificial batch cycle that we have to a more event-aware approach. You could argue that rather than moving technology from the front office to the middle office, what we really need to do is move middle-office processes toward the front office."

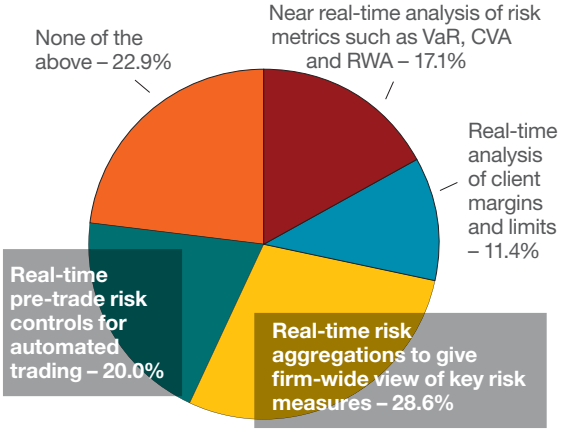
AUDIENCE POLL 3: What is driving an increased focus on real-time processing in your organization? (Name all that apply.)



AUDIENCE POLL 4: What is your approach to rolling out CEP-like capabilities to real-time–enable your organization?



AUDIENCE POLL 5: What is the key driver for real-time analysis of risk in your organization?



Overwatch

Surveillance has become an area where CEP is demonstrating its versatility. As regulations contained within policies such as the Dodd–Frank Act and the review of the Markets in Financial Instruments Directive (Mifid II) are demanding a greater level of oversight for fraud and general market-abuse behavior, while high-profile failures threaten greater levels of financial and reputational risk, firms are looking for more proactive ways of engaging in compliance activities.

"I think surveillance looks like the best use-case [for CEP]," says Zak Martin, head of risk technology and change for markets and international banking at RBS. "A hypothetical example may be matching up dealing patterns with phone calls made and security card swipes—you can look for patterns where something is amiss or outside of normal behavior. You're using those points to look for things that you may not have had the capacity to do before."

At-Trade

It's not just surveillance for market abuse and fraud where CEP finds its feet, however. Monitoring of algorithmic activity to prevent catastrophic losses such as those seen in the Knight Capital debacle last summer, with the addition of CEP functionality, can potentially be greatly enhanced.

"Post-trade controls such as market-impact analysis linked to kill switches are really an ideal use-case for CEP, and now people are talking about at-trade controls—the idea that you have a parallel stream running through CEP engines off the critical path to balance latency concerns, but with the ability to act as soon as possible in order to minimize possible exposure," says Apama's Bentley.

Theo Hildyard, director and product manager at Apama, adds that the technology is developing in such a way that it's not just straight kill switches that can be incorporated into the analysis of real-time data. On-the-fly automated customization of strategy processes, too, is a possible area of development.

"In theory, as well as sending your algorithm a message to shut down, it can send it a message telling it to adjust its behavior," Hildyard says. "That could be in response to a pre-trade risk check that says the algorithm is quite clearly broken, or it could be because market conditions have changed. CEP is a key component in that simply because it is the big-data-in-motion business logic and decision-making engine, with a good integration story, so you can plug it into these systems easily."

More than anything else, though, the increasingly interconnected nature of markets and participants is driving CEP, along with evolving concepts of big data and its supporting technologies, as Paul Rowady, senior analyst at Tabb Group, explains.

"The way I see this, in addition to the expanding spectrum of use-cases, is this idea of big data meets big memory," he says. "CEP's ability to tackle bigger and bigger workloads, whether that's more robust risk modeling, enterprise views of counterparty exposure in real time, given the migration and transformation of over-the-counter markets to listed markets, is going to be critically important." ■

Both webcasts were moderated by Anthony Malakian, US editor of Waters *and WatersTechnology.com.*

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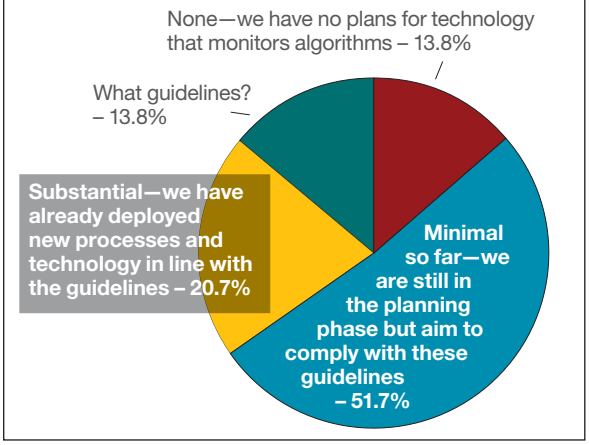
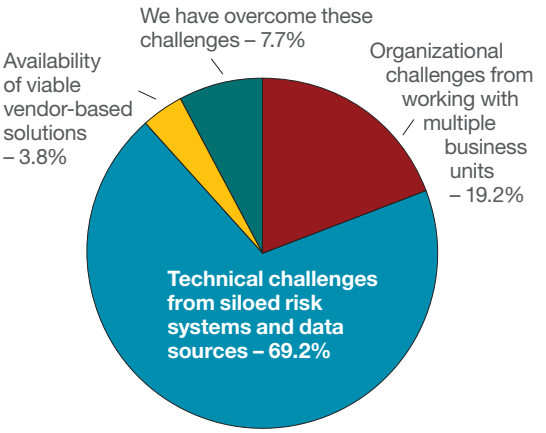
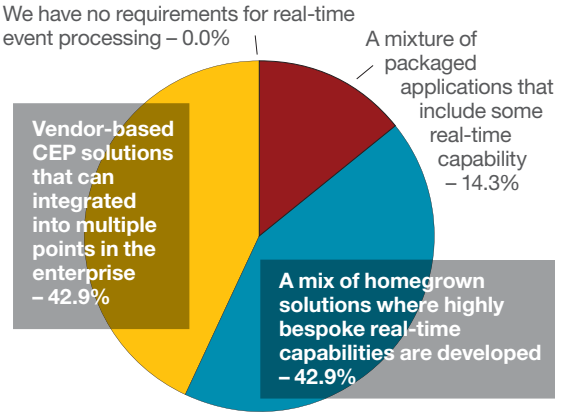
AUDIENCE POLL 6: What impact are regulatory guidelines on automated trading having on your organization?



AUDIENCE POLL 7: What is the largest barrier to calculating aggregated risk measures within your organization?



AUDIENCE POLL 8: While real-time processing is a key part of the risk architecture, what does your firm favor?



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