



Leveraging Complex Event Processing for Algorithmic Trading in FX



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Over the last year, a strong business case for automating foreign exchange trading has continued to drive the adoption of advanced trading technology. The FX market is characterized by fragmented liquidity - caused by an ever-growing set of liquidity pools and ever-increasing volatility. Within this environment, a growing number of firms are interested in lowering the cost and enhancing the profitability of FX trading, using techniques such as algorithmic trading. This interest can range from augmenting spot desks with automated trading systems that execute trades and

manage positions, to high frequency algorithms that seek out and act instantly on trading opportunities in the fragmented liquidity environment. In the high frequency world, traders realize that algorithms must act on opportunities before an increasing number of competitors who are aiming to get there first. This growing interest in trading automation comes at the same time as managing trading risk is very much at the fore-front of thinking, given the market climate and some high profile new stories. Automating and streamlining the processes of backtesting, tracking risk exposure in real-time and automatically hedging to manage risk, are all techniques that institutions now need to incorporate into their algorithmic trading plans. This article discusses a new technology that has been deployed successfully to address these business drivers within the FX market. The technology is Complex Event Processing (CEP).

Complex Event Processing

CEP is about monitoring, analyzing and acting instantly on patterns that indicate opportunities or threats to the business. In FX, this can be monitoring market data from FX venues, detecting patterns that indicate trading opportunities and automatically placing and managing orders to take advantage of these opportunities. CEP in FX can also involve monitoring risk levels as trades are placed and positions change and, if risk thresholds are exceeded, hedging positions automatically. An "event" in CEP represents any update - such as a new quote from a trading venue or a news article arriving on a newsfeed. These events are fed into a CEP engine, via an integration adapter layer that can connect to a wide variety of heterogeneous services. The CEP engine is the brain of the monitor-analyze-act functionality.

The patterns for which the CEP engine will monitor, analyze and act are described as event-based rules, as illustrated in Figure 1. Rules can contain arbitrarily complex temporal and logical

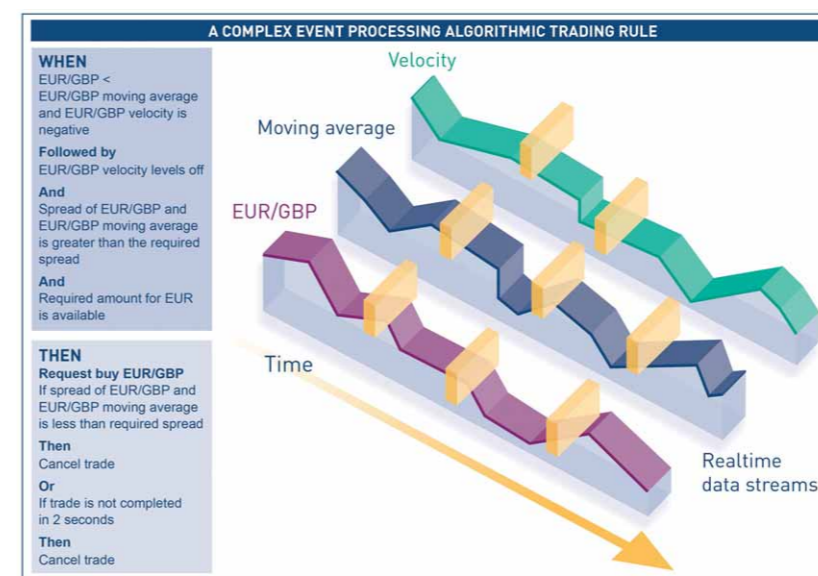


Figure 1: An example FX algorithmic trading rule

sequences, along with actions to take if the sequence is detected. In some CEP systems, such rules might be described either in a CEP language or a graphical modeling tool that is accessible to non-developers. Recently there has been considerable focus on the evidence that CEP adoption is being driven as much by the business as by technologists. Graphical tools that target business users, such as traders, and enable them to create and customize trading strategies without the need to program is a key contributor to this phenomenon.

Event-based rules respond when the data values in received events are relevant to the parameters of a rule. For example, a new event may cause the recalculation of a complex analytic or may be part of the detection of a pattern that indicates a statistical arbitrage opportunity has been identified.

Figure 1 is a simplified example of a CEP rule that monitors the EUR/GBP cross - looking for a

trading opportunity. This pattern requires the continuous recalculation of analytics, such as the moving average of EUR/GBP and the EUR/GBP velocity (i.e. if it is heading up, down or leveling). When an opportunity is detected, orders are placed - but if the situation reverts mid-trade, these orders are automatically cancelled.

Connecting to Multiple FX Venues

The FX market is characterized by liquidity that is spread across a range of different trading venues. These trading venues include bank-provided liquidity pools, as well as aggregators and ECNS, such as EBS, Reuters, Currenex, Hotspot and FXAll's Accelor. The growth in the number of trading venues has led to increasing liquidity fragmentation. This has driven a number of new requirements in trading infrastructure and CEP has been shown to be an ideal technology to meet these requirements.

The first requirement is the strong demand from trading groups to be

able to connect to not just one pool - but to multiple, if not all pools - to get a broader picture of what is happening in the market and to seek out best price and liquidity. Trading groups do not want to use different trading systems simply because of their connectivity to different pools; they want to use the same trading system and connect to multiple venues concurrently. Since a CEP engine treats all market updates as "events", events from multiple venues can easily be combined within the same platform.

To enable open connectivity, FX liquidity pools now provide electronic application programming interfaces (APIs) to enable trading systems to connect to them, receive market data and place orders. However, one FX complexity is that, unlike equities where the FIX protocol is rapidly normalizing the means of connecting to trading venues, all FX APIs do not yet adhere to a standard. This requires an electronic trading platform to implement connections individually rather than rely on a unifying protocol. Strong CEP platforms will mask the complexity of different APIs and protocols by providing an integration layer that enables connections to multiple trading venues. Within this layer adapters convert the incoming market data into events that the CEP platform can consume. Similarly, events that are generated by the CEP platform, indicating orders to be placed on a particular venue, are converted by adapters into order placement messages that the particular trading venue can understand. In this way the integration adapter layer is able to



translate between events and market data and orders.

Using events as the basic building blocks of trading strategies also yields advantages beyond straight FX. Cross-asset class trading can easily be implemented since messages from equities, derivatives and fixed income systems can also be treated as “events”. Combining FX events with other asset classes can enable applications such as cross-border trading, using FX as a real-time conversion for dual listed instruments.

In addition to other asset classes, the ability to connect to, monitor and respond to patterns in real-time news feeds is another way in which CEP is being used for competitive advantage by the FX trader. For example, an algorithm may buy Swiss Franc crosses on news of a conflict – reacting before humans can. News may also be combined with analysis of other market data – alerting a trader when a news article seems to be affecting a particular currency pair.

FX Market Aggregation, Liquidity Sensing and Smart Order Routing

Most traders are not satisfied to simply connect to the FX venues; they want to aggregate the information coming from the liquidity pools – in order to gain a unified view of the market. Rather than watching each pool individually, an aggregator creates a “rolled up” view of the market for each currency pair. For example, the top 3 best bids on EUR/USD could be on EBS, whereas the next best could be on FXAll Accelor and so on. An aggregated view combines this into one super book.

Aggregation is a computationally complex task, which increases as more liquidity pools are added into the mix. Every time one of the pools changes the aggregation algorithm must detect this, consider whether the change impacts the aggregated market view for a particular currency pair and make any necessary changes. This must be done with the minimum possible latency. CEP provides a powerful platform for aggregation. Event-based rules can be used to instantly detect and act on FX market changes that require fine-grain reorganizing of the aggregated view.

With an aggregated view comes the ability to immediately sense best liquidity and price combinations in response to an order from a client or an automated algorithm. The CEP system is able to monitor and analyze the aggregated view to identify the right liquidity and route orders to the appropriate trading venues to capture that liquidity. It is critical that this liquidity sensing and smart order routing happens with minimal latency – before a competitor moves first. Given that low latency actions are the foundation of CEP makes such technology ideal for this kind of application.

High Frequency FX algorithms

Traders are increasingly interested in developing proprietary algorithms that can capitalize on an aggregated view of the FX market. These algorithms monitor for particular trading opportunities in the market and upon detection, they are able to automatically place and manage orders in one or more FX venues.

One key driver that is evolving in algorithmic trading as a whole is the desire to differentiate from other players. It is becoming apparent that buying pre-built algorithms, built by third parties, does not provide the edge that traders need to compete effectively. There is a growing recognition within many firms that if an algorithm is available to everyone then the competitive advantage achievable is limited. Traders often want to either customize an existing algorithm or develop a completely new one. This is accentuated by the fact that the market is continuously evolving and new opportunities may be spotted at any time. It is the first-mover that capitalizes on such opportunities – so building and customizing algorithms rapidly is also key.

The technology requirements to enable such a scenario are complex. Analytics need to be continuously recalculated, complex logical and temporal conditions need to be continuously monitored, and trading actions need to be taken, such as placing orders. All this must take place with the minimal possible latency – as otherwise another algorithm may move first on an opportunity. CEP is an approach that has been proven to deliver these complexities, along with the advantage that complex scenarios are easy to develop, since the platform has been designed with this in mind.

Real-time Risk Management and Backtesting

Increasing the automation and productivity of FX trading through algorithms can also

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increase the potential risk exposure. Trading institutions know that managing risk is critical – and in this fast-moving environment being able to check risk before making trading decisions is the optimal solution. To this end CEP is being used to create real-time risk rules that execute “in-band” with the algorithmic trading rules. Risk rules may check, for example, that the quantity being traded does not exceed a certain level for a certain trader. Also, real-time analytics can be used to calculate, on an on-going basis, the value-at-risk for FX positions. If the risk exceeds a certain threshold, actions to auto-hedge the positions through trading can be automatically executed.

In order to ensure that as many potential risk situations are covered, as well as that trading algorithms actually work as predicted, the technique of backtesting is used. CEP platforms enable sequences of historical events to be used, in conjunction with market simulators to accurately test how algorithms would behave in certain real situations. Of course, recent events make clear that one cannot always predict the future with data from the past. Thus, key to any quantitative strategy – in FX or any other asset – is the ability to respond to market circumstances quickly with new strategies that accommodate new market realities.

Conclusions

Competitive advantage in FX trading is being gained by innovative firms that use the latest technologies in new and exciting ways. The FX algorithmic techniques that have evolved, such as market aggregation, rules-based algorithmic trading, smart order routing, real-time risk management and trading on the news, are tailored to the characteristics of the FX market. As introduced in this article, the technology challenges of connecting to a wide variety of FX venues and implementing these algorithmic techniques with low latency performance are being successfully addressed through Complex Event Processing. And more exciting developments are on the way - stay tuned!!