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Simulating Market Execution
The Battle for Order Flow

Simudyne —— Reality, re—engineered

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Executive Summary
A foreword from Justin Lyon, Simudyne CEO

Trading technology has always been at the cutting edge of financial markets. As technology has evolved from carrier pigeons, to telegraphs, to microwave communications and beyond, traders have always been pioneers.

Over the course of the last 100 years or so, it's not an exaggeration to say we have progressed from the speed of flight to the speed of light, as financial firms have continued to push the envelope of innovation.

The same is true on the execution desk, where sell-side firms have had to innovate to differentiate in a highly competitive market.

But as the pace and sophistication of trade execution innovation increases, achieving optimum pricing to attract and retain order flow becomes more challenging. At the same time, the regulatory burden is ever more stringent and increasing fines means that the pressure to comply is higher than ever.

With execution services already under the spotlight and more sophisticated performance measurement tools being used by investment managers, sell-side brokers operate in a tough environment.

In this brochure, we look at the challenges faced by execution teams within sell-side banks, and how agent-based simulation is key to helping them achieve their business objectives.

With key insights from trade publications, as well as our own experts here at Simudyne, we hope you find this brochure a useful tool in winning the battle for execution order flow.

Justin Lyon
CEO at Simudyne

Simulating Market Execution

Execution teams within sell-side banks are fighting for internal resource allocations in a capital-challenged environment and must grow their business and deliver a compelling ROI.

Sell-side execution desks are striving to achieve three key business objectives:

(01) Attract order flow;
(02) Enhance execution quality;
(03) Improve regulatory compliance

Attracting Order Flow

A key challenge for the sell-side in attracting order flow is competing against the variety of execution algorithm (algo) offerings from other sell-side firms. Execution desks competing for orders need tools that differentiate them and demonstrate to the buy-side the superior performance of their execution algorithms.

Furthermore, investment firms face a daunting task of selecting brokers to support their needs and justifying those selections to regulators.

In parallel, the unbundling of research under MiFID II in Europe makes attracting order flow more challenging.

It forces the buy-side to focus purely on execution quality to select brokers. Furthermore, best execution regulations require the buy-side to objectively select brokers using evidence-based processes.

Increasingly, investment managers are turning to technology vendors for solutions that provide performance transparency and assistance in determining these choices. These vendors provide solutions such as 'Total Cost Analysis' and 'Broker Wheels' that automate the process of algo selection for trader-directed flow. The rapid deployment of such tools creates both a threat and an opportunity for the sell-side, with brokers selected based on clear performance metrics. Brokers with consistently poor performance will struggle, while those that demonstrate reliable performance against diverse market conditions will thrive.

Enhancing Execution Quality

Execution quality is key to retaining and growing flow with customers. Traders constantly review and evaluate execution quality as the sell-side refine and launch new algorithms. Accordingly, the sell-side must constantly adapt and evolve, particularly as the industry begins to leverage predictive analytics to test performance against near-term market dynamics. Understanding and staying ahead of these challenges will be an important consideration in retaining and growing order flow for the sell-side

Improving Regulatory Compliance

Increased regulatory pressure has also raised the bar for both sell-side brokers and investment managers. In Europe, MiFID II increased responsibility on sell-side firms, with the directive ratcheting up the prevention, detection and containment of algorithms that might behave in an unintended manner and contribute to disorderly trading conditions. In parallel, best execution regulations scrutinize investment managers to demonstrate effective and transparent broker selection policies. While the sell-side have a regulatory responsibility to properly test their algorithms, there is also a business case in providing innovative tools to measure performance transparency on behalf of the buy-side, enabling them to meet their internal compliance guidelines.

Execution teams are in a highly competitive environment. Those seeking increased customer order flow must create a compelling business case to secure scarce capital from within the bank to invest and evolve their offerings. At a time when the sell-side is struggling with margin and the rising cost of doing business, the ability to effectively forecast order flow is critical to justifying investment.

"——— MiFID II and regulations that follow will be a catalyst for the adoption of regtech including predictive analytics, machine learning, artificial intelligence and natural language processing. This will not only ease compliance, but also create as yet unknown market opportunities that could reinvigorate business, raise margins and change the profile of capital markets for the better."

———

DR. AMIR SANI
HEAD OF RESEARCH AT SIMUDYNE

The Challenges

As the pace and sophistication of trade execution innovation increases, achieving optimum pricing to attract order flow becomes more challenging. At the same time, the regulatory burden is ever more stringent and increasing fines means that the pressure to comply is higher than ever.

With execution services already under the spotlight and more sophisticated performance measurement tools being used by investment managers, sell-side brokers operate in a tough environment. Against this backdrop, execution desks also face several modeling challenges in validating and differentiating their algo offerings.

Inability To Model Real World Environments

Execution strategies optimized in a test environment do not necessarily survive contact with the complexities of the real world. Achieving advertised benchmarks against a wide variety of market scenarios is critical to success. However, many execution strategies fail to achieve back-test performance benchmarks due to real-world dynamics such as execution fees, market impact, drifting execution latencies, inconsistent liquidity and volatility. Current execution workflows fail to model the true complexities of the entire trade lifecycle.

Historical Data Is Not Enough

Current approaches to back-testing and optimization are reliant on historical datasets as they are structured around exposing strategies to streams of tick-by-tick market data. This approach only produces optimum results when historical data is representative of future market dynamics, which is often not the case, for example, during periods of high uncertainty.

In addition, major challenges exist regarding the cleansing of historical data and in using data which is of poor quality or is incomplete. The cost of acquiring and cleansing data can be expensive. Work can be wasted when structural changes occur due to new market rules or where regulation changes the market dynamics.

" —— The challenge is to effectively model thousands of potential scenarios efficiently to increase the robustness of algos under a broader set of possible market conditions and outcomes, thereby mitigating against such shocks. Not doing so runs the risk of lost customer order flow, falling off broker lists at key buy-side clients, or even large regulatory fines."

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DR. AMIR SANI
HEAD OF RESEARCH AT SIMUDYNE

Inability To Accurately Measure Market Impact

One of the key differences between model performance and execution performance is market impact. This, however, is notoriously difficult to measure. Using static data can make it clear to see how a price reacts to a large order but much harder to reliably measure what would have happened had the trade been executed differently.

Optimizing execution performance is highly dependent on understanding the market impact that trades will have, how other market participants might react to a given trade, and the overall effect on price and volume.

No Obvious Tools For Reliable Algo-conformance Testing

The number of flash crashes occurring on financial markets has increased drastically over the past ten years, with thousands of stressed events being recorded. These flash crashes can be caused as a result of unintended herding behaviors caused by algorithmic execution strategies. At the same time, regulators are working towards stricter regulations to ensure that market participants do not contribute to disorderly markets. And yet, there continues to be no consistently reliable tool that enables algos to be tested at a low-level—that is, at the micro-market level. To truly test the impact of algos they need to be deployed in a sandbox that allows them to compete against each other.

Unexpected Market Behaviors

Market dynamics are affected by many macro and micro factors, ranging from economic data and global events to negative company announcements and unexpected correlations. While many such scenarios may represent a low probability, their impact can be extreme.

PART III

Agent-based Simulation

Agent-based simulation greatly expands our understanding of real-world phenomena. By re-creating the low-level interactions that occur between trading entities it is possible to examine systemic effects such as asset price cycles, runs on funding, margin calls and asset fire sales.

In the agent-based simulation framework you can represent:

- The different trading strategies of market participants such as high frequency traders (HFT), investment managers or competing executions desks.

- The micro-structure of exchanges including the execution policies, order types, speed bumps or auction rules.

- The latency and locations of different exchanges or execution venues.

- The banks own internal infrastructure including smart-order routers, circuit breakers and trade processing.

Explore Extreme Market Events

The recreation of the low-level interactions between market participants means that these simulations are stochastic in nature and running them multiple times will generate a range of outcomes. By running the same simulation thousands of times, you produce tail events, stressed conditions and market crashes.

Specific scenarios can also be run in order to produce large amounts of data. Therefore, for the first time algos can be optimized to run in environments that rarely occur, such as in mini-flash crashes.

Accurately Model Market Impact

Uniquely, agent-based simulation allows banks to run the same simulation thousands of times with or without an order. In comparing the results of the two categories of simulation it is possible to more accurately quantify the likely impact of a trade. This same process can be run hundreds of times with different execution strategies to determine which approach is the optimum for every individual execution order.

Create Scenarios With No Historical Precedent

Agent-based simulators are calibrated and optimized against historical data to ensure that they produce data that is indistinguishable from the real world. Once the simulation faithfully creates market data, the underlying parameters are tweaked to produce novel data.

Run Many Times Faster Than Replay Servers

Traditional replay servers are restricted to a maximum throughput that is determined by processing power.

The nature of agent-based simulation is that back-tests do not need to run consecutively and can be distributed across machines to run concurrently, speeding the process up by many multiples.

" ——— Unlike statistic-driven models that are tied to past data, disconnecting from history produces new market dynamics that reflect both the possible and plausible behavior of future markets."

———

JUSTIN LYON
CEO AT SIMUDYNE

PART IV

Why Simudyne

Simudyne's unique expertise in agent-based simulation significantly reduces the investment of time and resource needed to build market simulators. What would normally take many months of engineering, tens of thousands of lines of code, and a deep understanding of distributed systems, can now be delivered at a fraction of the time and cost.

Simudyne can drastically reduce your time to market, saving the bank millions.

Simudyne is optimized to simulate market execution with a library of specific functions that save you time and reduce the complexity of the challenge. These easy to use, off-the-shelf components handle much of the basic functions that every simulator needs such as building the order book, defining trader characteristics, and catering for different order types and exchange protocols.

The calibration of market simulators requires massive compute power, which is where Simudyne's ability to distribute across existing infrastructure, solves the largest challenge facing agent-based market simulation.

The distribution of models can also significantly increase the speed and efficiency over existing replay and back-testing services.

The Simudyne platform is technology agnostic, utilizing a bank's existing Hadoop infrastructure and ensuring it is cost effective and easy to deploy. As a deployed solution, the technology is safe and secure. It sits behind the customer's firewall and all data and models remain entirely proprietary to the bank. The technology has already been integrated with key internal systems at banks, drawing data from existing market data platforms and communicating with execution platforms using the FIX protocol.

The Simudyne team are the market leaders in agent-based financial market simulation for best execution.

Partnering with Simudyne ensures your bank is using the most advanced technology supported by the best advice that the world has to offer. As banks embark on projects using this innovative technique, Simudyne delivers hands-on advice from a unique team of PhDs and market experts. The firm has a proven track record in working with financial service customers to build high-fidelity market simulators that can be integrated with the bank's business critical infrastructure.

Practical Applications

Differentiate Your Business Today

Using Simudyne for optimization and back-testing processes can deliver immediate results:

Differentiate your market execution strategies and attract order flow by marketing a genuinely innovative approach.

Move up the rankings on the broker wheel by optimizing your execution strategies and deploying them in a wider range of market environments:

- Test in a wide range of environments to create more robust algorithms

- Improve benchmark performance with highly optimized algorithms

- Test execution strategies against other predatory or competitive strategies

- Demonstrate that your bank is not contributing to disorderly markets by reducing unintentional herding behaviors.

" —— Simudyne is ground breaking technology that is currently being leveraged across Barclays, and enables us to model multiple scenarios on huge data sets, so we can understand our risk, exposure and options." - Jes Staley, chief executive officer at Barclays Bank

Algo Back-testing

Develop execution algorithms that can be deployed in a wider range of environments, scenarios and customer order types using agent-based simulation.

Market Impact

Agent-based simulation is a unique way of determining the market impact of any trade by running identical simulations with or without a given trade.

Market Slippage

Modeling latency, market volatility or the market impact of news enables the modeling of market slippage.

Market Manipulation Prevention

By including malicious activities in the model, such as order book spoofing agents and other prohibited trading strategies and simulating their activities, it is possible to develop more effective market manipulation mitigation policies.

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Simudyne is a rapidly growing technology business,
harnessing the power of advanced simulation,
to help organisations make radically better decisions.
Our efficient and scalable simulation platform allows
enterprises to create a virtual environment where they can
test drive their decisions, fail fast without consequences
and create solutions that drive growth.