A Guide to Innovation in Hedge Fund Technologies

April 2013

About this Report

This report considers innovation in Hedge Fund technologies by illustrating some of the emerging technologies available for Hedgefunds that undertake Computer based trading either by HFT (High Frequency Trading) Programme or AT (Algorithm based trading). There is also an emerging sector that is bringing these technologies into to the realm of the smaller institution and even the very skilled individual. The objective of the Guide is to give insight to Entrepreneurs and other interested parties on the areas in which Entrepreneurial opportunities reside.

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This report will always be in Beta

This report is a work in progress and it is our intention to publish it every 6 months. If you know additional sources of data please inform us and they will be incorporated into the next edition.

An Apology in advance

As many readers are involved intimately in FinTech transactions you may have much more additional information on the detail of specific transactions. A full and complete and unreserved apology is offered in advance for any misreporting, please contact the author(s) to report any inaccuracies.

Collaboration

An open call is made for Collaboration on data sources and ways to enhance the value of this report to members.
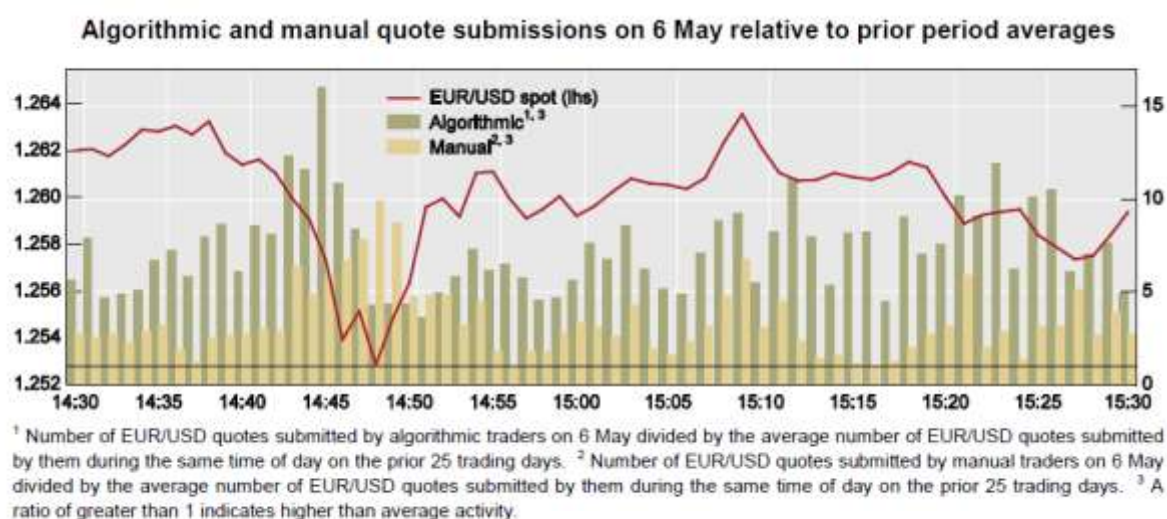
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1.0 Preface and Executive Summary

Algorithmic and manual quote submissions on 6 May relative to prior period averages

[1] Number of EUR/USD quotes submitted by algorithmic traders on 6 May divided by the average number of EUR/USD quotes submitted by them during the same time of day on the prior 25 trading days. [2] Number of EUR/USD quotes submitted by manual traders on 6 May divided by the average number of EUR/USD quotes submitted by them during the same time of day on the prior 25 trading days. [3] A ratio of greater than 1 indicates higher than average activity.

Source: EBS.

The flash crash of 2.45pm on the 6th May 2011

Executive Summary

HFT (High frequency trading) involving millions of trades each second across all markets and all of the worlds geographical domains demands a unique technological supply chain. Just one element of the HFT market, FX (Foreign Exchange) trading, is estimated to be worth an average of $4.37 Trillion per day in 2012 ($4.7 Trillion in 2011[1]) The most advanced mathematical models known are used, computer systems process data at their extreme limits of performance; accounting, reconciliation and reporting systems strain to deal with massive amounts of data, and that's before regulatory, compliance and governance questions have to be answered. At each stage of Hedge Fund trading activities and internal processes, you are dealing with dazzling complexity, volumes beyond comprehension, and reaction times measured in millionths of a second. When innovation goes wrong you may find yourself in or near Chapter 11 as fast as your trading desk spins, Knight Capital[2] lost $440m due to algorithms that went out of control in August 2012 in the space of 45mins. An Ernst and Young Global Hedge Fund survey[3] lists Compliance, Risk and Investment Management, and Client service as the key internal investment areas for Hedge Funds in 2013. A continuous arms race between trading desks is taking place, the struggle to manage this complexity creates a large international market for innovation, and there are many opportunities for the Fintech Entrepreneur.

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[1] http://www.e-forex.net/articles/free/Features/1798/Analytics,+models+and+algorithms+%E2%80%93+pressure+builds+on+FX+Market+Data+platforms

[2] http://www.bloomberg.com/video/knight-capital-loses-440m-on-trading-breakdown-sPuZUk0DRJWeVmmIIY4E1g.html

[3] P16 Ernst & Young Global Hedge Fund and Investor Survey http://www.ey.com/Publication/vwLUAssets/Global-hedge-fund-and-investor-survey_2012/$FILE/CK0582_Global-HF-Survey-2012.pdf

2.0 Focus of review

This review focuses on illustrating companies at each stage of the supply value chain as examples of innovation and opportunity for Fintech Entrepreneurs, it is not a fully comprehensive guide of every company supplying this industry, some large well known large companies will be mentioned as well as smaller start-up ones. Big Data permeates all of capital market technologies, in this report it is not treated as a specific topic, see the London New Finance Report on Big Data in Finance.

3.0 Trading – Front Office

Trading in volume and speed can only be carried out automatically by computer programs i.e. CBT (Computer based trading). CBT breaks down into two main streams, HFT High frequency Trading and AT (Algorithm based trading). Special flows of financial market price data are required to drive these systems.

3.1 Innovations in Trading

FX leads in HFT (High frequency Trading) and AT (Algorithmic Trading). Volumes are estimated at circa $4Trillion per day, of which at least 40-60% of the trades are estimated to be high frequency AT. Every major bank has a highly sophisticated trading system, Bloomberg and Reuters offer trading platforms leveraged off their information flows and historical data stores. Deutsche Bank even calls their system Autobahn. Barclays and UBS have announced major upgrades to their systems in Feb 2013, Barclays focusing on liquidity, UBS compliance, collateral and cost. In parallel there are large numbers of other kinds of market makers, brokers and quasi exchanges that participate in the core trading. There is a continuous development race taking place in terms of systems and the mathematics that drive trading, 1 millionth of a second can be a competitive advantage.

3.2 Forces that are reshaping Hedge Fund Technologies

1) **Systems**: Integrated v own build v cloud based. The pendulum has moved from own build, expensive and difficult to manage, towards integrated solutions from one single vendor who in many instances assembles the best fit software packages from a number of suppliers. Innovation has moved towards hosted data centres and now it's now exploring cloud and SaaS (Software as a service).

2) **Network centric systems:** network connectivity is vital for information flow, price discovery and order placing and to be able to trade in a multiplicity of global marketplaces. This is a force pushing system configuration towards the points of best network connectivity by either location, bandwidth or fibre optic concentration.

3) **Algorithm development and Trading Strategies**: Internal or externally sourced, key elements are back testing, simulation and assurance, audit and implementation control. No one firm can have a monopoly over mathematical talent, and algorithms have shorter and shorter shelf lives. With the new development tools that are easier to use, design and implementation of new algorithms can be instant.

4) **Big Data** software and their underlying techniques allow large amounts of transactional data processing to be done in real time or near real time; these techniques are just starting make an impact.

5) **Collateral and Cash management.** The market has moved towards cash collateral market requirements with higher levels of security required. In the wake of the Lehman crash no financial institution or country is considered to be secure. From being a follow-on activity, middle or back office action, collateral and cash management is now a risk management imperative.

6) **Order settlement,** execution, fulfilment, validation, reconciliation. The growth in the number of markets, clearing and matching systems and OTC instruments traded drives complexity.

7) **Speed –** The unceasing need to reduce latency

8) **Risk,** Compliance, Assurance and Audit regulations are increasing in the main markets, and as trading becomes worldwide at every available exchange, much more varied.

9) **Transparency** to investors and clients.

10) **STP** straight through processing, all trading systems and reporting and mid and back office are updated in real time.

4.0 Examples of innovation

4.1 Trading

Par FX – FX Trading platform designed to be more effective by combating downsides of HFT latency. These are transparency, all counterparties named, all currencies on one platform, and firm executable pricing based in London sponsored by Tradition interdealer broker.

Trader Tools –Light FX SaaS hosted service provides the whole FX trading cycle process within one environment. It is claimed the system is lower cost to use and has tighter spreads, it comes out of the box with all major market feeds built in.

4.2 Cloud Computing

Interxion is a cloud and data centre provider, a carrier and is software neutral. How the hedgefund, trading, markets and exchange communities are using their services is instructive of how technologies and markets are evolving. ITG's new relationship with Interxion in London illustrates this new dynamic between technology based agency brokerage firms and cloud data centres. ITG focuses on its own proprietary technologies and trading expertise while using Interxions expertise in datacentre hosting and their established data links with all of the major exchanges including NYSE Euronext, NYSE Liffe, NASDAQ OMX, London Metal Exchange, Bolsa de Madrid, BATS, Chi-X Europe, Singapore Exchange (SGX) and the Australian Securities Exchanges (ASX), the matching engines of Equiduct, Quote MTF, Burgundy and the Nordic Derivatives Exchanges. Interxion also offers direct access to Deutsche Börse Group's trading systems through a shared market access solution.

Through this relationship they also host ITG's Posit MTF European dark pool, which strengthens their financial community. Trading is moving to datacenters that can provide lower latency and faster linkages to more exchanges than any one organization could create. This change in the structure of the technology chain changes the market entry point for the Entrepreneur.

4.3 Networks

Dealhub is an example of how FX trading systems are developing into network connection systems as trading exchanges and platforms fragment with its connection as a service product offering.

4.4 Algorithms[4] (important read note below)

4.4.1 Development of Algorithms

Including backtesting, trading strategies, screening and their integrated trading platforms. Ten companies are listed here each with different attributes highlighted to give a view of product differentials:

Quantoplan bill's itself as the world's first algorithmic trading platform in your browser for individuals or firms. It is an algorithm development environment and community; you retain all the intellectual property in the algorithms you develop using its tools.

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[4] All the software, systems and firms are illustrated are for educational an academic use only. There is no recommendation or solicitation to any London New Finance member of such software. HFT and AT are only for the most qualified FCA compliant investor and professional, this investment class is not suitable for individual's or the majority of investors. Seek advice from a FCA qualified IFA before considering any form of investment.

Equalmetircs – Visual algorithm development integrated into a trading platform with backtesting and simulation features with a 3,000 orders per second trading cloud attached. There is also a marketplace to purchase add-on components and algorithms from other providers.

Trading Technologies although part of an integrated solution, X_Trader, it features a class leading ADL (Algorithm Design Lab) drag and drop algorithm development environment, this example highlights how the process of algorithm design is changing and getting closer to the trading desk.

Smart Quant A lower cost professional algorithmic and AT software development platform

Deltix Software A single platform for AT strategy and order execution development deployable in your own site or on in the cloud, the Platform won two awards at the Technical Analyst Awards 2013.

Quantshare A trading platform development tool with AI (Artificial Intelligence) plug-ins and simulation aimed towards the semi professional market.

IQ Broker – Broker neutral High Frequency and AT development platform using .net framework aimed at Hedge Funds.

TSSB A machine learning predictive model learning platform

FXone AT trading platform Algorithms can be build using an excel spreadsheet logic and interface.

Spotware C Algo and C Trader – FX trading platform that enables users to create trading robots in a C# open API, web and mobile interface support.

4.4.2 Trading Strategies

Quantpedia a library resource of 230 trading different trading strategies, from asset class momentum system rotational to effect in stocks in small portfolios.

Zignals a trading strategies marketplace

5.0 Integrated Solutions

There is a trend towards buying integrated solutions by Hedge Funds. The argument is why spend all that time, energy and cost building up your technology infrastructure when you can buy just as good from the marketplace, the counter argument is that if you have your own proprietary technology you can beat the market.

FastFill plc is a SAAS full cycle derivatives trading, middle and back office software technology provider. The Hedge Fund can focus on trading with all the infrastructure provided by cloud computing.

Quant House – provide end to end systemic trading solutions with ultra low latency market data, algotrading strategies and development framework and full infrastructure solutions, they are part of S&P capital IQ (McGrawHill) and have access to the parent company infrastructure resource and data feeds and history.

ConvergEX Group the link goes through to ConvergEx's partnership list, displaying the collaborative nature of the global brokerage and technology supply chain, ConvergEx also won a Waters Technology buy side algorithmic technology award for its Abraxas buyside algorithm.

Flex Trade is an example of broker neutral trading platforms, execution systems, FX Algorithmic trading solutions. It is an example of how international partnerships are emerging; they developed a class leading system with ADS Securities (Abu Dhabi) for Middle Eastern institutional FX trading. Their Flex Edge product uses exchange provided data using predictive analytics to estimate daily volumes in real time.

RTS Realtime Systems they provide the whole trading and connectivity systems for AT and HFT trading and have a series of trading platforms specifically designed for Hedge Funds.

Example of a Trading Ecosystem built around a AT provider Cyborg Trading

AT Supplier	Trading Platforms	Signal Providers	Brokers
CYBORG TRADING	its STERLING TRADER OANDA Interactive Brokers TRADING TECHNOLOGIES	trade ideas	Seven Points CAPITAL COBRA TRADING OANDA

6.0 Specialist Data Feeds

Data feeds are the oxygen of markets and trading activity, they used to be exchange controlled and available from only a few large expensive suppliers. This has changed as the number of markets and traded securities have increased as has the need for sub second latency feeds.

OneTick – One Market Data – Specialist data feeds combined with a range of processing software to provide data feedstock's and processed data for systematic and algorithmic trading systems.

Ultrafeed from NASDAQ is a prepared datafeed for all the markets covered by NASDAQ equities, options, futures, indices, mutual funds, and bonds. The equity data has rich and in-depth historical data.

Interactive Data provides a very wide range of specialist information services allowing price discovery and management of price through the whole Hedge Fund holding life cycle. Its 7 ticks information service offers low latency price data.

Superderivatives – Cloud based pricing system for derivates, available on desktop, iPad or Smartphone from $1,500 pa, a disruptive price.

7.0 Risk Management

Risk management has been re-emphasised by the $440m loss at Knight Capital in August 2012. An emerging trend is the use of open source software and big data techniques to develop risk systems. There are a number of problems to address; examples are real time VAR (value at risk), real time profit and loss and settlement-matching of pool traded securities. The complexity of traded derivative securities and their non-standard construction has led to many derivate products and their positions being calculated by using excel spread sheets. This is an inherently risky fragmented method that needs formalising to raise the quality of risk management.

OpenGamma – A real time risk management system for front and mid offices, completely open platform with ease of integration and excel integration, a leader for the adoption of open source systems within capital markets.

Risk API - Portfolio Science Inc produce an API adding – remote risk analytics for Excel

Risk data – provides a risk analysis system to over 100 institutions

Mongo DB by 10Gen A new development in risk management is the use of open source sharded Databases to monitor risk in real or near time. 10Gen provide solutions based on Mongo DB, the cost equation is attractive but not the overriding factor, its speed of deployment and capability that is driving the increased volume of system development. Other open software used for this purpose is Apache Hadoop together with H Base and Apache Cassandra.

8.0 Clearing

Clearing and settlement of billions of trades daily is highly complex, markets at lower volumes seem to cope but when volatility occurs all systems are put under severe stress. The major settlement houses struggle to keep up and are continuously upgrading their systems to cope.

Torstone Technologies Torstone has a recognised settlement, middle and back office system software product, it has just released a VPC (virtual private cloud) cloud based version of its Inferno software suite.

9.0 Margin & Collateral Management

Since the 2007-8 crash, margin requirements have been revised upwards and much stronger control has been exercised over collateral arrangements for stock lending for trading purposes. The failure of two major market participants, Bear Sterns and Lehman Bros, sent shockwaves through Capital Markets and has resulted in strict requirements being imposed by market participants. The Sovereign default of Greece and Cyprus heightens risk awareness.

4sight – Collateral management system - specialist software to manage all aspects of collateral lifecycle. Controls collateral in a central account and optimises collateral obligations, scenario analysis and EMIR and Dodd Frank compliance, also for borrowing/lending Swaps, Repo, ETF, and OTC.

10.0 Regulatory and Compliance

Market reporting and regulatory compliance have been back office functions that have been neglected. Regulators and exchanges are now taking much stricter legal interpretations on what should be reported. SEC, FCA and Exchange fine levels are becoming significant.

BrightSun Group a Capital markets big data development company has a product called **"Bright Spot"** market abuse system designed to consolidate and analyse all trades over a multiplicity of locations and markets to identify potential regulatory and compliance breaches, designed for compliance officers and regulators.

Fund Apps provides a cloud based compliance and risk monitoring service for funds; it generates market notification documentation, notification of regulatory changes and manages the whole workflow cycle including alert generations, involved with market reporting compliance.

11.0 Middle & Back Office

A Hedge Fund in a box a partnership has been created between **Equinoxe** and **Formicary** to deliver a complete solution front, middle and back processing solution for Hedge Funds with funds under £1bn under management with 24/7 infrastructure and system maintenance and support. **Equinoxe reported** in December 2012 that it had 145 funds and $10bn under administration.

Sunguard 360 a very comprehensive Hedge Fund complete SaaS solution from an established supplier with a large number of add-on solutions for any aspect of fund management.

12.0 Hardware

The hardware race is to go as near to the speed of light as possible over as long as possible distances. More and more attention is focused on co-location and how to move data faster within networks.

Finextix offers outsourced low latency trading systems, network and exchange connections and risk management. A differentiator is that it gets deep into the technology optimising FPGA hardware for low latency. It uses the best in class networking connection technologies and focuses on getting the best balance between hardware, network, software.

Datacom Trading Solutions – monitoring systems for trading data feeds its current Tradeview solution can monitor 60m trade messages a second. Without the security of monitoring 100% network connection reliability and performance, HFT trading strategies enter risk territory.

Celoxica offers a range of FPGA hardware and software integrated systems for low latency trading systems, its latest product is a binary feed handler specifically designed for the new OPRA (Options price reporting authority) protocol effective from April 2013. The data volumes are staggering with estimates of 24bn messages per day.

13. Entrepreneurial Opportunities

- Speed: optimisation of hardware, software and networks. Hardware solutions for network bottlenecks.
- Algorithm and trading strategy development
- Marketplaces for algorithms and trading strategies
- Independent back testing, assurance and monitoring of algorithms
- Application of Big Data techniques to:
  - Value at risk
  - Real time Trading Profit and Loss
  - Audit, Validation , Compliance and Security
  - Settlement, matching and clearance of trades
  - Spread control
- Trading performance dashboards and visualisations
- Network connection optimisation
- High performance cloud computer centres for co-location
- SaaS and cloud software solutions
- Transparency
- Mid and Back Office – application of big data techniques to enable systems to cope with volume and complexity
- Further standardisations of security traded and trade metadata to enable more effective STP processing.
- Pre processed data feeds for price movement and volumes
- Security systems – as trading moves to a cloud based environment
- Compliance – Use of big data to increase levels of assurance
- HCI – application of HCI (Human Computer Interaction) science to trading environments
- STP (straight through processing) a company and whole industry benefits if STP is more widely adopted, develop solutions are aimed at eliminating bottlenecks. STP creates in itself a whole new supply eco system – risk, compliance, collateral and cash management etc.
- HFT and AT will continue its move further into the Financial Services Asset Class supply chain moving nearer and near towards retail markets.
- Secure API connections from throughout the technology chain
- Open source software products as a differentiator, not only as a market entry technique. The whole technology value chain is so complex, open source has the capacity to generate solutions faster and more be cost effective
- The excel spreadsheet environment is unstructured and systemically increases risk

Appendix 1 – other examples of innovation

Company	Products
Analysis Trading Strategy	
Recognia	Actionable Technical Analysis
Sentiment Trader	Sentiment Analysis modelling
Tethys Technology	Trading Strategies
Updata	Technical Analysis Platforms
Trader Made	Desktop Charting
Data	
ACTIV Financial	Low latency data feed systems and managed solutions
CQG	Graphing and trading
eSignal	Live Client Data
RIMES	Data streaming from 500 sources
Trade Signals	Trading signals FX, Oil, Gold, Indices
Auto Trade Execution	
EBS (ICAP)	Spot FX Platform
MTS Markets	Fixed Income market
Portware	Automated Trading System
Smart Trading Technologies	Liquidity management systems