Algorithmic Trading: Pros and Cons

Algorithms have become such a common feature in the trading landscape that it is unthinkable for a broker not to offer them because that is what clients demand. These mathematical models analyze every quote and trade in the stock market, identify liquidity opportunities, and turn the information into intelligent trading decisions. Algorithmic trading, or computer-directed trading, cuts down transaction costs, and allows investment managers to take control of their own trading processes. It is a style of trading and not a separate business.

This paper discusses the key effect that the rise in use of algorithms has on the trading environment, fund managers, and buy-side traders, as well as on integration issues, build or not to build. The paper also discusses the emerging algorithmic trading trends. Algorithm innovation continues to offer returns for firms with the scale to absorb the costs and to reap the benefits.
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Introduction

In today’s hyper-competitive and cost-conscious trading environment, fund managers and buy-side traders have turned to computerized algorithms provided by brokers. Algorithms have become a must-have for brokers seeking to gain new business and retain their current clientele. Trade carried out using algorithms is known as algorithmic trading. Algorithmic trading can be defined as “placing a buy or sell order of a defined quantity into a quantitative model that automatically generates the timing of orders and the size of orders based on goals specified by the parameters and constraints of the algorithm”. The rules built into the model attempt to determine the optimal time for an order to be placed that will cause the least amount of impact on the price of the financial instrument. Algorithmic trading is a way to codify a trader’s execution strategy. Algorithmic trading or computer-directed trading cuts down transaction costs and allows fund managers to take control of their own trading processes.

What does algorithmic trading mean to the buy-side and sell-side firms? And how will it impact the technology spend? Is it really as important as the buzz suggests, or is it just another trend that is being hyped up so much that everyone feels they have to ride the wave? Aite Group, a Boston-based consultancy firm, expects traditional buy-side firms to account for 30 percent of all algorithmic trading by 2008—nearly double the current figure. With this kind of projected growth, even the sell-side institutions are pushing for market share with a glut of product offerings.

Buy-side firms are gravitating toward rules-based systems. For example, instead of placing 1,00,000-share order, an algorithmic trading strategy may push 1,000 shares out every 30 seconds and incrementally feed small amounts into the market over the course of several hours or the entire day. By breaking their large orders into smaller chunks, buy-side institutions are able to disguise their orders and participate in a stock’s trading volume across an entire day or for a few hours. The time frame depends on the traders’ objective, how aggressive they want to be, and constraints such as size, price, and order type, liquidity and volatility of the stock and industry group. More sophisticated algorithms allow buy-side firms to fine-tune the trading parameters in terms of start time, end time, and aggressiveness. Algorithmic trading is appealing to buy-side firms because they can measure their trading results against industry-standard benchmarks such as volume weighted average price (VWAP) or the S&P 500 and Russell 3000 indices.

Algorithmic trading volumes are currently driven by sell-side proprietary traders and quantitative hedge funds. In their never-ending quest to please their customers, being the first to innovate can give a broker a significant advantage over the competition, both in capturing the order flow of early adopters and building a reputation as a thought leader. It is possible to create an algorithm and enjoy a significant time window ahead of the competition if that algorithm addresses a really unique execution strategy.
Developing Algorithms

Popular Algorithms
In practice the most commonly used algorithms in the market place are: arrival price, time weighted average price (TWAP), volume weighted average price (VWAP), market-on-close (MOC), and implementation shortfall (the difference between the share-weighted average execution price and the mid-quote at the point of first entry for market or discretionary orders). Arrival price is the midpoint of the bid-offer spread at order-receipt time, and it also notes the speed of the execution. VWAP is calculated by adding the dollars traded for every transaction in terms of price and multiplying that by shares traded, and then dividing that by the total shares traded for the day. MOC measures the last price obtained by a trader at the end of the day against the last price reported by the exchange. Implementation shortfall is a model that weights the urgency of executing a trade against the risk of moving the stock. Most algorithms already allow customers to change the timing of executions, the rate of order-filling attempts at the beginning or end of the trading day, and the tolerance for the slippage of a stock from certain benchmarks.

Algorithms Development Process
Development of algorithms involves a high level of collaboration with the client as algorithms are meant to meet the trading strategy objectives of the trader. Algorithms are meaningless if the strategies don’t perform. The basic processes involved are: closely interacting with the users to understand their strategies, creating an algorithm based on the inputs, presenting the client with results of back tests and analysis using historical tick-level data. The algorithm is then released to one or two beta clients, who begin to use it on small volumes of live trades. From that point the vendor and the client will engage in a period of iterative feedbacks during which they conduct post-trade analysis to ensure that the desired results are being achieved. The final product is moved up and down the development chain with constant feedback from the end user. Once the required results are obtained the product is finalized. The basic fact to remember is that the client is just interested in results and they demand good performance, speed of execution. So the manner in which an algorithm is tested or the manner in which it is implemented is rarely of concern to the trader.

Algorithmic Components in Trade Cycle
Algorithms are used extensively in various stages of the trade cycle. Broadly we can classify them into pre-trade analytics, execution stage, and post-trade analytics.

Pre-trade analytics involve thorough analysis of historical data and current price and volume data to help clients determine where to send orders and when; whether to use algorithms or trade an order manually. The pre-trade analysis is designed to help buy-side traders understand and minimize market impact by choosing the level of aggressiveness and a time horizon for trading various stocks. Traders can select varying levels of aggressiveness and visualize them against the time horizon for completing the trade. Most compare the spread between bid and ask prices, reference that against the volatility of a given stock, and attempt to create a range of potential outcomes. A lot of the broker-sponsored algorithmic trading systems attempt to measure or project the trade costs.

In the Execution stage, traders can create the lists of stocks, choose a particular strategy—such as implementation shortfall—and enter the start time and the end time. Traders can also monitor the performance and progress of the algorithms in real time and change the parameters if the stock is moving away. Additionally, users can filter portfolios by sector, market cap, exchange, basket, and percent of volume, profit and loss per share. Several brokers are designing algorithms that sweep crossing networks and so-called dark books liquidity pools that match buy and sell orders without publishing a quote.

Post-trade analytics track commissions and assist in uncovering the costs involved from the time a trade is initiated all the way through to execution. Post-trade analytics are meant to improve execution quality and facilitate the making of investment decisions. The most prevalent trading benchmark in use today is VWAP, which is popular because it is easy to measure. Although it provides comparative results, it is not as useful.
for evaluating strategies that are trying to do something other than follow the market midpoint. For example, if a stock is not liquid, if one trades a large volume of stocks over the course of the day and measures it using VWAP metric, one becomes the VWAP.

Algorithmic trading in practice

**Incoming Orders**
- Buy 100,000 shares of X company

**High Touch or Low Touch**
- Price volatility of stock
- Market capitalisation of stock
- Execution venue
- Expected trading costs
- Low volatility
- Large cap stock
- Low expected execution costs

**Fast or Slow Input**
- Fund Manager Strategy
- Trade Horizon
- Low Urgency

**Define Low Touch**
- Average trading volume
- Order size
- 3% of average daily volume

**Routing and Execution (OMS)**
- Execute slow
- Execute Low touch
- Execute Algorithmically

**Block Trading**
- Crossing Networks
- Algorithmic Trading
- Direct Market Access
- ECN’s

*Fig 1* Some of the generic issues involved in choosing appropriate execution method
Industry Issues

Where the Industry Is Now
The industry is in the middle of an adoption phase. It is estimated that around 40 percent of the trades made on the London Stock Exchange (LSE) now originate from algorithmic trading systems. About 15 percent to 20 percent of buy-side firms have adopted algorithmic trading broadly, and they are using it within the confines of their Order Management System (OMS) workflow. It is also clear that algorithms are more cost-effective for low-maintenance trades and that has meant head-count shifts and reductions on sales desks. Algorithms have become such a common feature in the trading landscape that it simply is unthinkable for any broker not to offer them because that is what clients want. No broker can be taken seriously today unless it offers at least the basic algorithms—VWAP, TWAP, implementation shortfall, and arrival price. It will cost a broker at least $5 million to $10 million a year to build and maintain algorithms, hire quantitative analysts or financial engineers, and build the required market-data infrastructure. “Anyone who wants to offer a comprehensive brokerage solution has to offer algorithms at some point,” contends Harrell Smith, director of the securities and investments practice at Celent.

It is difficult to confirm categorically whether or not the investment for developing algorithms justified the cost savings. Another bigger question is what the opportunity cost is of not getting more business, of maintaining future and current market share in a slim-margin and fairly commoditized business. What seems clear is algorithms are firmly a part of the brokerage business. It is a perception issue—if you are a bulge bracket full-service broker, you cannot just offer VWAP and TWAP; you must have different sophisticated algorithms that are all being constantly refined.

Who’s Leading the Charge?
According to The Tabb Group, Credit Suisse, Goldman Sachs, Morgan Stanley, and Investment Technology Group are the pioneers in the field. They have captured the most desktop real estate and clients. Other firms that are aggressively pushing their solutions include Citigroup, Lehman Brothers, BNY Brokerage, JPMorgan Chase, Merrill Lynch, and Nomura Securities. Other sources include buy-side quantitative analysts that create their own algorithms and third-party vendors like FlexTrade Systems, Progress Software and Portware, which offer canned algorithms and tools to develop customized algorithms.

To Build or Not to Build
Most buy-side firms get their analytics from brokers as part of an overall service package. However, there is a perception that sell-side brokers offer biased analysis that favors their own algorithms. Moreover buy-side managers are concerned with disclosing too much information about their proprietary trading strategies. As a result, buy-side firms often choose to use third-party vendors or build pre-trade and post-trade algorithms in-house. To limit disclosure of their trading strategies when using pre-trade tools provided by brokers, some buy-side firms run the software in-house rather than send guarded data to the brokers. So more technologically savvy resourceful buy-side firms conduct their own analysis, which requires closely integrated research, trade histories from its in-house OMS and trading team and substantial amounts of real-time data. There are valuable vendor solutions but their solutions are limited by the information that brokers and the buy-side are willing to share.

In spite of the reservations regarding the algorithms supplied by the sell-side brokers, large number of buy-side managers still look to sell-side for supply of an array of algorithms as part of an overall service package. Some of the bias issues and concerns of buy-side are addressed by agency brokers. Firms that run on a strict agency basis-such as Instinet, EdgeTrade, NYFIX, and ITG-believe that one of the main attractions of their businesses is that their nonproprietary stance means algorithms serve the customer alone. But, there is a lot of confusion on the buy-side as to which broker’s algorithm is best to use for a particular stock or strategy. Ultimately “to build or not to build” depends upon, whether we are writing algorithms just because somebody thinks it is neat or whether we are solving clients’ problems.
Integration Issues
A lack of technological integration with buy-side OMSs has restrained the use of pre-trade analytics. Although broker-sponsored trading systems have algorithms and analytics built in, very few vendor and in-house OMSs support the real-time tick data that allows for informed, on-the-spot decisions. This is because most of the OMSs were built at the time when algorithms were not in existence. But that is beginning to change. Another issue is many of the top US mutual funds run proprietary OMSs that would require a broker-dealer to make individual configurations for each client. Integrating homegrown algorithms with proprietary systems, the implementation of algorithms into the front-end system is a resource-intensive process. In dynamic trading environment, time to market is of utmost important. This necessitates that the algorithm be integrated into an OMS or Execution Management System (EMS). Facilitating this process requires strong relationships with the vendors of these systems and a homogenization of the technical parameters of algorithmic offerings. One step toward addressing these issues would be to standardize delivery of pre-trade and post-trade analytics on the Financial Information eXchange (FIX) protocol. By doing so, buy-side traders will be provided the ability to consolidate the analytical data and tools from all of their brokers into a single platform tied directly to their execution and order management technology. This will not only allow traders to easily contrast, compare, and determine which algorithms and strategies to apply to each trade, but will also enable them to execute directly on that information.
Algorithmic Trading Trends

Algorithms have sparked a fundamental change in everything—an exciting era of opportunity for those who innovate. It is difficult to foresee precisely all the contours of algorithmic landscape. But some broad trends are referred to here. In the coming years, the evolution of the algorithmic landscape will result in firms re-evaluating and evolving their views, trading strategy, asset-class mix, the relationship between buy-side and sell-side, the very composition and skills of the people they employ and information technology.

Customized Algorithms

The buy-side until now predominantly access algorithms pre-built by sell-side brokers. Buy-side players are gradually moving away from “commoditized” algorithms in order to capture their own intellectual property in customized algorithms.

Algorithms Migrating to Currencies

The use of algorithms in multiple asset classes will continue to increase. There are strong indications to date that algorithms also have a place in the $2 trillion-plus global foreign exchange market, at a time when investors are incorporating foreign exchange (FX) into multi-asset-class strategies. Market participants have long recognized that established equity trading techniques such as baskets and order slicing apply to FX. They are quickly finding out that in the fast-moving FX markets, algorithmic trading is even more effective. It is a fact that algorithms in FX markets are still at an early stage relative to the equities markets.

Fixed Income Next

The introduction of algorithmic trading is being explored in the fixed-income market. It is happening slower than in foreign exchange. The reason for the slow uptake is due to a different market structure in terms of how it functions and operates and algorithmic trading takes off fastest where there is an order-driven environment and greater price transparency. Once European markets embrace the Markets in Financial Instruments Directive (MiFID) algorithmic trading across fixed-income markets gets a boost to take off. MiFID promises to be catalyst, by encouraging a move away from dealer-led markets to central order-driven pools of liquidity.

Algorithms Connect Dark Pools Creating More Liquidity

Technically, any off-exchange marketplace that executes shares anonymously (without quoting) could be considered “dark” in that it provides limited opportunity for information leakage. According to TABB Group, crossing networks handle five percent to eight percent of buy-side flow. Some of the broker-dealer dark books include Goldman Sachs’ Sigma X, Credit Suisse’s CrossFinder, and UBS’ Price Improvement Network (PIN), while crossing networks include ITG’s Posit, LiquidNet, Instinet Crossing, NYFIX Millennium and Pipeline. Algorithms are used extensively by broker-dealers to match buy and sell orders without publishing quotes. By controlling information leakage and taking both the bid and offer sides of a trade, broker algorithms are in a way enabling improved liquidity, pricing on shares for client, and higher commissions to brokers.

Cross-Asset Trading Adoption of Algorithmic Techniques

Traders are quick to find out cross-asset trading opportunities to generate Alpha (risk-adjusted “excess return” on an investment). Technology has enabled the traders to monitor and respond to multiple liquidity pools across various asset classes. A trader may, for example, buy equity, hedge with a derivative of the equity, and take out an FX position—all within the same strategy. We will see an uptake in innovative algorithms to capitalize on high frequency cross-asset opportunities. The sophistication of these new combinations requires detailed simulation and careful testing. Modern algorithmic trading platforms provide the tools to back-test, profile, and tune new strategies before deployment.

Algorithms for News Analysis

Markets are moved by news. Buy-side firms and traders are increasingly interested in strategies that are able to analyze news events and its impact on a firm or industry. If the algorithm can analyze and react to
the news faster before a human trader; advantages can be realized. An algorithm could, for example alert a trader if a news is released on a company X and if the company stock rises or falls by say one percent in the value of that stock within five minutes. For example, Reuters NewsScope Real-time product lets clients use live news content to drive automated trading and respond to market-moving events as they occur. Each news item is ‘meta tagged’ electronically to identify sectors, individual companies, stories or specific items of data to assist automated trading.

**Algorithms for Managing Trading Risk and to Meet Regulatory Requirements**

Given the criticality of risk management there is an increasing demand for algorithms that monitor and respond to risk conditions on real-time basis. Using real-time analytics, algorithms can continuously re-calculate metrics like Value-at-Risk (VaR) and automatically hedge a position if VaR is exceeded. Compliance with law is of utmost importance and it is becoming burdensome with ever increasing stringent regulations. Firms going forward will increasingly harness the latest in algorithmic trading technology to address regulatory compliance issues. In parallel, regulators will begin to automate surveillance to monitor trading operations for patterns of abuse.

**Alpha goes to the Firm with the Best Algorithms**

Algorithmic trading is now entering the mainstream. In the earlier days, possessing pre-packaged ‘black-box’ algorithms was enough to generate Alpha. Alpha now goes to the firm with the best algorithms and what is considered “best” changes by the day. Only the firms that can introduce new and innovative algorithms quickly will able to benefit from rapid market changes and the new trading opportunities that constantly emerge.
Algorithms: Areas of Concern

Lack of Visibility
We know what a specific algorithm is supposed to do, measure its pre-trade analytics and see how the post-trade results match up to that expectation. But if the trader didn’t select the most optimal algorithm for that trade little can be done. This problem is caused by a lack of visibility and transparency into the algorithm while it is executing orders.

Algorithms Acting on Other Algorithms
If fund managers’ trading pattern is spotted and regular; tracked with the use of algorithms, then these algorithms are liable to be ‘reverse engineered’. This implies that their buy and sell orders are pre-empted and used to the maximum effect by their competitors. Here, algorithms are acting on other algorithms.

Which Algorithm to Use?
With brokers offering many algorithmic strategies, one concern is that buy-side institutions lack the tools to understand which algorithm to use for a particular stock. The lack of a standard benchmark has made it almost impossible to assess the quality of algorithms. Buy-side firms are having a hard time evaluating when to use a particular algorithm. For example, if a portfolio manager tells a trader to sell a mid-cap, semi-illiquid stock within five hours—because the manager has to raise cash—the trader may be confused about which algorithm would be the best solution, given the constraints on liquidity and time. They need a certain level of sophistication and understanding to use it.

Algorithmic trading requires careful real-time performance monitoring as well as pre and post-trade analysis to ensure it is properly applied. Traders must calibrate the algorithms to suit portfolio strategy. Far from the sole or final answer to best execution, algorithmic trading represents an additional tool in a trader’s expanding kit. Far more important is aligning execution choices with the level of order difficulty involved in terms of: order size, liquidity, and trade urgency. Low touch venues such as algorithmic trading lend themselves best to easier types of orders such as low-urgency and small orders for large cap stocks. But urgent orders for a large volume of small cap stocks would require a higher-touch approach to ensure best execution and cost efficiency.

Missing Ingredient—The Trader’s Gut Feel
Algorithms are simply advanced trading tools and they cannot replace the human elements or make interaction redundant. Algorithms fail to capture a trader’s “gut feel”. It is the intraday trading characteristics of a stock that assist a trader in determining the right strategy, whether to back off or be more aggressive. In order to allow their guts to play a proper role, the traders need to see precisely what actions their algorithms are taking, what venue the orders are being sent to, and where they get filled. It is early in the development of trading software to think that the thought process of a human trader can be mimicked by an algorithm. Algorithms can not compete with the ability of the human brain to react to unanticipated changes and opportunities. Some algorithm providers are trying to addressing this issue by offering instant messaging (IM) services that work with the algorithm. As trades go on, a trader is alerted of issues that arise and the trader can alter the strategy depending on the nature of news.

At the end of the day, it’s the clients who drive the demand and innovation necessitating next generation algorithms. The next generation of algorithms will be able to “speak” to the trader, to let the trader know what is going on dynamically, and allow the trader to interact with the algorithm. Soon we will have adaptive algorithms that adjust their execution at each moment in time in response to what they see happening in the market just as a human trader.
Optimal Approach to Algorithmic Trading

The best execution through use of algorithmic tools depends to a large extent on the presence of various critical ingredients, such as:

- Clear understanding of portfolio management strategies' objectives
- Robust pre-trade models
- Balancing timing and impact cost issues
- Effective intelligent integration of OMS and direct market access trading platforms
- Close, iterative relationships with algorithmic trading providers
- Thorough post-trade analysis and feedback

All these critical requirements make the design of the algorithmic platform a daunting challenge requiring the following attributes:

- Adaptable:
  - Providing high speed transmission of market data and transaction messages to other applications and users
  - Offering a vendor-agnostic platform that is able to accept and distribute data from any market data vendor
  - Having pre-integrated security and monitoring for both compliance and cost-effective operations

- Streamlined:
  - Ensuring optimized acquisition, processing, and delivery of market data through an efficient and integrated platform

- Reliable:
  - Enabling continuous delivery of market data with the robustness to support the needs of the front-office

- Open Architecture:
  - Promoting interoperability by using open published specifications for Application Program Interface (APIs), protocols, and data and file formats. Open architectures enable companies to build loosely coupled, flexible, and reconfigurable solutions
Conclusion
Algorithms are widely recognized as one of the fastest moving bandwagons in the capital markets. Employing rules-based strategies has enabled buy-side firms to increase productivity, lower commission costs and reduce implementation shortfall.

Algorithmic trading cuts down transaction costs and allows investment managers to take control of their own trading processes. By breaking large orders into smaller chunks, buy-side institutions are able to disguise their orders and participate in a stock’s trading volume across an entire day or for a few hours. More sophisticated algorithms allow buy-side firms to fine-tune the trading parameters in terms of start time, end time, and aggressiveness. In today’s hyper-competitive, cost-conscious trading environment, being the first to innovate can give a broker a significant advantage over the competition both in capturing the order flow of early adopters and building a reputation as a thought leader.

How TCS Can Help?
Tata Consultancy Services (TCS) has decades of experience in offering solutions to sell-side and buy-side firms in areas like order management, execution, data management, compliance, and regulatory reporting. With such a vast experience, TCS brings a deep domain understanding and an innovative approach in building algorithms. In collaboration with the client, TCS provides customized solutions to meet the client’s specific ideas on the trading strategy. The tasks broadly covers spending time with traders to understand their strategies, coding algorithms, building systems for capturing and storing tick data, working out tick data analytics, and presenting the client with results of back tests and analysis. In a nutshell, TCS offers technology and business consulting solutions that will help companies realize a better return on investment for their algorithmic investments.

References


About TCS Financial Services Practice
The Financial Services practice of TCS, with its in-depth understanding of the financial services industry, develops innovative, result-oriented, and cost-effective services to ensure that clients around the world meet the challenging requirements of this industry.

About Tata Consultancy Services (TCS)
Tata Consultancy Services (TCS) is among the leading global information technology consulting, services, and business process outsourcing organizations. Pioneer of the flexible global delivery model for IT services that enables organizations to operate more efficiently and produce more value, TCS focuses on delivering technology-led business solutions to its international customers across varied industries.

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