# *Algorithmic Trading Update 2005: Advanced Execution Goes Mainstream*

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**Harrell Smith**
hsmith@celent.com

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**Celent Communications**
88 Pine Street, 31st Floor
New York, New York 10005
USA

Tel.: +1.212.269.7540
Fax: +1.212.269.7541
Email: info@celent.com

www.celent.com

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# EXECUTIVE SUMMARY

Over the past several years, the market has developed numerous algorithmic trading strategies, the result of innovations by both sell-side firms, hedge funds and independent technology providers. Today, every major broker-dealer offers a full suite of algorithmic trading solutions, as do a number of agency brokers. Buy-side OMS providers tout their ability to interface with leading broker-dealer algorithms and direct market access (DMA) systems. Advanced trade management/routing platforms and DMA providers have embedded algorithms in their front-ends, and provide access to a range of third-party algorithmic trading destinations. Hedge funds, the earliest developers of integrated quantitative research and trade executions systems, continue to roll out ever-more sophisticated algorithms. In short, algorithmic trading has become an integral part of today's equity markets.

However, algorithms' importance relative to traditional methods of executions and research should not be overstated. The term "algorithmic trading" has been used interchangeably—and incorrectly—with "black box trading," quantitative trading" and "program trading" as a catchall phrase to describe systems that will one day disintermediate the human trader altogether. Indeed, reports of the death of the buy-side and sell-side trader are greatly exaggerated. Algorithms are simply advanced execution tools that serve to make traders more efficient.

This report examines the growth of algorithmic trading as well as key trends affecting the development of algorithmic trading initiatives.

Key findings of this report include:

- **Algorithmic-based equity trading is expected to increase from approximately 14% of overall trade volumes to nearly 25 percent by 2008.** Traditional buy-side firms, who thus far have been slow to embrace advanced execution strategies, represent the largest growth sector. Over the next fours years, the buy-side's use of algorithms is expected to increase at a compound annual growth rate of 28 percent (versus 11 percent for hedge funds and 7 percent for sell-side firms).

- **Growth in algorithmic trading will depend on firms' cost-benefit analysis of taking execution in-house.** Although commissions for algorithmic and DMA trading are the lowest in the industry by far, firms must also take into account the indirect costs associated with delay, trade impact and missed trades. At present, the buy-side as a whole is not yet comfortable navigating the numerous algorithmic strategies at their disposal. Increased education, in the form of more robust pre- and post trade analytics, and hands on assistance from sell-side providers, will play a large role in expanding algorithmic trading beyond its current base of users.

- **Long-term growth opportunities lie in the fixed income, options, foreign exchange, and futures markets.** Algorithms will also play a larger role in multi-asset execution, driving cash and derivatives trading via an integrated e-trading strategy.

- In the face of increased competition from advanced execution management/order routing platforms, **traditional buy-side order management systems will struggle to remain relevant.** The systems used by many active buy-side trading desks replicate most, if not all, of the key functions of a traditional OMS, including compliance and reporting. As buy-side firms look for increased flexibility, more customizable front-ends, consolidated order routing and lower costs, OMSs will contend with advanced platforms that have already staked their ground in the quantitative trading community.

This report also includes cases studies covering two of the more actively used algorithms on the market today, providing insight into how algorithms are used according to the underlying security and prevailing market conditions. In addition, the impact of Regulation NMS on algorithmic trading is discussed in the context of sell-side and buy-side participants. Its impact on technology vendors serving the algorithmic trading community as a whole is discussed as well.

"Algorithmic Trading Update 2005: Advanced Execution Goes Mainstream," presents an overview and analysis of strategic issue and trends facing algorithmic trading. An upcoming report will present a detailed examination of the leading technology vendors, systems providers and sell-side participants in this space.

# MARKET OVERVIEW

As much interest as algorithmic trading has generated in the financial services community, there remains a certain amount of confusion as to what, exactly, constitutes an algorithmic trading solution. Indeed, the term "algorithmic trading" has been used interchangeably with "program trading," "quantitative trading," and "black-box trading" as a catch-all phrase to describe computer-driven tools that have led to increased automation in (1) identifying investment and trading opportunities, and (2) executing orders for a variety of asset classes. But is algorithmic trading really the same as quant trading? Or program trading? More importantly, how advanced is the market in terms of adoption and technological innovation?

## ALGORITHMIC TRADING DEFINED

Broadly defined, an algorithm is any quantitative model that automatically executes a specific order according to the parameters of the given algorithm, as well as any user-defined constraints that can be imposed at the time of execution. Specifically, algorithms analyze an order and determine the timing, size, and destination of its constituent trades. In many cases, algorithms are designed to generate results tied to a specific benchmark, such as the volume-weighted average price of a particular security over the course of a day. Examples of some of the more well-known algorithms available today are listed in Table 1 below.

**Table 1: Examples Algorithmic Trading Solutions**

| Objective | Algorithm | Definition |
|---|---|---|
| Order Scheduling | VWAP (Volume Weighted Average Price) | Seeks to return an average price of a security over the course of a trading day (or other time period), weighted according to trade volume. |
| | TWAP (Time Weighted Average Price) | Also referred to as Time Slicing. Seeks to return an average price of a security over a given time period at an even rate, as opposed to a volume-based rate of execution |
| | Implementation Shortfall/ Arrival Price | Seeks to beat the mid-spread price that prevailed at the time the order was received; can be used to minimize implementation shortfall by beating the arrival price. |
| Trading Strategies | Pairs | Automates relative value pairs trading. Can be used for single pairs or for relative value baskets |
| | Arbitrage | Automates risk arb strategies. |
| Order Routing | Various | Algorithms that automatically perform smart order routing functions, such as accessing "hidden liquidity" at various price levels across multiple exchanges and ECNS. |

*Source: Instinet, Celent Communications*

**Algorithms vs. Quant Trading...** Some industry observers have expanded their definition of algorithmic trading solutions to include sophisticated analytical programs that alert traders when specific investment opportunities arise. These models vary widely across the spectrum of technical analysis and sophistication, and range from the relatively straightforward (ratios or formulae that, according to historical analysis, generate an expected return) to the truly complex (employing non-linear programming techniques to determine underlying statistical patterns in security movements).

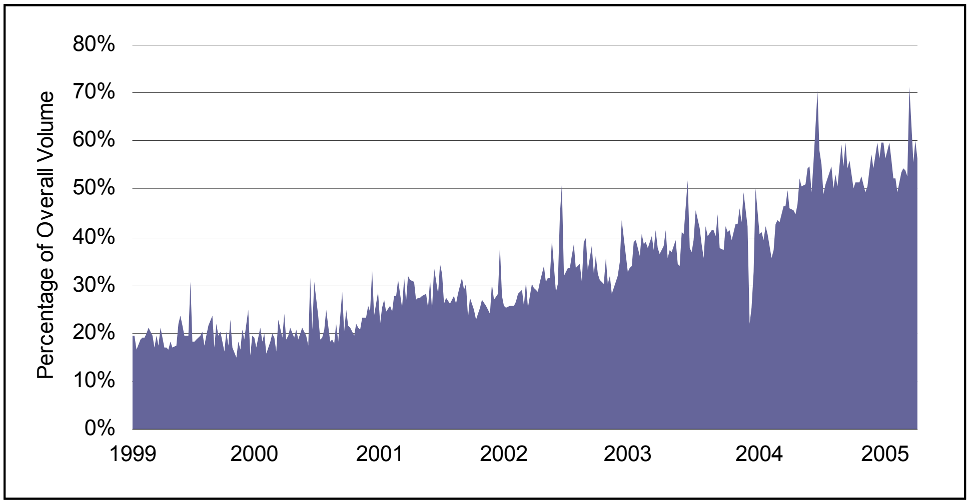
Strictly speaking, these so-called "predictive" models are algorithms as well. The most sophisticated rely on real-time tick-data analysis and are supported by special high-speed databases. So-called "quant funds" were some of the earliest developers of algorithms, and most would argue that their proprietary analytical and trading models together constitute an integrated algorithmic trading solution. The term "black-box trading" was coined to describe these highly sophisticated auto-trading systems.

However, the predictive models at the heart of such systems are more accurately classified as "quantitative research" tools—that is, programs that have been developed to analyze current market conditions based on historical and/or real-time data and *identify* specific trading opportunities. In contrast, algorithmic trading as discussed herein involves the *execution* of a pre-determined order in which the timing, size and destination of that order are determined according to the parameters of a specific algorithm. Simply put, advanced, real-time predictive models identify the "what" in a particular strategy; algorithmic trading solutions identify "when, where, and at what size" that order should be executed. (For more information, please see Celent's September 2003 report "An Overview of Quantitative Research and Trading.")

**... and Program Trading.** Program trading as a concept first gained international attention on "Black Monday," October 19, 1987. Following a strong sell-off during the previous week, the Dow Jones Industrial Average dropped 508 points, losing close to 25 percent of its market value. The S&P 500 dropped over 20 percent. In the aftermath of the crash, the media focused its attention on computer-driven portfolio analytics and research models—collectively described as "program trading" tools. Theorists surmised that as a result of the short and intense sell-off the week before, many such programs were telling their portfolio managers to cut their positions on Monday. US regulators soon zeroed in on these automated trading tools, viewing them as an underlying cause of the global crash.

As a result, the NYSE implemented a new kind of reporting procedure, the Daily Program Trade Reporting (DPTR) application. According to the NYSE, a reportable program trade is one that involves 15 or more securities, linked in some form, with a total value over US$1 million. The growth of program trading as a percentage of overall trade volumes is shown in Figure 1 on page 7. The securities can be for any market, domestic or international. For example, a single index rebalancing involving 500 names would be considered a program trade, as would a sizable arbitrage trade (e.g. selling an exchange-traded fund while simultaneously buying the underlying equity components).

**Figure 1: Reported NYSE Program Trading**




*Source: New York Stock Exchange*
*Note:* Data for 2005 as of April 8

Algorithmic trading and program trading, however, are not synonymous. Although the NYSE includes VWAP as a reporting strategy for program trades, other algorithmically generated-trades certainly escape the NYSE's attention. In addition, decisions about when and where to execute a series of trades could have been made by an algorithm sitting on a buy-side trader's desk. The executing broker might suspect that the trades were part of a larger order that was being directed by an algorithm, but would not be able to report them as such without speaking with the client.

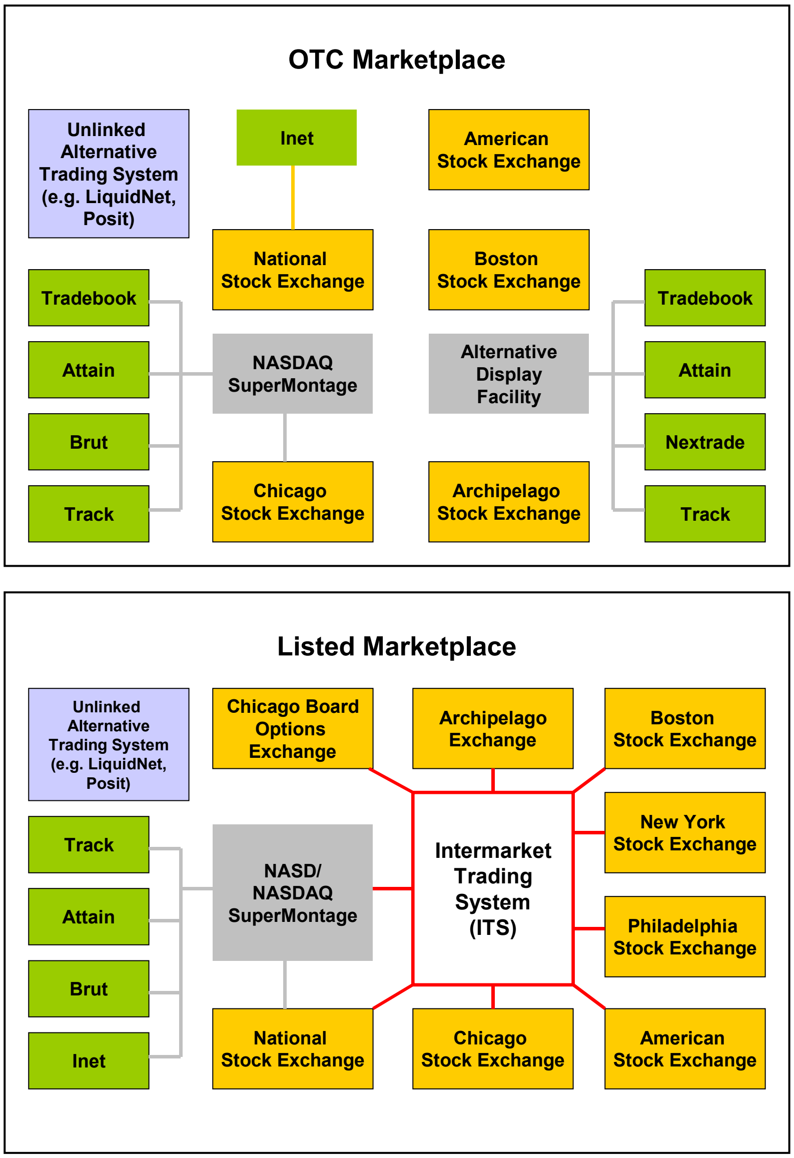
Of course, program trading as defined by the NYSE also includes activity that is not driven by algorithmic trading solutions. For example, assume that a buy-side trader sends his or her broker a list of 40 names that must be executed by the end of the day, or the order would be considered incomplete. The broker would recognize this list as a program trade and is required to report it as such. The broker might, however, execute all of these trades manually. Alternatively, he or she might trade some or all of the names with the assistance of an algorithm. Therefore, while some overlap surely exists, the growth of program trading as defined by the NYSE does not, in and of itself, track the growth of algorithmic trading.

## HOW DID WE GET HERE?

The global equity markets remain extremely fragmented, perhaps no more so than in the United States (Figure 2). Indeed, market fragmentation was the driving force behind the creation of the first generation of "smart order routing" algorithms that were geared toward negotiating—and taking advantage of—these disparate pools of liquidity.

**Figure 2: The OTC and Listed US Equity Markets**



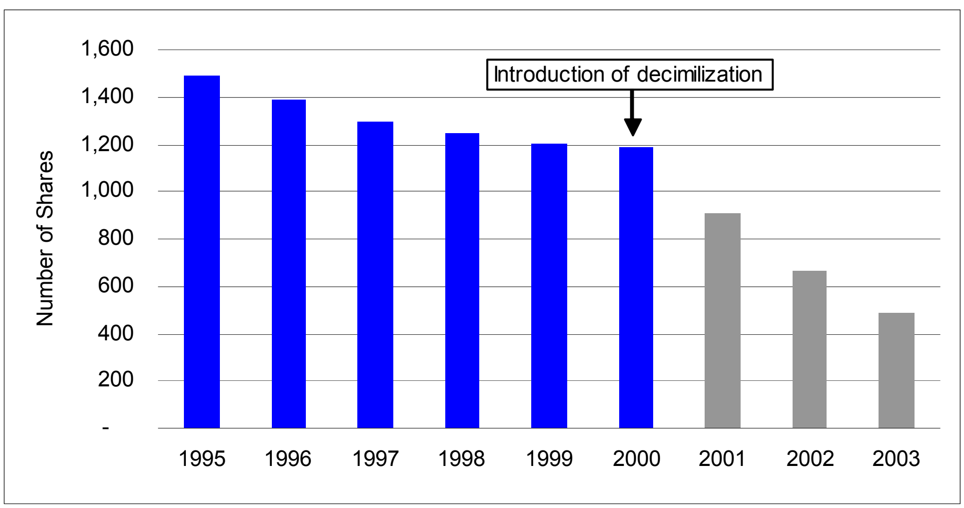

*Source: Celent analysis*

For example, a typical smart order routing algorithm would automatically sweep for hidden liquidity at a certain price level at various ECNs and exchanges. Others would automatically peg an order to the bid or ask at certain destinations, showing appropriate size to the exchange or ATS and moving the bid/ask up or down as the market moves.

However, market fragmentation was certainly not the only factor that contributed to the growth of algorithmic trading. As noted earlier, hedge funds were some of the earliest developers of sophisticated computer-driven modeling and automated trading systems. Quant funds created an array of proprietary algorithms that automated ever more complex trading strategies.

Structural changes and technological advancements also helped spur interest in advanced execution. Decimalization led to a sharp increase in the number of equity orders and a corresponding decrease in average trade size (Figure 3). The cost of "stepping in front of an order"—picking off a trade by bidding/asking a penny more/less—also decreased[1]. Size essentially disappeared and bid/offer spreads tightened considerably. As a result, firms became much more interested in algorithmic trading solutions that could help traders navigate this new market environment. From a technology standpoint, the development of FIX, increased use of electronic trading, faster delivery of market data, and dramatic increases in the speed and reliability of trade execution further propelled the market towards wider adoption of algorithmic trading solutions.

**Figure 3: Shrinking Average Trade Sizes**




*Source: New York Stock Exchange*

1. The SEC recently passed Regulation NMS, which established a number of new rules regulating trading in US equity markets. Among these were new rules on sub-penny quoting. For additional information, please see Celent's April 2005 report "Regulation NMS: One Rule to Bind the All."

**Traditional Paths to Execution.** Although algorithms first gained attention within the hedge fund community as the engines of sophisticated quant trading strategies, algorithms have been sitting on the desks of major sell-side firms for years (see Path 1, Figure 4 on page 10). Clients would send an order to their broker over the phone or via a FIX connection, and the broker would execute the trade via an integrated algorithmic trading solution.

As buy-side firms (hedge funds in particular) developed more sophisticated algorithmic trading strategies in-house, these firms would send constituent trades directly to brokers for execution (Path 2). Finally, the advent DMA allowed firms to send algorithmically generated orders directly out into the marketplace (Path 3). At the same time, DMA vendors began bundling order routing algorithms into their front-end platforms. Clients, however, maintained proprietary algorithms on separate applications.

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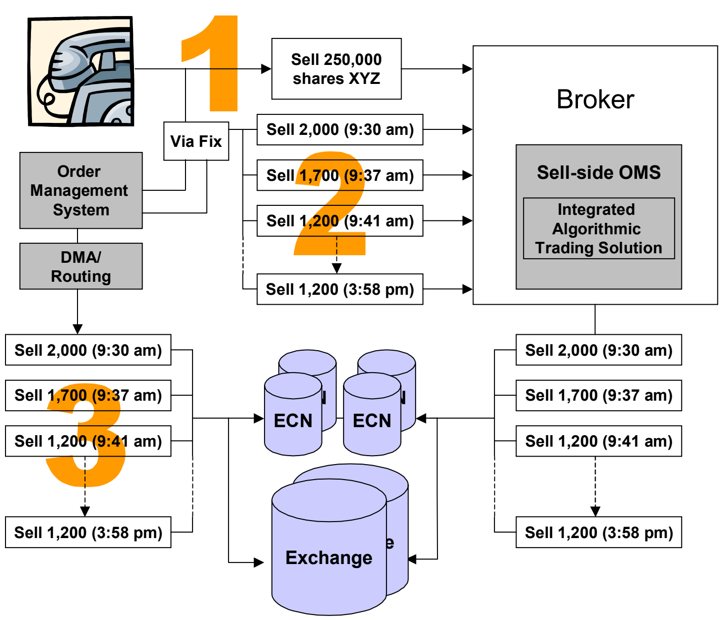
**Figure 4: Traditional Paths to Algorithmic Execution**




*Source: Celent Communications*

## ALGORITHMIC TRADING TODAY

Today, the market has evolved into an increasingly complex—and no less fragmented—web of market destinations, and algorithms can be found at any number of "stops" along the way. Sell-side firms (and, increasingly, smaller broker-dealers as well) offer algorithmic trading as part of their consolidated suite of execution services. Traditional OMS providers tout their ability to interface with brokers' algorithmic services. DMA vendors and advanced trade management systems providers bundle algorithms into their front ends. At the same time, these firms provide a broker-neutral portal to any number of sell-side destinations, and include APIs/open architectures with which clients incorporate their own proprietary algorithmic strategies. In short, algorithms seem to be everywhere.

**The Rise of DMA.** In the model above, DMA vendors essentially provided a portal through which buy-side firms could route trades generated by their own algorithms. At this stage in the market's development, DMA vendors operated more or less as independent software companies, many of whom were associated with agency brokers. As the popularity of DMA increased, however, larger sell-side firms took notice and set off on a buying spree, acquiring leading DMA providers and folding them into their suite of execution services (Figure 2).

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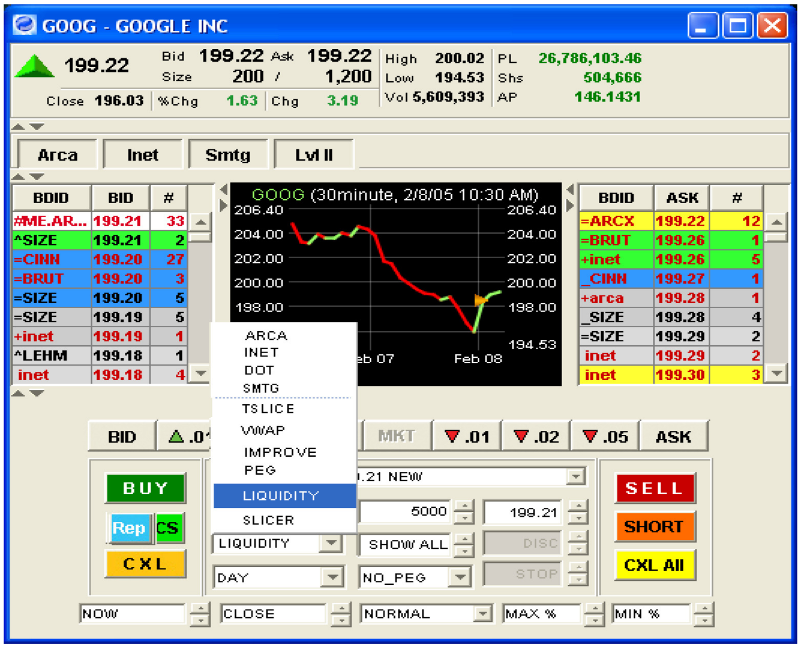
**Table 2: DMA Platforms Acquired by Broker Dealers**

| Platform | Owner | Date Acquired |
|---|---|---|
| Direct Access Financial Corp. | Bank of America | February 2004 |
| Sonic Trading | Bank of New York | March 2004 |
| Lava Trading | Citigroup | July 2004 |
| REDIPlus[1] | Goldman Sachs | September 2000 |

*Source: Firms*
[1]REDIPlus acquired via purchase of Spear, Leeds & Kellog (SLK)

Today, DMA vendors, both independent and broker-sponsored, have begun bundling a variety of algorithms into their front ends. These extend beyond traditional order routing services to include both well-known (VWAP, TWAP, etc.) and more advanced algorithmic strategies (Figure 5). Independent vendors have developed their own algorithms internally, and are now exploring relationships with established full-service broker-dealers. (FutureTrade, for example, now offers its clients access to a number of CSFB's algorithms.) Brokers are also taking a coordinated approach to DMA. Far from simply rolling out separate DMA platforms to complement their traditional offerings, sell-side firms are using DMA front-ends as portals to their full suite of execution services.

**Figure 5: Algorithmic Trading—An Integrated Component of DMA Platforms**




*Source: FutureTrade*

**Advanced Order Routing/Trade Management Systems.** Broker-neutral execution and trade management platforms stand at the heart of many firms' advanced trading systems. Not to be confused with traditional order management systems, these platforms essentially stand between traditional OMSs and execution destinations, providing clients with a centralized platform for single-order, basket, and algorithmic trading strategies across a variety of asset classes (although equities trading still accounts for the largest percentage of transaction volume).

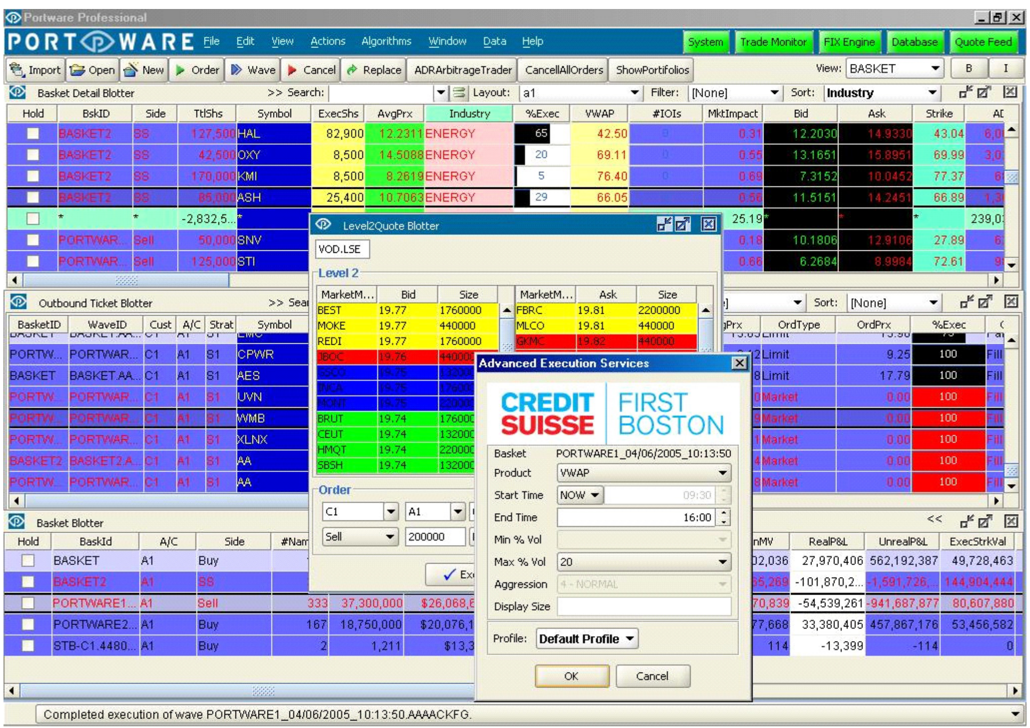
The leading platforms in this field continue to be Portware and Flextrade. Target clients are buy-side firms, hedge funds and/or sell-side desks seeking to take greater control over the development and implementation of advanced execution strategies. These systems duplicate many of the functions of traditional OMS platforms (real-time position keeping, P&L, reporting and risk management, etc.), while also providing a host of advanced analytical tools and connections to numerous markets and third-party execution destinations. In terms of algorithmic trading services, clients have several different options from which to choose:

- **Third-party Algorithms.** Users can access algorithmic trading strategies at any number of broker-dealers, ECNs and DMA destinations. In most cases, access to these destinations is embedded in the platform—users can navigate from one destination to the next from a single screen (see Figure 6).

- **Proprietary Algorithms.** Clients who have developed algorithms in-house can host them separately and link them to these platforms via an API. Alternatively, clients can build algorithms directly within the platform itself. The neutrality of these platforms allays fears that proprietary code might find its way into the hands of banks or broker/dealers.

- **Embedded Algorithmic Strategies.** These systems also come with a suite of pre-packaged algorithms, covering the more commonly used strategies such as VWAP.

**Figure 6: Algorithms as Integrated Components of Advanced Order Management Platform**




*Source: Portware*

Note: Portware provides clients with access to numerous broker-sponsored algorithmic trading destinations, including Credit Suisse First Boston. Portware's interface with CSFB is shown above for illustrative purposes only. Readers should not infer any preference on the part of Celent or Portware for CSFB's algorithmic trading solutions.

**Traditional OMS Providers.** OMS providers have been working diligently to integrate their platforms with brokers' algorithmic trading solutions. Firms such as Charles River, Macgregor, Eze Castle and Linedata offer embedded access to numerous broker strategies. In addition, Bloomberg and Reuters both offer similar services to their clients as an integrated extension of each firms' proprietary OMS. In Bloomberg's case, clients can also use the system as pre-trade analytics and order-routing solution that can be integrated with an existing third-party OMS platform.

OMS integration has not come without headaches, however. The lack of a standard communication protocol for algorithmic trading is one of the biggest impediments to efficient OMS integration. FIX 4.4 incorporates TargetStrategy tags that were designed specifically for structuring algorithmic trading messages. However, almost 90 percent of the trading community currently uses either FIX 4.0 or FIX 4.2, neither of which supports algorithmic trading. As a result, brokers have defined custom tags according to their own development protocols, causing delays and frustrations for OMS providers seeking to provide a single interface for their clients. Efforts to create greater standardization also have been hampered by concerns over secrecy. More complex algorithms involve greater customization in terms of defining tags, and brokers do not want to disclose the inner workings of their algorithms for the sake of more efficient OMS integration. Although FIX Protocol Limited (FPL) created the Algorithmic Trading Working Group to help address these concerns, progress to date has been slow.

**Broker-sponsored Platforms.** As noted above, leading broker-dealers have integrated their algorithmic trading solutions with a number of DMA providers, advanced trade management systems and traditional OMS platforms. However, leading brokers continue to develop and market their own proprietary front ends. In addition to industry heavyweights such as Credit Suisse First Boston, Goldman Sachs and Morgan Stanley, technology focused agency brokers such as ITG, BNY Brokerage and Miletus Trading have entered the fray, offering advanced solutions geared specifically towards more quantitative trading shops.

As brokers have rolled out ever-more sophisticated algorithms to their clients, the need for robust pre- and post-trade analytics has increased. Front-end platforms now offer a variety of tools with which traders can evaluate strategies and monitor trade performance against a variety of benchmarks (Figure 3 on page 15).

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**Table 3: Examples of Broker-provided Analytical and Order Management Tools**

| Pre-trade Analysis | Order Interface / Trade Monitoring | Post-trade Analysis |
|---|---|---|
| Real-time cost and performance estimates | Real-time monitoring of progress and performance of orders | Comparison of executed trades against a variety of benchmarks |
| Recommended optimal trading strategy based on expected market impact and timing risk for varying degrees of aggressiveness | Ability to modify an order in progress by adjusting user-defined parameters (or via outright cancellation). | Breakdown of performance by sector, exchange, index, market cap, etc. |

*Source: CSFB, Goldman Sachs, Miletus Trading*

Larger sell-side firms have also begun pushing their services out to small and mid-size broker-dealers who lack the resources to develop algorithmic trading solutions of their own. In order to reach these firms, larger broker-dealers have integrated their offerings with leading sell-side OMS platforms (royalblue, SunGard Trading Systems' Brass and Broker DirectU2, etc.) in addition to platforms such as Portware that serve both the buy-side and sell-side communities.

**Data Latency and Execution Speed.** As the buy-side takes greater control over the trading process, hyper-fast (and accurate) delivery of market data and trade execution becomes increasingly important. In response, some of the larger hedge funds are abandoning consolidated data feeds in favor of raw, direct feeds piped in directly from exchanges. While the differences in delivery speeds between data aggregators and direct market feeds appears miniscule—between 100 and 200 milliseconds on average—this is an eternity for firms employing advanced, quantitative analysis and algorithmic trading strategies. In addition, the sheer volume of data traffic has increased dramatically over the past few years, and is only expected to rise further. For example, the Options Price Reporting Authority (OPRA), which aggregates all quotes and trade information from the options exchanges, estimates that peak traffic rates will increase to 62,000 messages per second by the end of 2005, versus 31,000 messages per second in February 2004. Some quote vendors are facing capacity constraints, and are beginning to employ so-called "conflation" technology that does not deliver every single quote update. As a result, firms demanding comprehensive data solutions are increasingly turning to direct market feeds.

The cost of obtaining, normalizing and routing these feeds to the appropriate desks within an organization can be substantial, however. In addition, speed does not necessarily imply quality. Firms that implement direct feeds face the not insignificant task of "data scrubbing"—catching (and reconciling) large data discrepancies in real time. Although third-party data aggregators tout their data-cleansing abilities, many of the larger buy-side firms and funds prefer to cleanse data internally. A number of "market data infrastructure providers," such as HyperFeed Technologies, Infodyne, Wombat Financial Software and CMS Web, have emerged to help firms address the numerous logistical issues involved with implementing direct market feeds.

Execution speed has also become increasingly important. Trading in a fractured market environment is inherently inefficient. Theoretically, firms wishing to achieve optimal transaction speeds would have to hardwire their trading systems directly into the data centers of each exchange and ECN. This, of course, is simply not an economical solution, a fact not lost on network providers such as Savvis and Radianz. Smaller firms wishing to compete in a fractured and increasingly electronic trading environment depend on these and other network providers to provide a consolidated point of access to numerous market destinations. In addition to connectivity, network providers are addressing execution speed via hosted trading solutions. For example, Radianz reports that some broker-dealers now place their algorithmic trading solutions directly on the network itself.

**Aggregation Platforms.** The newest entrant into the trade routing and advanced order management field is Electronic Specialist (ESP), a firm that promises anonymous access to a variety of broker-sponsored algorithms. Numerous systems discussed earlier provide a single point of access to broker destinations. However, one must be a client of those brokers to access their solutions.[2] ESP, however, provides a broker-to-broker, anonymous execution model. Because trades are "back-to-backed" through ESP, all orders are anonymous—ESP is the counterparty to all partner broker-dealers. The firm believes this to be a competitive advantage, as some buy-side quant shops are reluctant to send trades (generated by proprietary, in-house algorithms) directly to large dealers who might model order flow and reverse engineer their algorithms.

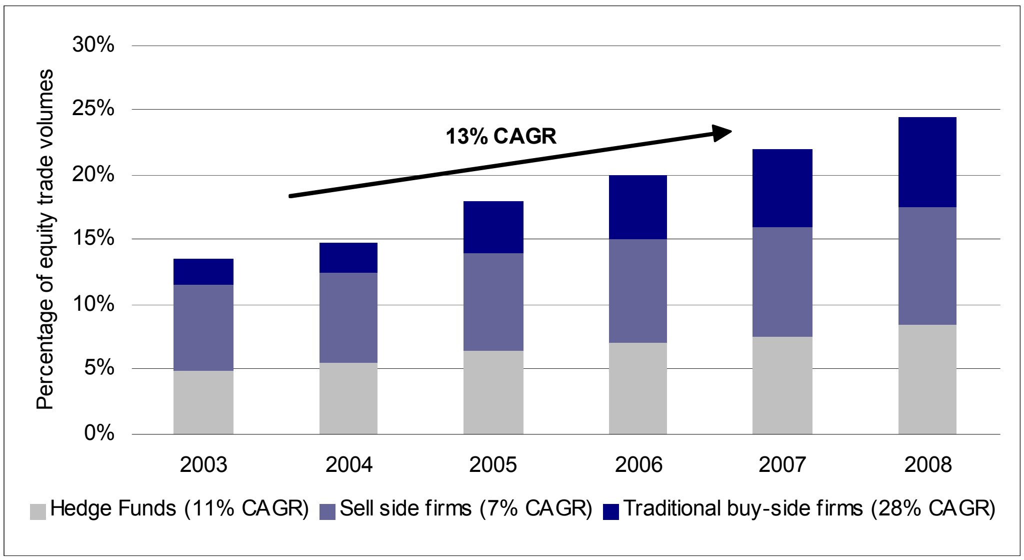
2. Note: ESP has partnered with Portware, Flextrade, Inforeach, Neovest, Sterling Technologies and RealTick for access to the firm's list of consolidated broker-sponsored algorithms. Thus, fully anonymous trading is available via these platforms as well, provided that trades are routed through ESP.

# GROWTH AND SECTOR PARTICIPATION

Celent predicts that algorithmic-based equity trading will increase from approximately 14 percent of overall trade volumes to almost 25 percent by 2008, representing a compound annual growth rate (CAGR) of 13 percent. Traditional buy-side firms, who thus far have been relatively slow to embrace algorithmic trading, represent the industry's largest growth segment, with an estimated five year CAGR of nearly 30 percent.

**Figure 7: Projected Growth In Algorithmic-based Equities Trading**




*Source: Celent Communications*

## HEDGE FUNDS

As the earliest adopters of advanced execution strategies, hedge funds will continue to develop integrated, quant-driven trading systems. The influx of capital into the hedge fund community and the explosion in the number of funds worldwide has depressed returns considerably. As a result, funds are creating ever more complex trading strategies with which to generate alpha. Algorithmic trading will continue to play an integral role in these strategies, as funds employ proprietary and third-party models. More traditional funds seeking to bring execution in house will rely on the suite of trading tools provided by their prime brokers.

Of note, however, is the difference in technological sophistication—and size—of hedge funds. Although recent estimates place the number of hedge funds at more that 8,000 worldwide, most of these can be described as less than technologically advanced ("two guys, a dog and a Bloomberg" is how a large fund manager humorously put it). While there are certainly numerous funds capable of taking advanced execution in-house, most of the hedge fund community relies exclusively on the sell-side for execution services. (For more information, please see Celent's October 2004 report "The Burgeoning Business of Prime Brokerage.")

## TRADITIONAL BUY-SIDE FIRMS

Traditionally, buy-side equity traders were viewed with certain amount of derision by their colleagues on the research side. After all, it was the portfolio managers who developed sophisticated investment strategies based on extensive fundamental research. Traders, on the other hand, were viewed as little more than order clerks. As a result, buy-side trading desk technology lagged well behind that of more advanced, quant-based hedge funds. Trading costs, both direct and indirect, were largely ignored, particularly at firms focused on long-term investment strategies

However, the bear market of 2000–2002 and relatively flat returns over the past two years have forced buy-side firms to re-examine the costs associated with trade executions. Firms have hired more experienced traders who can take greater control over orders. As such, the buy-side is beginning to look to the trading desk as a source of alpha. Technology budgets have also been slashed, forcing firms to seek out efficiencies wherever they can be found. As a result, the buy-side is investing much more heavily in electronic trading technologies than it has previously.

Although traditional buy-side firms still lag behind other industry segments in terms of algorithmic trading, the next three to four years will see a dramatic increase in buy-side adoption.

- **Education.** More robust pre- an post-trade analytical tools will help buy-side traders navigate the various algorithms at their disposal. In addition, the sell-side will take a more active role in educating their clients about which strategies are appropriate for various trading situations.

- **Moving beyond VWAP.** For many buy-side firms, algorithmic trading means one thing—VWAP. As such, many firms remain somewhat leery of algorithms, viewing them as benchmarks to mediocrity. As the sell-side continues to develop and aggressively markets additional algorithms, however, buy-side attitudes will change.

- **Increased focus on alpha.** As noted above, many buy-side firms increasingly look to their trading desks as profit centers; traders in turn are expected to be more efficient. As a result, there is increased interest in the use of algorithms to handle "low-touch" trades, freeing up traders to focus on more difficult orders.

## SELL-SIDE FIRMS

Continued downward pressure on commissions (and revenues as a whole) will force the sell-side to seek greater efficiencies in their trading operations. Algorithms will allow sell-side traders (like their buy-side counterparts) to take on greater volumes and focus their energies on more complex trades. The sell-side will also expand its reach by integrating with a wider array of traditional OMSs, broker-neutral trade management platforms and even independent DMA vendors. As noted above, dealers are also taking a larger role in educating their clients, providing support and training for algorithms available via sell-side sponsored front-ends.

The sell-side as a whole will also expand its algorithmic offerings via increased partnerships between large and small to mid-size broker-dealers. For smaller broker-dealers, the ability to offer algorithmic trading solutions has become a competitive necessity. Although larger brokers are often loathe to process transactions for other sell-side firms they view as competitors, benefits come via fees and an increased footprint in the industry.

# ALGORITHMIC SOLUTIONS APPLIED: TWO CASE STUDIES

The following examples illustrate how two of the better-known algorithmic trading solutions are employed by market participants today.

## VOLUME WEIGHTED AVERAGE PRICE (VWAP)

As noted in Table 1, VWAP algorithms seek to return the average price of security over a trading day, weighted according to traded volume. Many buy-side traders and portfolio managers measure execution performance by deviations from a stock's VWAP. As such, the popularity of VWAP algorithms has soared over the past few years; today, VWAP algorithms are perhaps the best-known and most widely-used algorithms in the market.

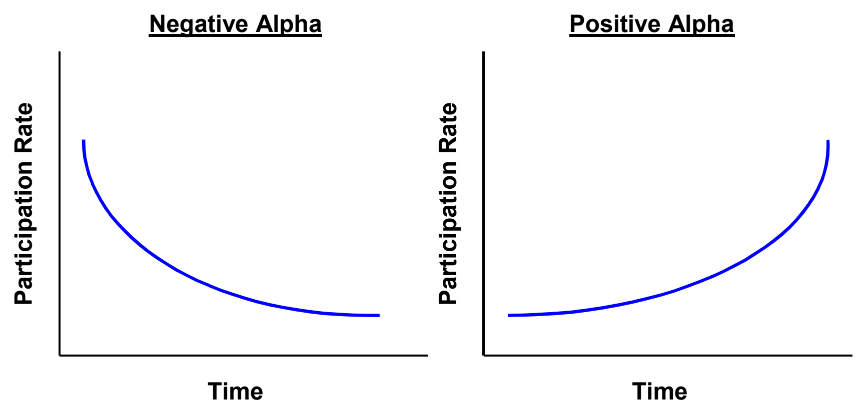
Assume that a trader would like to execute a sell order for 250,000 shares of Microsoft (MSFT) and that he or she would like to trade to a VWAP benchmark. Typically, this would involve "working" the trade (i.e. breaking the order up into smaller pieces and manually executing them over a period of time) to minimize market impact and achieve a net price close to the day's VWAP. As with any other trading strategy, the difficulty in achieving VWAP stems from uncertainty—in this case, uncertainty relating to a security's price-volume distribution over the course of a day.

Figure 9 on page 22 shows the performance of Microsoft on April 19, 2005. The distribution of trade volumes throughout the day follows a familiar "smile" or U-shaped pattern, with heavier volumes at the start and close of the trading day. Chart A illustrates the market impact of the day's opening activity. Between 9:30 am and 11:00 am, Microsoft trades from a high of US$24.79 to a low of US$24.47, before settling into a range-bound trading pattern for most of the day. The impact of the day's trading at the open can be seen further in Chart C, which shows an almost complete lack of movement in VWAP after 11:00 am. However, Chart C also shows noticeable spikes (or "noise") in trade volume distribution. The early concentration of volume and the related amount of noise visible throughout the course of the trading day underscores the need for accurate volume forecasts when trading to a VWAP benchmark.

A trader who manually executes such an order will have to closely monitor market conditions, order fills, volumes, etc., over the course of the day, making adjustments to his or her trading strategy as necessary. For a so-called "difficult" order, this is time and effort well spent. In the case of a very liquid security, a trader's energies are better focused elsewhere. The opportunity cost of "order maintenance," therefore, is an additional consideration when choosing whether to employ an algorithmic trading solution.

In many cases, the concept of alpha comes into play as well. As noted above, many buy-side firms now look to their trading desks as profit centers, and view VWAP as a benchmark to mediocrity. In the example of Microsoft, the stock price dropped sharply in the opening hour of trading. If a trader was expecting Microsoft to end the day lower and expected most of the day's loss to be incurred at the open, he or she would be inclined to execute a greater proportion of trades early in the day. This "negative alpha" view is not captured by VWAP algorithms alone, and must adjusted by the trader at time of execution.

**Figure 8: Impact of Alpha on VWAP Strategy—Sell Order**

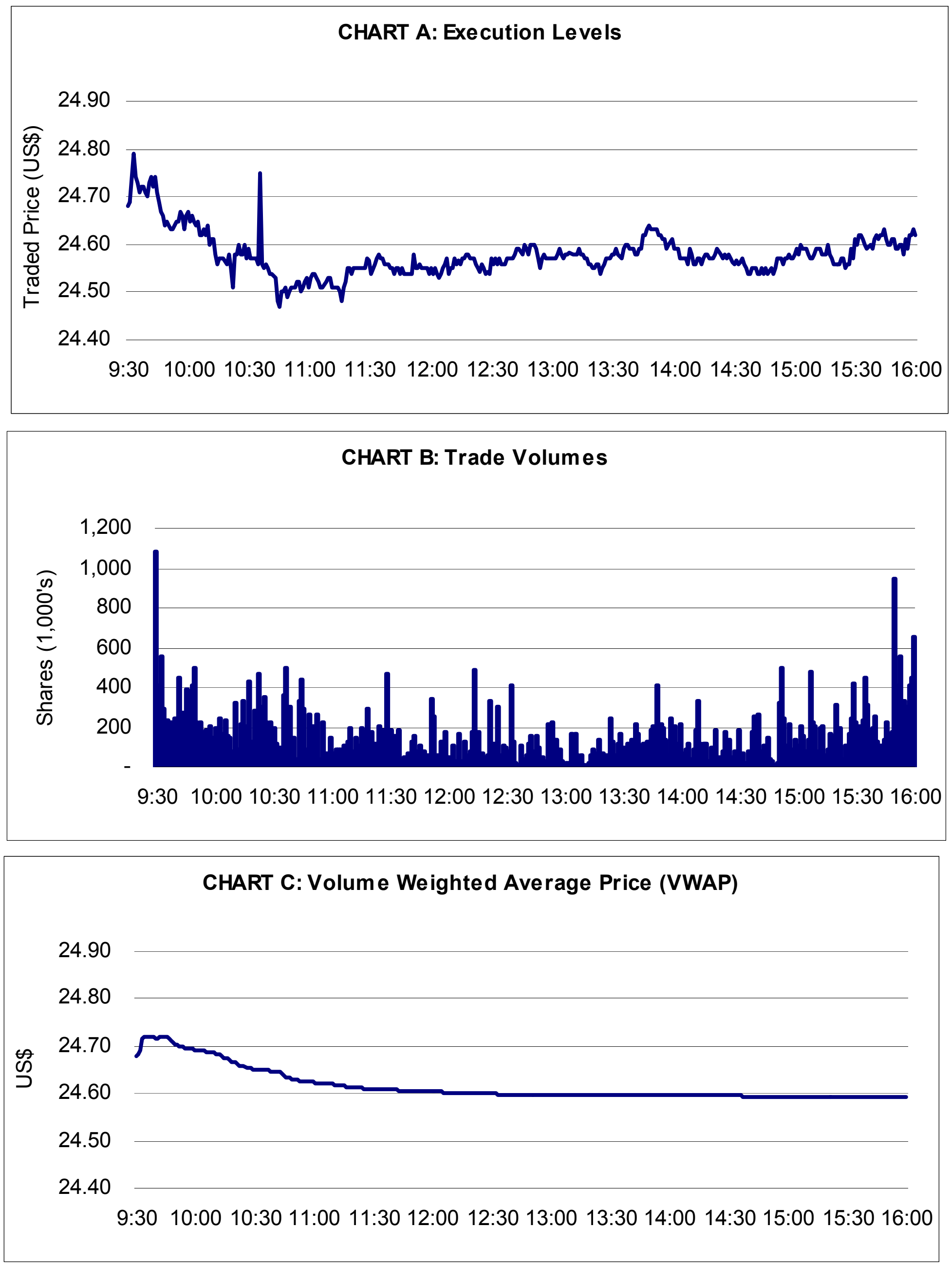



*Source: Miletus Trading*

Therefore, the value of a VWAP algorithm is in (1) anticipating a stock's expected price/volume distribution, and (2) automatically adjusting order size and timing according to real-time analysis of market activity, order fills, and a trader's view towards achieving alpha (if desired). Most VWAP algorithms also mitigate the market impact of orders by sending trades to multiple liquidity pools. The performance of these various market destinations is also monitored, influencing future routing and timing decisions.

However, VWAP algorithms are not appropriate to every security or trading situation. Unlike other algorithms, VWAP is a mandatory participation strategy—trades must be executed in order to match the security's volume schedule. Consider the previous example of a sell order of 250,000 shares of Microsoft. With a market cap of approximately US$275 billion and average trade volumes approaching 68 million shares per day, Microsoft presents a significantly different trading target than a less-liquid, mid-cap stock such as Marvel Enterprises, Inc. (MVL) (Figure 10 on page 23). An order of 75,000 shares of MVL represents approximately 10 percent of average daily trading volume; 250,000 shares of MSFT is a drop in the bucket, representing less than 0.40 percent of average volume. In the case of MVL, a VWAP algorithm may force execution at unfavorable times, leading to severe market impact. Therefore, trading into or out of a liquid, large cap stock for positioning purposes is an ideal scenario for VWAP execution; working an order for a relatively illiquid, small- to mid-cap stock, in which the order represents a large percentage of average daily volume, is not.

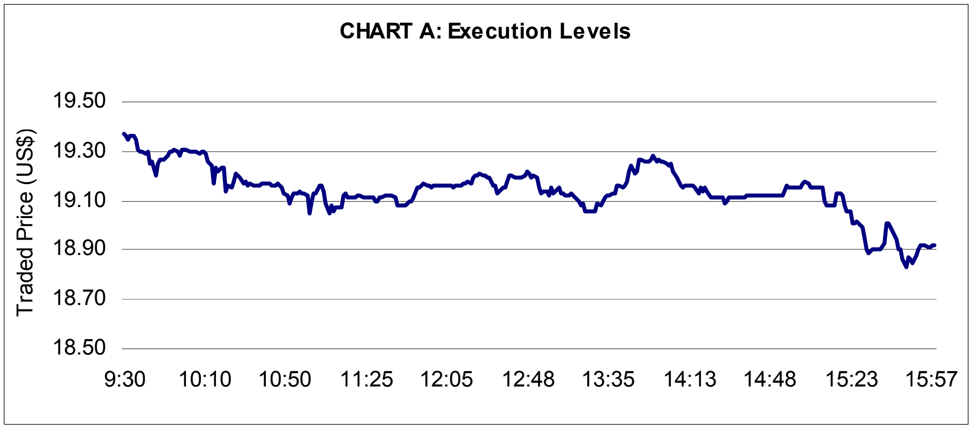
**Figure 9: Microsoft (MSFT) Trading Activity: April 19, 2005**

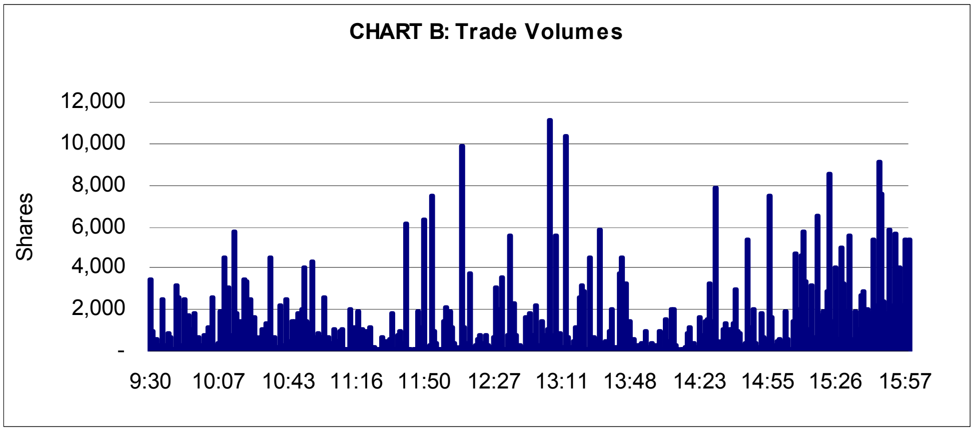


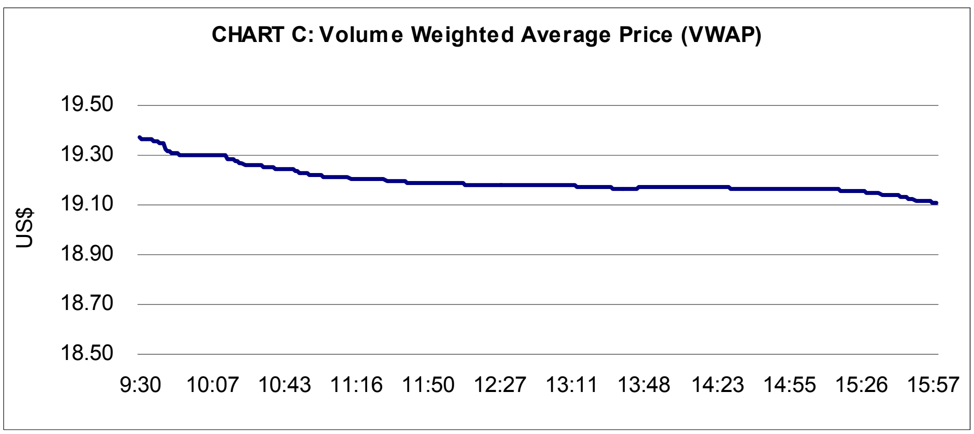

*Source: Bloomberg, Celent analysis*

**Figure 10: Marvel Enterprises (MVL) Trading Activity: April 22, 2005**



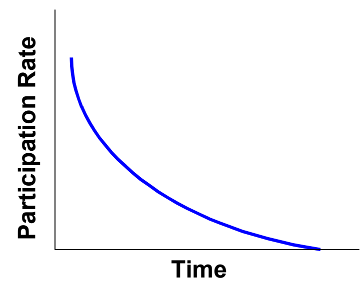

*Source: Bloomberg, Celent analysis*

## IMPLEMENTATION SHORTFALL

Implementation shortfall algorithms are relatively new to the market as a whole. However, they are fast becoming one of the more popular strategies available.

Also known as "arrival price" algorithms, implementation shortfall algorithms seek to minimize losses/maximize gains arising as a result of the difference in a security's price between the time an order is submitted and its price at the time of execution. As such, these strategies have high target participation rates and employ trading schedules weighted towards the short-term trading horizon. Implementation shortfall strategies trade more aggressively at prices better than the arrival price and in line with prices worse than the arrival price.

**Figure 11: Implementation Shortfall—Target Participation Schedule**




*Source: Celent Communications*

The following example demonstrates how a typical implementation shortfall strategy might be employed[3]. (In this simplified example, only one security is traded, as opposed to a basket of stocks.) Examples of pre-trade, order monitoring and post-trade analytical tools are presented as well, showing trade flow from start to finish. Of note is the information available via pre-trade analysis, which includes:

- Cost and performance estimates
- Analysis of difficult trades
- Recommended optimal trading strategy

Assume that a trader would like to execute a buy order for 75,000 shares of Marvel Enterprises. Representing approximately 10 percent of average daily trading volume, an order of this size could be considered somewhat challenging to a trader wishing to (1) minimize market impact, and (2) beat or match the price that prevailed when the buy order was received.

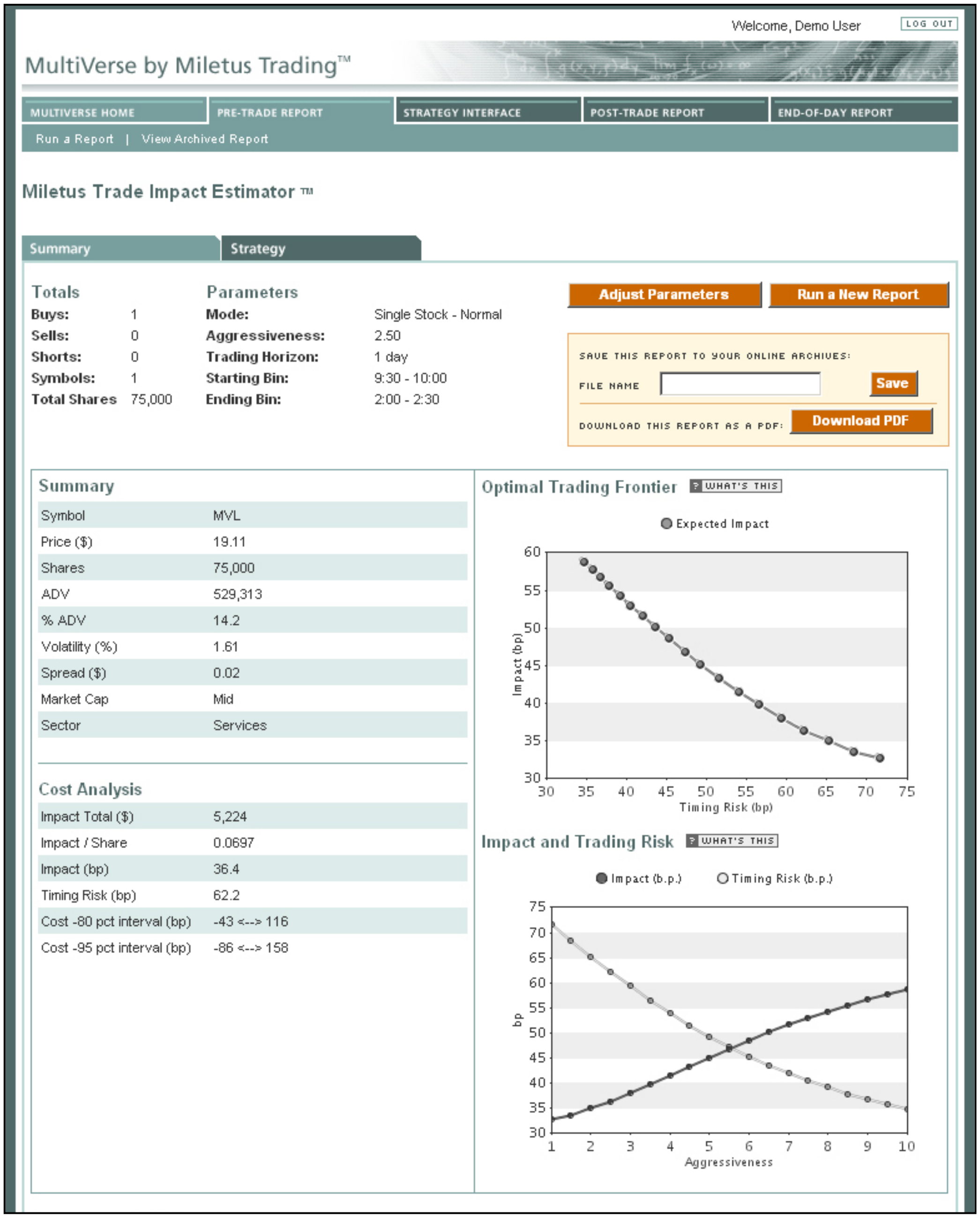
3. Celent has chosen Miletus Trading, LLC, a New York-based broker focusing on advanced execution strategies, to provide an example of an implementation shortfall strategy. As noted earlier in this report, algorithmic trading solutions are available from numerous broker-dealers. Readers should not infer any preference on the part of Celent for the Miletus MultiVerse trading platform, nor is the functionality deployed by Miletus necessarily unique to the MultiVerse platform.

In order to gauge market impact and timing, the trader has chosen an Aggressiveness level of 2.5 (based on a range of 1–10). With a level of 1 representing a very easy, "click and forget" style trade, 2.5 implies earlier volume participation and a slightly more aggressive execution strategy. In addition, the trader has entered an end-time of 2:30 pm (versus a typical end time of 4:00 pm for a VWAP-style order), which is also representative of a more aggressive strategy. In this example, the pre-trade analytics engine estimates that the total impact of the trade will be US$5,224, or 36.4 basis points (Figure 12 on page 26). The timing risk associated with this strategy is estimated to be 62.2 basis points.

Figure 13 on page 27 shows a matrix of the expected cost of trading based on order size and level of aggressiveness. One can see a clear divergence between Impact and Timing risk as the level of aggressiveness increases. As the speed which orders are submitted and executed increases, the potential impact of the order on market price increases (due to a more aggressive trading strategy over shorter time horizon). Of course, a shorter trading horizon minimizes the risk that the market will move away from the initial bid/offer spread price, which is reflected in a decrease in Timing risk. Traders are alerted to difficult trades via color-coding.

**Figure 12: Pre-trade Analytics (1)**




*Source: Miletus Trading*

## Figure 13: Pre-trade Analytics (2)

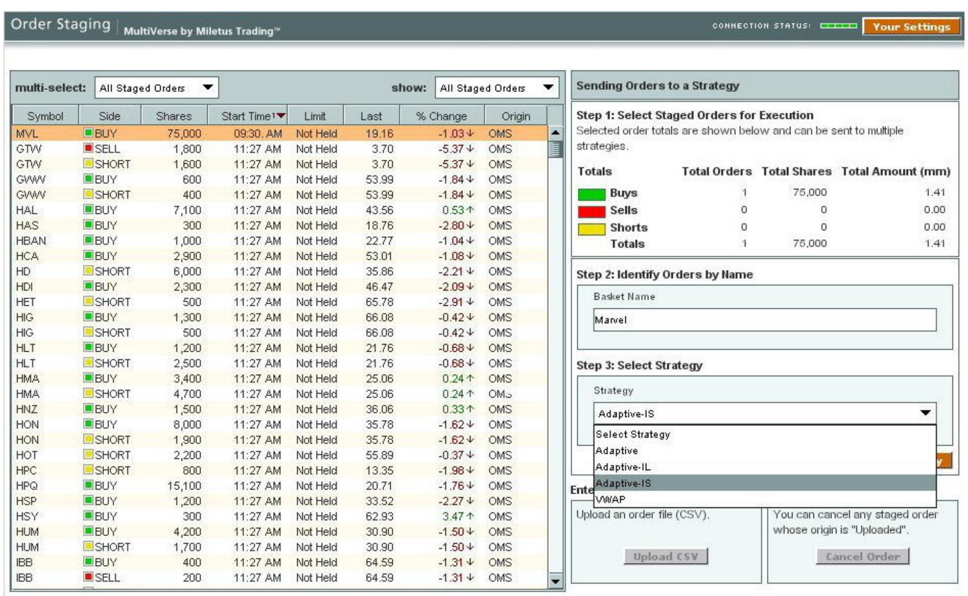
Less Aggressive — Key: very difficult, difficult — More Aggressive

| Shares | | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 | 4 | 4.5 | 5 | 5.5 | 6 | 6.5 | 7 | 7.5 | 8 | 8.5 | 9 | 9.5 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37500 | Impact (bp) | 21.6 | 21.8 | 22.0 | 22.2 | 22.5 | 22.8 | 23.1 | 23.4 | 23.9 | 24.8 | 25.6 | 26.6 | 27.5 | 28.4 | 29.4 | 30.2 | 31.0 | 31.9 | 32.8 |
| | Timing Risk (bp) | 71.7 | 68.4 | 65.3 | 62.3 | 59.4 | 56.7 | 54.1 | 51.7 | 49.4 | 47.3 | 45.4 | 43.6 | 42.0 | 40.5 | 39.1 | 38.0 | 36.8 | 35.8 | 34.9 |
| 45000 | Impact (bp) | 23.9 | 24.1 | 24.2 | 24.5 | 24.8 | 25.1 | 25.8 | 26.7 | 27.7 | 28.8 | 29.9 | 31.1 | 32.3 | 33.5 | 34.6 | 35.8 | 36.9 | 37.8 | 38.9 |
| | Timing Risk (bp) | 71.6 | 68.5 | 65.3 | 62.3 | 59.4 | 56.7 | 54.1 | 51.6 | 49.4 | 47.3 | 45.4 | 43.6 | 42.0 | 40.6 | 39.2 | 38.0 | 36.8 | 35.8 | 34.9 |
| 52500 | Impact (bp) | 26.0 | 26.2 | 26.4 | 26.6 | 27.3 | 28.2 | 29.4 | 30.7 | 32.0 | 33.3 | 34.6 | 36.0 | 37.3 | 38.7 | 40.0 | 41.2 | 42.5 | 43.6 | 44.7 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.3 | 62.2 | 59.4 | 56.7 | 54.1 | 51.6 | 49.4 | 47.3 | 45.4 | 43.6 | 42.0 | 40.5 | 39.2 | 38.0 | 36.8 | 35.8 | 34.8 |
| 60000 | Impact (bp) | 28.0 | 28.2 | 28.5 | 29.4 | 30.5 | 31.9 | 33.3 | 34.8 | 36.3 | 37.8 | 39.3 | 40.8 | 42.3 | 43.6 | 45.1 | 46.4 | 47.6 | 48.7 | 49.7 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.3 | 62.3 | 59.4 | 56.7 | 54.0 | 51.6 | 49.4 | 47.3 | 45.3 | 43.6 | 42.0 | 40.6 | 39.2 | 38.0 | 36.8 | 35.8 | 34.9 |
| 67500 | Impact (bp) | 29.9 | 30.3 | 31.5 | 32.8 | 34.3 | 35.8 | 37.4 | 39.1 | 40.7 | 42.4 | 44.1 | 45.7 | 47.3 | 48.7 | 50.1 | 51.2 | 52.3 | 53.3 | 54.4 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.4 | 47.3 | 45.4 | 43.6 | 42.0 | 40.5 | 39.2 | 38.0 | 36.8 | 35.8 | 34.8 |
| 75000 | Impact (bp) | 32.8 | 33.6 | 35.0 | 36.4 | 38.1 | 39.8 | 41.5 | 43.3 | 45.1 | 46.9 | 48.6 | 50.2 | 51.7 | 53.0 | 54.3 | 55.6 | 56.7 | 57.8 | 58.8 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.2 | 62.2 | 59.4 | 56.6 | 54.0 | 51.6 | 49.3 | 47.3 | 45.4 | 43.6 | 42.0 | 40.5 | 39.2 | 37.9 | 36.8 | 35.8 | 34.8 |
| 90000 | Impact (bp) | 41.9 | 42.2 | 42.9 | 44.2 | 45.9 | 47.7 | 49.7 | 51.6 | 53.4 | 55.0 | 56.7 | 58.2 | 59.8 | 61.2 | 62.5 | 63.8 | 65.1 | 66.2 | 67.3 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.4 | 47.3 | 45.3 | 43.6 | 42.0 | 40.5 | 39.2 | 37.9 | 36.8 | 35.8 | 34.8 |
| 105000 | Impact (bp) | 50.6 | 50.8 | 51.4 | 52.3 | 53.8 | 55.7 | 57.4 | 59.1 | 60.8 | 62.5 | 64.1 | 65.5 | 67.0 | 68.5 | 69.9 | 71.2 | 72.4 | 73.6 | 74.7 |
| | Timing Risk (bp) | 71.5 | 68.4 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.3 | 47.3 | 45.4 | 43.6 | 42.0 | 40.5 | 39.1 | 37.9 | 36.8 | 35.8 | 34.8 |
| 120000 | Impact (bp) | 58.8 | 59.0 | 59.6 | 60.5 | 61.6 | 62.9 | 64.4 | 65.9 | 67.6 | 69.1 | 70.7 | 72.3 | 73.8 | 75.2 | 76.6 | 77.9 | 79.2 | 80.5 | 81.6 |
| | Timing Risk (bp) | 71.6 | 68.3 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.3 | 47.3 | 45.3 | 43.6 | 42.0 | 40.5 | 39.1 | 37.9 | 36.8 | 35.8 | 34.8 |
| 135000 | Impact (bp) | 66.6 | 66.9 | 67.5 | 68.0 | 68.7 | 69.6 | 70.9 | 72.4 | 73.9 | 75.5 | 77.1 | 78.6 | 80.2 | 81.6 | 83.0 | 84.3 | 85.6 | 86.8 | 88.0 |
| | Timing Risk (bp) | 71.6 | 68.4 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.3 | 47.3 | 45.3 | 43.6 | 42.0 | 40.5 | 39.1 | 37.9 | 36.8 | 35.8 | 34.8 |
| 150000 | Impact (bp) | 74.1 | 74.3 | 74.5 | 74.8 | 75.3 | 75.9 | 77.0 | 78.4 | 79.8 | 81.3 | 82.9 | 84.4 | 85.9 | 87.4 | 88.8 | 90.2 | 91.5 | 92.7 | 94.0 |
| | Timing Risk (bp) | 71.6 | 68.3 | 65.2 | 62.2 | 59.3 | 56.6 | 54.0 | 51.6 | 49.3 | 47.2 | 45.3 | 43.6 | 42.0 | 40.5 | 39.1 | 37.9 | 36.8 | 35.8 | 34.8 |

*Source: Miletus Trading*

Figure 14 shows the order staging interface. Staged orders have either been uploaded via a comma separated values (CSV) file, sent via FIX from a third party OMS, or input manually.

## Figure 14: Order Staging

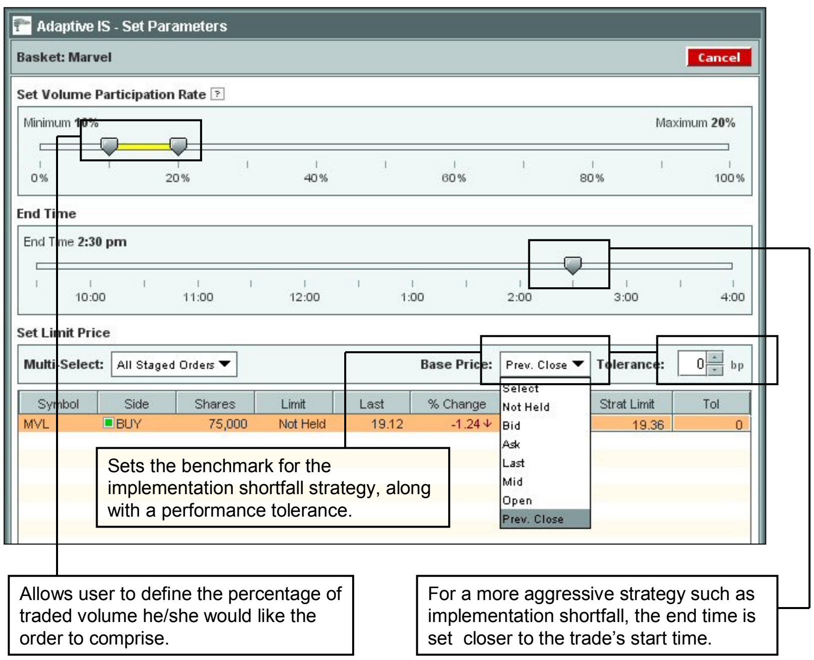



*Source: Miletus Trading*

At this point, a trader will select an appropriate algorithm for each order, via a drop-down menu at lower right. (Concealed by the drop-down menu is a help button for choosing the right algorithm).

Having chosen a strategy, a trader then adjusts a variety of user-defined parameters before submitting the order (Figure 15). For the implementation shortfall strategy, traders can adjust participation rates, end time, base price and performance tolerance. The order is then submitted, at which point it is live and the algorithm begins executing the trade.

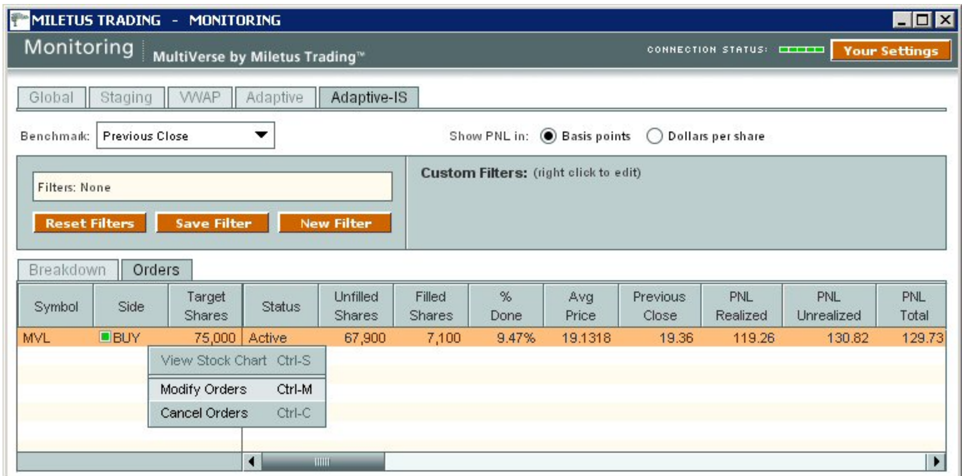
**Figure 15: User-defined Parameters for Implementation Shortfall Algorithm**




*Source: Miletus Trading*

Traders can monitor the status of all trades in real time, as shown in Figure 16 below. The right-click drop-down menu allows one to immediately modify or cancel any number of orders.

**Figure 16: Order Monitoring**




*Source: Miletus Trading*

Post-trade analysis of orders is shown in Figure 17 below. Drop-down menus allow traders to gauge performance by comparing results to a variety of benchmarks. Were this a basket trade, performance could be broken out by sector, exchange, index, market cap, spread and trade date.

**Figure 17: Post-trade Analysis**


| | Buys | Sells | Shorts | Total |
|---|---|---|---|---|
| Symbols | 1 | 0 | 0 | 1 |
| Trades | 1 | 0 | 0 | 1 |
| Shares | 75,000 | 0 | 0 | 75,000 |
| Values | $1,427,408 | $0 | $0 | $1,427,408 |
| % Shares | 100.00% | 0.00% | 0.00% | 100.00% |
| % Value | 100.00% | 0.00% | 0.00% | 100.00% |
| Avg % DV | 28.46% | n/a | n/a | 28.46% |
| Dollars per Share | -0.0121 | n/a | n/a | -0.0121 |
| Basis Points | -6.36 | n/a | n/a | -6.36 |
| Dollars per Share | -0.0121 | n/a | n/a | -0.0121 |
| Basis Points | -6.36 | n/a | n/a | -6.36 |
| Dollars per Share | 0.3549 | n/a | n/a | 0.3549 |
| Basis Points | 186.47 | n/a | n/a | 186.47 |

*Source: Miletus Trading*

# LOOKING AHEAD

## HIGH TOUCH VERSUS LOW TOUCH

**Cost Versus Complexity.** More and more services are being introduced that put execution directly in the hands of the buy-side. The buy-side's ability to use ever more complex trading tools will determine just how far the market will progress in terms of adopting a self-service model. If pre-trade analytics prove too difficult for the average buy-side trader to negotiate, he or she will most likely revert to more traditional methods of execution, regardless of the additional costs.

Figure 4 below shows the relative brokerage fees for a variety of different executions services. Algorithmic trading and direct market access (or a combination thereof) clearly offer significant cost savings in terms of commission rates.

**Table 4: Commissions Across Various Execution Services**

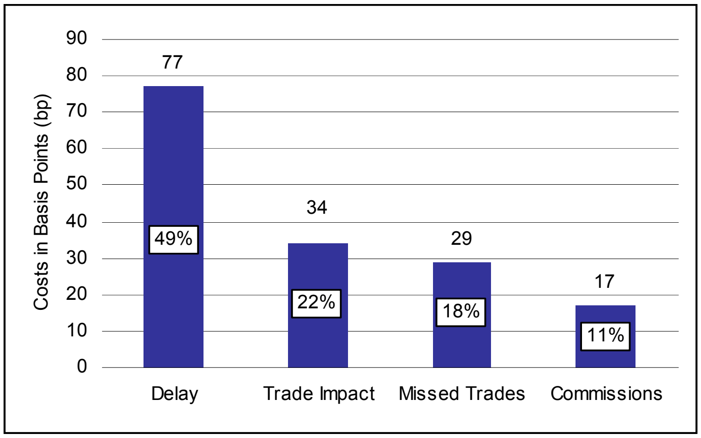
<table>
<tr><th colspan="2">Execution Services</th><th>Cost per Share (cents)</th></tr>
<tr><td rowspan="2">Single-stock, full-service</td><td>Agency</td><td rowspan="2">3 — 6</td></tr>
<tr><td>Capital request</td></tr>
<tr><td rowspan="2">Portfolio trading</td><td>Agency</td><td>1 — 3</td></tr>
<tr><td>Capital request</td><td>0 — 25</td></tr>
<tr><td colspan="2">Algorithmic trading</td><td>0.5 — 2</td></tr>
<tr><td rowspan="3">Direct market access (DMA)</td><td>Broker-sponsored (RediPlus, Lava, etc.)</td><td rowspan="3">0.5 — 2</td></tr>
<tr><td>ECNs (Inet, Tradebook, etc.)</td></tr>
<tr><td>ATS (POSIT, Liquidnet, etc.)</td></tr>
<tr><td colspan="2">Boutique execution brokers</td><td>2 — 4</td></tr>
<tr><td colspan="3">Source: GSAT</td></tr>
</table>

However, trading costs are not measured solely in terms of commissions. Indirect costs (delay, trade impact and missed trades) account for 89 percent of all trading-related costs (Figure 18 on page 31). Direct costs—essentially, commissions—account for just 11 percent

As a result, both vendors and sell-side participants will spend considerable resources in an effort to help the buy-side understand these new tools and the potential costs associated with using them. Education will come in a variety of forms, but the focus will be on more personalized services. (If one thing is certain, it is that traders do not read manuals.)

**Figure 18: Overall Trading Costs**




*Source: Wayne Wagner (Plexus), testimony to House Financial Services Committee, March 12, 2003; GSAT*
Note: Delay refers to the opportunity cost of slow transactions.

**What Happens When Things Go Wrong?** As smaller technology firms (and specialized quant brokers) take a greater role in the execution process, the buy-side is becoming increasingly concerned about trade execution and settlement/reporting services. Regardless of advances in automated trading, clearing and settlement, mistakes are bound to happen. Trade breaks, incomplete fills and other trading-related errors continue to plague the market. As execution moves further away from the sell-side trading desk, the question becomes: who is ultimately responsible? Many smaller firms lack the support staffs to resolve these problems in an efficient manner. As a result, traditional buy-side firms may well be swayed by the sell-side's promise of more robust trading and back-end support.

## THREATS TO TRADITIONAL OMS PROVIDERS

In order to gain a foothold in the market, providers of advanced trade management and routing platforms have been very careful not to antagonize traditional OMS vendors. Indeed, these firms have actively partnered with OMS providers on a range of integration initiatives. However, as many buy-side firms demand increased flexibility, lower cost, and a consolidated package of execution and order routing services, traditional OMS providers will struggle to remain relevant. Advanced execution management systems fulfill many of the same duties as OMSs, including compliance and reporting. Although OMS providers are working diligently to integrate with broker-sponsored algorithmic solutions and DMA providers, they will likely face increased competition from more flexible and customizable front-ends.

## THE EFFECT OF REGULATION NMS

The passage of Regulation NMS ("Reg NMS") will have a clear impact on the market for algorithmic trading. Front-end technology providers, sell-side firms, buy-side firms and other market participants will all feel the effect of Reg NMS to one degree or another.

**Front-end Providers.** For providers of front-end technology to both the sell-side and the buy-side, Reg NMS presents new opportunities to serve their clients. OMS and advanced trade management system providers, DMA vendors, and other algorithmic trading vendors will be expected to develop compliance systems for the Order Protection Rule and the rule regarding blocked and crossed markets. These firms will also be expected to change their own systems as necessary to comply with the ban on sub-penny quoting, to distinguish between manual and automated quotes, and to update order types such as the intermarket sweep order to comply with the new rules.

**Smart Order Routing Algorithms.** Smart order routing systems will be slightly impaired by the Order Protection Rule, although the SEC could have approved a stricter version of the rule that would have seriously impeded smart order routing. The Order Protection Rule reduces flexibility in terms of when and where algorithms can route trades. As a result, smart routing algorithms have less opportunity to be "smart." Consider the example in Figure 19 below.

**Figure 19: Impact Of The Order Protection Rule On Smart Routers**

| Nasdaq | ArcaEx | NSX |
|---|---|---|
| 10.00 100 | 9.99 300 | 9.98 500 |
| 9.98 200 | 9.98 400 | 9.96 600 |
| 9.97 400 | | |

*Source: Celent Communications; "Regulation NMS: One Rule to Bind Them All"*

Without the Order Protection Rule, a smart order router trying to execute 1,000 shares might choose to bypass the US$10.00 bid at Nasdaq and send a 700-share market order to ArcaEx and a 300-share limit order (priced at US$9.98) to NSX. It might bypass Nasdaq because only 100 shares are available at US$10.00, or because Nasdaq may be slightly slower at executing orders. It could also send the full 1,000 shares, priced at $9.98, to Archipelago and hope to tap into hidden liquidity. But under the Order Protection Rule, the smart router has less choice. It would be required to hit the US$10.00 bid at Nasdaq and the US$9.99 bid at Archipelago, most likely in an intermarket sweep order. The US$9.98 bid at NSX is protected, but the same-priced bids at Nasdaq and Archipelago are not. The only decision for the smart router is where to execute the remaining 600 shares at US$9.98. The less liquid a stock is, the less choice is left to the smart router. Nevertheless, the ability to route orders to the appropriate market for the best possible execution will remain as important as ever. Celent expects that sell-side sponsored algorithmic trading and DMA services will increase as a result of Reg NMS.

**Effect on Other Algorithmic Trading Solutions.** There was concern that Reg NMS might adversely affect mandatory participation strategies such as VWAP and order sweeping algorithms. However, the Order Protection Rule exempts intermarket sweep orders and certain algorithmically generated orders such as VWAP that are executed without regard to the prices available at the time of order submission.

## NEW MARKETS AND ASSET CLASSES

Although the market has focused almost exclusively on equity-based algorithmic trading, other asset classes are on the horizon. The fixed income, futures, options and foreign exchange markets will all see an influx of algorithmic trading, although Celent views this as a long-term growth opportunity. Algorithms will also play a larger role in multi-asset execution, driving cash and derivatives trading via an integrated e-trading strategy.

## ALGORITHMS AS COMMODITIES?

Strictly speaking, no two algorithms are the same. Firms are continually tweaking their own algorithms, even the more commonly used strategies such as VWAP. This is not to say, however, that traders should be willing to pay for access to 6 or 7 different VWAP strategies; the performance of such algorithms will eventually regress to a mean. At that point, certain structural factors may give one firm an advantage over another. For example, larger broker dealers with internal liquidity can provide natural fills (executing an order before sending it out into the market), reducing market impact.

However, the complexity of algorithms that are either available or in development today far exceeds that of VWAP or simple time slicers. Firms are continually working to develop new algorithms. On the horizon are strategies that analyze trading from a portfolio level, extend automated spread trading to baskets as opposed to single stocks, and arbitrage between different asset classes.

# CONCLUSION

In February of 1996, Gary Kasparov, the reigning world chess champion, went up against IBM's Deep Blue in a duel of man versus machine. Kasparov famously lost the opening game of the six game match, marking the first time that a computer had defeated a world champion under tournament conditions.

With the advent of algorithmic trading, it has been suggested that human traders might one day face a similar fate. However, it would be a huge mistake to draw parallels between man versus computer in a game of chess and the role of a trader in today's market. At the end of the day, algorithms are simply another set of tools that traders now have at their disposal. Decisions about how to best use these tools (including understanding which algorithms are appropriate for each trading scenario) remains a trader's responsibility.

As noted earlier in this report, some hedge funds have developed extremely sophisticated, integrated research and trading systems—"black boxes" that take a purely quantitative approach to trading. There is a certain subset of trading (highly statistical arbitrage strategies, for example) for which such systems may indeed trump their human counterparts. However, the range and complexity of securities, asset classes, and investment strategies that make up the global capital markets far exceeds the analytical capabilities of any algorithm.

If anything, the role of the trader in today's world is enhanced, not diminished, by algorithms. The ability to automate so called "low-touch" trades means that traders can now make better use of their time, focusing on more complex orders and strategies. Of course, less time spent on low-touch trades means that traders can take on even more volume. While the end result of this increase in efficiency may be a marginal reduction in headcount, the value of human capital in an increasingly sophisticated trading environment will only increase.

# OBJECTIVITY AND METHODOLOGY

**Objectivity.** Celent is an independent, privately owned research and consulting firm that provides technology and business strategy advice to the financial services industry. Celent provides unbiased insight into industry trends, competitors in the market, and market sizes. Celent's research reports are written by in-house analysts with extensive experience at a variety of top global financial services firms, technology vendors, and consultancies.

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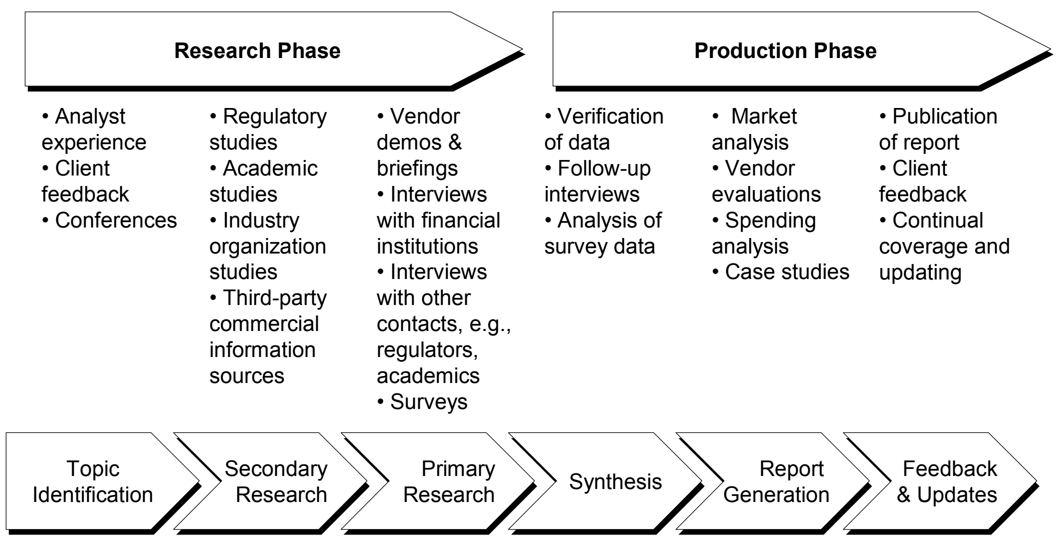


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# ABOUT CELENT

Celent Communications is a research and advisory firm dedicated to helping financial institutions formulate comprehensive business and technology strategies. Celent publishes reports identifying trends and best practices in financial services technology, and conducts consulting engagements for financial institutions looking to use technology to enhance existing business processes or launch new business strategies. With a team of internationally experienced analysts, Celent is uniquely positioned to offer strategic advice and market insights on a global basis.

Celent's research services cover the following six sectors of financial services: Retail Banking, Wholesale Banking, Retail Securities and Investments, Institutional Securities and Investments, Life/Health Insurance, and Property/Casualty Insurance.

For inquiries, please visit www.celent.com, email info@celent.com, or contact:

***Headquarters:***
745 Boylston Street, Suite 502
Boston, Massachusetts 02116
USA
Tel.: +1.617.262.3120
Fax: +1.617.262.3121

Wall Street Plaza
88 Pine Street, 31st Floor
New York, New York 10005
USA
Tel.: +1.212.269.7540
Fax: +1.212.269.7541

50 California Street, Suite 1500
San Francisco, California 94111
USA
Tel.: +1.415.439.5291
Fax: +1.415.439.5299

16, Place Vendôme
75001 Paris
France
Tel.: +33.1.42.61.06.88
Fax: +33.1.42.61.03.12

Imperial Tower, 15th Floor
1-1-1 Uchisaiwaicho
Chiyoda-ku, Tokyo 100-0011
Japan
Tel.: +81.3.3507.5694
Fax: +81.3.3507.5601

23 Berkeley Square
London W1J 6HE
United Kingdom
Tel.: +44.20.7665.6931
Fax: +44.20.7665.6650