

*part 4:*

## Emerging trends and future direction



**97** *Chapter 10*  
**Basket algorithms – The next generation**

**107** *Chapter 11*  
**The future of algorithmic trading**

# Basket algorithms – The next generation

Implementation Shortfall strategies for baskets of stocks

*\*Anna Bystrik and \*\*Richard Johnson*

Algorithmic trading, once considered an obscure method of automatic benchmark-driven order execution, is going mainstream in the world of trading. The estimates of 35% to 40% of total US equity volume traded through algorithms by 2008 no longer look wildly optimistic.

The labour-efficient and objective nature of algorithms appeals to buy-side traders as it gives them more control of their order flow. A skilled trader may be able to outperform any of the modern trading algorithms for a single stock. However, it would be impossible to expect the same trader to monitor every single position in a basket of a hundred names or more. The algorithmic method enables these positions to be traded automatically in a cost effective way versus the traditional trading desk.

Since most strategies aim to match specific benchmarks like VWAP, TWAP, Close, or Arrival Price, the algorithm's performance

is transparent and measurable. The trader can therefore easily compare performance across different providers and implementations.

This chapter will focus on Implementation Shortfall strategies for baskets of stocks. The emergence of these advanced strategies, such as ROBE™ from Miletus Trading, is a sign that algorithmic trading has evolved beyond the first generation of core strategies. In short, algorithmic portfolio trading is not only labour-efficient and objective, but a very promising and largely unexplored domain in the field of rule-based execution.

In order to fully understand algorithmic portfolio trading strategies, one must examine the ideas underlying the Implementation Shortfall (IS) strategy for an individual stock. Several years ago, Almgren and Chriss introduced the concept of an efficient trading frontier (ETF)<sup>1</sup>, which is the bedrock of most IS strategies today.

\*Anna Bystrik, PhD,  
research analyst,  
Miletus Trading

\*\*Richard Johnson,  
senior vice  
president in charge  
of Product Sales,  
Miletus Trading

## Emerging trends and future direction

### Efficient trading frontier – single stock

The breakthrough paper ‘Optimal execution of portfolio transactions’ by Robert Almgren and Neil Chriss<sup>2</sup> quantifies the relationship between two important components of trading costs – market impact and timing risk. Any attempt to devise a strategy with low timing risk leads to aggressive trading and an inevitable increase in market impact costs. Conversely, the decision to minimise market impact necessitates passive trading, and a high degree of timing risk.

These ideas become easier to grasp if a simple example is used to illustrate the concepts. Consider a sell order of 78,000 shares of XYZ to be completed by the end of the day. The difficulty of this trade depends on the expected trading volume for XYZ. As a proxy for expected volume, it is common to use a 20-day average daily volume (ADV). If ADV is 650,000 shares then the position constitutes 12% of the ADV.

Clearly, there are many ways to complete this trade within a day. One possibility is to use a VWAP strategy. Ideally, this approach will maintain a steady participation rate of 12% throughout the day. There are, however, several assumptions which need to be satisfied for a smooth execution: (a) 650,000 shares of XYZ is an accurate volume forecast; (b) the intra-

day volume distribution (U-curve) is consistent with the historic averages; and (c) the trading strategy is able to maintain the indicated participation rate at all times.

The market reality may invalidate these assumptions. For example, U-curves can be quite unpredictable, and on any given day may vary from historic averages. For simplicity, assume XYZ has a perfectly flat intra-day volume profile – with 50,000 shares traded in each 30-minute bin (in the United States the stock markets are open for six and a half hours, from 9:30 to 16:00, giving thirteen 30-min bins). In this simplified example, maintaining a steady 12% participation rate by trading 6,000 shares per bin completes the order.

In this example the trading is passive, thus minimising temporary market impact of trades. Market impact in general is very difficult to measure or estimate (cf.<sup>3</sup>). The existing pre-trade analysis tools (TIE™ from Miletus Trading) apply advanced statistical techniques to large trade databases in order to estimate market impact for any pre-selected execution strategy. In this example, a pre-trade engine may produce a market impact estimate of 30 bps. Any other trading strategy is likely to lead to a higher impact estimate.

On the other hand, for VWAP execution the timing risk is relative-

<sup>1</sup> R. Almgren, ‘Optimal execution with nonlinear impact functions and trading-enhanced risk’, *Applied Mathematical Finance* 10<sup>1</sup> (2003), 1-18.

<sup>2</sup> R. Almgren and N. Chriss, ‘Optimal execution of portfolio transactions’, *J. Risk* 3 (Winter 2000/2001) 5-39.

<sup>3</sup> A. Freyre-Sanders, R. Guobuzaitė, K. Byrne, ‘A review of trading cost models: reducing transaction costs’, *J. Investing* (Fall 2004), 93-115.

## Emerging trends and future direction

ly high. After three hours of trading more than half of the original position is still exposed to market volatility. The timing risk (understood as standard deviation of the average trade price) depends primarily on the volatility of the stock and is thus easy to estimate. If daily volatility for XYZ is 170 bps, then the timing risk for a VWAP strategy will be around 100 bps.

Is VWAP the optimal strategy if the benchmark is Arrival Price? It may be, but only for a trader who is not worried about market risk. A risk-averse trader may prefer a more aggressive strategy, which starts to trade at a higher participation rate (e.g. 20% in the morning), reducing the position faster. This strategy may cause 40 bps of market impact, but reduce timing risk to 70 bps. An even more aggressive strategy will lead to the estimates of 48 bps of impact and 60 bps of risk. Which is preferable? The correct way to approach this question is to construct a 'utility function'  $U = I + \lambda R$ , where  $I$  is the expected impact,  $R$  is the timing risk of the strategy and  $\lambda$  is a risk-aversion coefficient which reflects the trader's preferences. Since the optimal trading strategy seeks to minimise this function, it may be more appropriate to refer to it as a 'penalty function'. Take  $\lambda = 0.5$  and compute the penalty for each of the three sample strategies (see Fig. 1): for the VWAP strategy

$$U = 30 + 0.5 \cdot 100 = 80 \text{ bps,}$$

for the second strategy

$$U = 40 + 0.5 \cdot 70 = 75 \text{ bps,}$$

and for the third strategy

$$U = 48 + 0.5 \cdot 60 = 78 \text{ bps.}$$

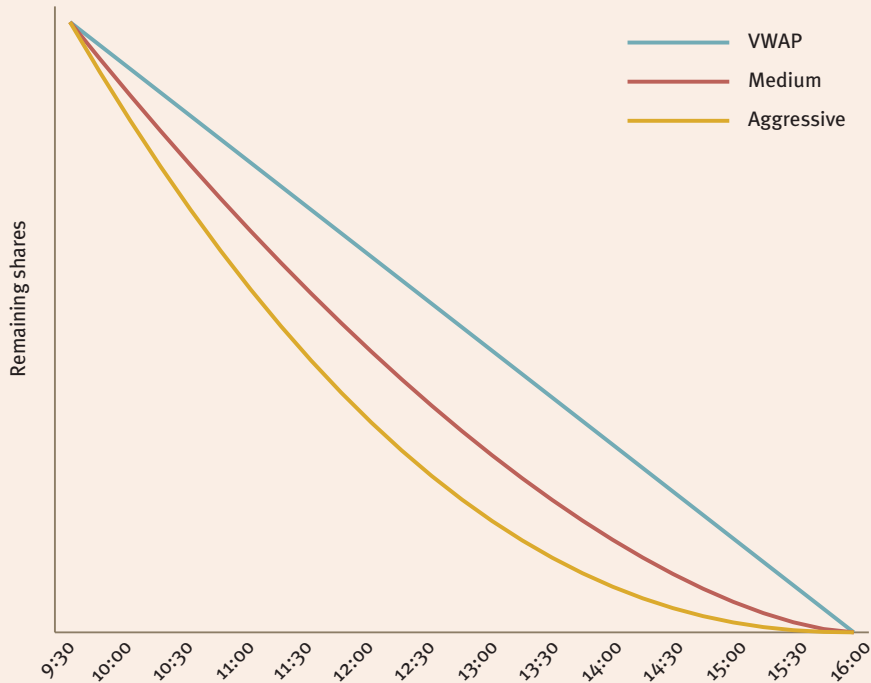
The results are close, but the penalty is the smallest for the second strategy. Thus, for  $\lambda = 0.5$ , the second strategy is preferable. The VWAP strategy is too passive, while the third strategy is overly aggressive. Note that for  $\lambda = 1.5$  the third, more aggressive, strategy is preferable due to a higher risk-aversion level.

In their work, Almgren and Chriss outline how to build a unique optimal trading strategy for each level of risk-aversion; the set of these optimal strategies defines an efficient trading frontier. Most modern pre-trade tools are capable of calculating these optimal strategies and assessing the difficulty of a trade schedule. However, these calculations are of limited value when it comes to designing and implementing a real-world trading strategy. There are many high frequency variables in the data which are not going to conform to their historic, pre-trade estimates. Factors such as intra-day volatility, spread and predicted volume may vary with each tick; hence the static execution schedule will no longer be optimal.

A workable high frequency trading strategy necessitates a more flexible application of ETF concepts. Rather than calculate a static

## Emerging trends and future direction

Figure 1: Three different execution strategies



execution schedule for a given  $\lambda$  in a utility function  $U = I + \lambda R$ , it is essential to consider incremental changes in utility. Instead of trying to minimise  $U$  for the day, look at the short-term increment  $\Delta U$ , and determine the rate of trading which leads to the maximal improvement in utility. The usual trade off between impact and timing risk is still present but on a shorter time scale. The target participation rate will constantly change, according to the specified  $\lambda$  and actual market

conditions. If observed volatility levels are low, the strategy will slow down without increasing the timing risk estimate. Similarly, it should also respond to the changes in volume and be able to take advantage of unanticipated sources of liquidity.

In summary, a modern IS single-stock strategy should combine a mathematical ETF framework with the flexibility required for trading. That way, the overall urgency of trading conforms to the stated demands, and the strat-

## Emerging trends and future direction

egy delivers better execution quality by reacting to changing market conditions.

### Optimal trading strategies for baskets

The calculations are more complex in the design and implementation of an IS portfolio trading strategy. At this point, let's consider the following questions:

- How does one estimate impact and timing risk for the basket? And what is the correct way to construct an efficient trading frontier in this case?
- How does one take advantage of market opportunities and different sources of liquidity while maintaining the prescribed constraints and urgency of execution?
- How does one accommodate the assorted constraints on the basket (dollar balance/ratio, sector constraints) without sacrificing performance?

A good portfolio trading strategy should address these problems; simply combining single stock IS strategies will not solve any of them.

### Efficient trading frontier – portfolios

The market impact estimate for a portfolio can be calculated by simply adding the market impact estimates of individual trades.

However, aggregating timing risk estimates is considerably more

involved. There are two possible approaches here, although both have their limitations.

The first approach to risk estimation is based upon the use of historic correlation coefficients among the stocks in the portfolio. One problem is that it is difficult to obtain a reliable estimate of a correlation matrix – and virtually impossible to accurately estimate all of the correlation coefficients in large portfolios. Even smaller portfolios require a sample size of several months in order to obtain a meaningful estimate – and there is no guarantee that the obtained values are suitable for intra-day timing risk calculation.

The second approach involves selecting and using risk factors to construct and utilise a model for timing risk estimates. There are some drawbacks here as well: which risk factors to select besides the standard triple (market, size, value); and how to filter out noise in this model. However, with the proper choice of risk factors and sampling intervals, this approach is preferable to correlation matrices.

Once both expected input and timing risk are calculated, it becomes possible to compute the optimal trading strategy for a given  $\lambda$ . Since the market impact is usually modelled as a nonlinear function of participation rate (cf. <sup>4</sup>), this calculation immediately leads to a large nonlinear optimisation problem. For a

4 G. Iori, M. G. Daniels, J. D. Farmer, L. Gillemot et al., 'An analysis of price impact function in order-driven markets', *Physica A*, 324 (2003), 146-151.

## Emerging trends and future direction

portfolio of 300 names the optimisation problem for one day will involve at least  $300 \cdot 13 = 3900$  variables (if the trading day is split into thirteen 30-minute bins). This is pushing the upper limit of capabilities for modern optimisers. Because of this, many existing pre-trade engines settle for an approximate solution in the case of large portfolios. It is crucial to remember that the static optimal schedule has very limited value – more so for a basket of stocks as there are many more variables which can change throughout a given day.

### Dynamic portfolio trading strategies

A dynamic portfolio strategy should satisfy the same requirements as a single stock IS algorithm; being capable of reacting to changing market conditions and consequent updates in statistical estimates.

Let  $\Delta T$  be a relatively short time interval (on the order of a few minutes). The strategy should aim to minimise the change in the utility function ( $\Delta U = \Delta I + \lambda \Delta R$ ) over this interval. This problem may seem intractable, primarily due to the complicated nature of portfolio risk estimates; nevertheless, given a good factor risk model,  $\Delta R$  can be estimated in a relatively simple manner. The key here is to use a well-known concept of MCR (marginal contribution to risk) for each security in the basket.

If  $x(k)$  is the size of the position  $k$  in the basket, then the MCR of this position can be estimated as the partial derivative  $q(k) = \partial R / \partial x(k)$ . Knowing the MCR of the position allows us to estimate how the portfolio risk changes if the position is reduced by some small increment  $\Delta x(k)$ .

Moreover, in terms of short time interval  $\Delta T$ , the overall change in risk can be approximated as

$$\Delta R = \sum_{k=1}^n q(k) \Delta x(k)$$

and the overall change in utility then can be represented as

$$\Delta U = \sum_{k=1}^n \Delta U(k)$$

where  $\Delta U(k) = \Delta I(k) + \lambda q(k) \Delta x(k)$ .

The advantage of this approach is that now the interaction between stocks in the portfolio is eliminated, at least for very short time-frames. Then it becomes possible to find the optimal participation rate for each stock in the basket – that is the trading rate which minimises each individual utility increment  $\Delta U(k)$ . If the strategy then executes at this rate over the period  $\Delta T$ , the result will be optimal for the entire portfolio.

## Emerging trends and future direction

A dynamic strategy adjusts the target rates continuously; therefore, it can quickly react to opportunities that arise from changing market conditions. The Miletus ROBE™ (Risk-Optimized Basket Execution) strategy uses this dynamic approach to control market impact and timing risk.

Note that ‘off-the-shelf’ risk models are not suitable for high-frequency trading applications; it is necessary to develop a robust model calibrated for a shorter time horizon. Based on experience, a three-factor model with sectors as additional risk factors yields superior results when implementing dynamic trading strategies.

It is interesting to note that it is entirely possible for some positions in the portfolio to have zero MCR. In this case they don’t contribute to the overall portfolio risk, and will always be traded at a steady rate (close to that of a VWAP strategy) regardless of the specified value of  $\lambda$ . Some positions may even have negative MCR; subsequently they perform a valuable function of risk reduction on the portfolio level. These positions will be traded at a slower rate – the higher the  $\lambda$ , the slower the rate. Figure 2 (overleaf) shows participation rates for different values of marginal contribution to risk. In general, this shows that simply merging optimal schedules for stocks in the basket may give an

overall portfolio strategy which is very far from optimal.

### Dealing with constraints

The nature of dynamic portfolio trading strategies allows accommodation of many constraints (such as single stock participation rates, portfolio dollar balance/ratio, sector constraints) without a dramatic increase in computational overhead. The challenge is to make the necessary adjustments in a smooth way, without sharply varying participation rates.

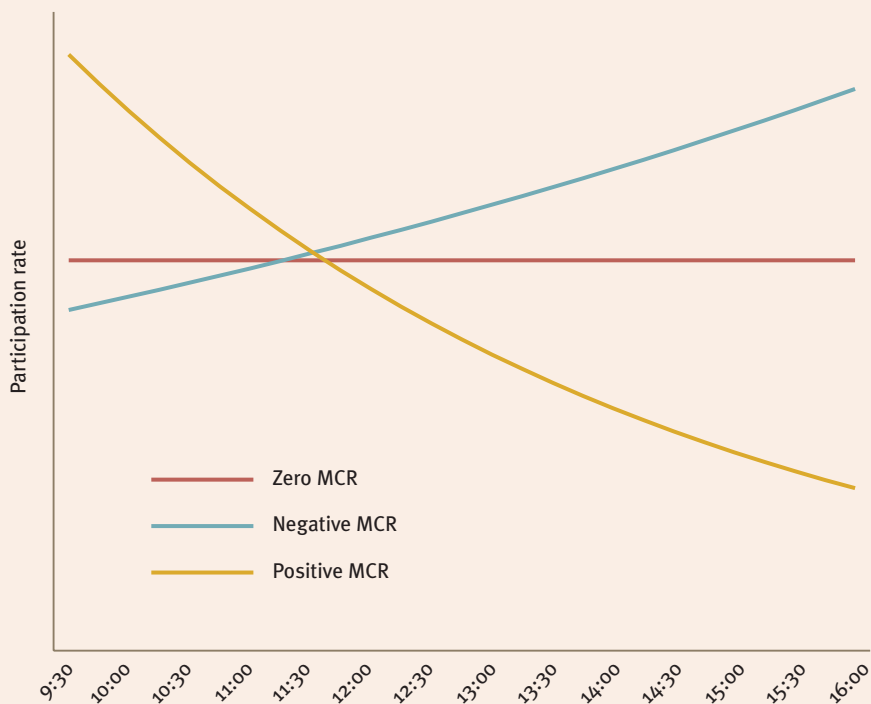
Building participation rate ceilings into a strategy is practical and straightforward to implement. It is less trivial to accommodate ‘hard’ dollar balance/ratio constraints. The optimal way to control risk with a perfectly balanced two-sided basket may result in a temporary imbalance at some point during the day. To achieve a market neutral portfolio, the side with a higher overall beta will execute faster. In this case, the risk model and the customer-imposed constraints contradict each other. The strategy must work within the constraints by selectively adjusting the participation rates or modify a utility function to include a constraint penalty.

### One-sided portfolios

Basket algorithms are also applicable when dealing with a one-sided portfolio; in this scenario the primary

## Emerging trends and future direction

Figure 2: Marginal contribution to risk



objective is to minimise active risk – a tracking error versus a benchmark. Typically the benchmark will be a market index, but custom benchmarks provided by the client can also be incorporated. A basket algorithm used in conjunction with a futures hedge is the best way to minimise market risk when executing a one-sided basket.

It is vital to refine the basket trading algorithm to handle one-sided lists, since it serves as an important tool for several more

complicated trading tasks. Portfolio algorithms are occasionally applied to baskets where the imbalance is 2:1 or more. Moreover, it may be required to maintain this dollar ratio throughout the trading period. The risk management techniques used for balanced baskets are less effective in this setting. The most practical way to trade a portfolio with these constraints is to split it into two one-sided portfolios, and then apply the IS strategy for each of them. This way the

## Emerging trends and future direction

trading schedule for each side is optimal. If the value of  $\lambda$  is the same for each sub-basket, the dollar ratio constraint is easy to satisfy, and only minor adjustments to the participation rates will be required.

In special situations, transition trading may require having separate benchmarks for each side of a balanced basket. For example, if a plan sponsor wishes to reduce his large-cap holdings and replace them with small-cap stocks, it makes sense for him to consider a different benchmark for each side of a transition portfolio. Once again, the portfolio is split into two smaller baskets, and each is traded separately versus a different benchmark – such as S&P 500 and Russell 2000, respectively. The strategy performance is then judged based on the tracking error for each side.

Other varieties and customisations of portfolio trading strategy may be demanded by transition traders. In fact, some transition managers now apply the ETF approach to planning the transition, viewing it as a multi-period optimisation problem<sup>5</sup>. Since a dynamic portfolio-trading strategy is also based on the ETF approach, its use allows the manager a better control over the process of transition.

### Next generation

The next generation of trading algorithms has come a long way

from the static schedules derived from historical U-curves that underpinned the first generation of algorithms. These original algorithms helped traders manage their workload by allowing them to send large lists of stocks for automated execution; the trading logic, however, was applied individually to each stock in the list. Now traders can access advanced algorithms that will trade each stock in the portfolio according to how every other stock is behaving and adapt to continually changing market conditions. The benefits of incorporating real-time risk and market impact analytics will be immediately apparent to index fund managers, hedge funds and transition traders, who desire a risk neutral way to move from one portfolio to another. After these early adopters, usage of basket algorithms will spread to the wider investment community, especially if delivered through an intuitive trading application that allows them to monitor risk and performance in real time and adjust constraints to align the execution strategy with their trading goals. ■



<sup>5</sup> C. Blake, D. Petrich, A. Ulitsky, 'The right tool for the job: using multi-period optimization in transitions', Transition Management, Institutional Investor 2003

# The future of algorithmic trading

What will be the shape of algorithmic trading in the year ahead, as brokers strive for market share and buy-side demand grows for a higher order of intelligence in engineering algorithms?

*Robert L. Kissell\**, *Andrew Freyre-Sanders\*\** and *Carl Carrie\*\*\**

In the last few years, we have witnessed the rapid adoption of algorithms to trade single stocks. Future pundits might call 2005 the ‘year of the algorithm for the institutional equities trading business’. As the institutional trading environment has become more competitive, traders have turned to efficient algorithmic execution. Algorithms like VWAP, TWAP, POV, PEG, SMARKET, and Implementation Shortfall are all part of the traders arsenal when executing single stock orders. A recent survey of buy-side traders indicates that the drivers behind the trend of algorithmic adoption are: (1) control over the trading process, (2) ability to focus on value added activities, and (3) cost control. In addition to these gains, trading algorithms have allowed

firms to trade stealthily to reduce both the explicit and implicit trading costs by lowering commissions and reducing impact costs.

## Fast forward to 2006

In 2006, the battle for market share in the algorithmic space will extend across the European, Latin American and Asian markets. In the Americas we will likely see more creative algorithmic deal making as broker/dealers will struggle to remain competitive in the ‘low-touch’ segment. As buy-side firms continue to reduce the number of execution partners in their efforts to increase cost-efficiencies, many small broker/dealers will not be able to commit the required financial resources needed to remain competitive in the low-touch DMA and algorithmic segment of the market.

**\*Robert L Kissell**,  
vice president,  
Global Execution  
Services,  
JP Morgan

**\*\*Andrew Freyre-Sanders**,  
head of Algorithmic  
Trading, EMEA,  
JP Morgan

**\*\*\*Carl Carrie**,  
head of Algorithmic  
Trading, USA,  
JP Morgan

## Emerging trends and future direction

■ “Sustaining algorithmic performance will require new investment in low-latency market data and order connectivity.”

Algorithmic trading requires substantial research and development. While many firms were able to develop first generation algorithms with reasonably small measures of dispersion around targeted benchmarks, it has become increasingly clear that benchmark performance (or transaction cost analysis) will become more of a competitive differentiator and require more sophisticated financial engineering. Additionally, sustaining algorithmic performance will require new investment in low-latency market data and order connectivity to fragmented exchanges, ECNs, alternative crossing networks and inter-listed market centres. Service desks may also require new ‘high-touch’ services such as consultative meetings with their algorithmic analysts, interactive algorithmic order and execution analysis and algorithm-of-algorithms analytics for trading baskets.

A rapidly changing and highly competitive landscape for algorithmic trading in 2006 will encourage

some broker/dealer algorithmic providers to creatively partner with vendors and other broker/dealers, while some clients will look to outsource dealing and/or partner to create unique competitive advantages in capabilities and cost structure.

### Trading analytics

New pre-trade capabilities provide traders and investors with the required transparency to specify appropriately chosen algorithms. They provide portfolio managers with liquidity information as well as algorithm risk and cost breakdowns. Some of the new measures that are becoming part of the new standard execution terminology, include: Market Impact, Timing Risk, Risk Contribution and Trading Difficulty. It’s possible that these sensitivities will become as critical to stock traders as Delta, Vega and Gamma are for options traders.

Determination of appropriate algorithms and algorithmic parameters is much easier with accurate information on pre-trade liquidity, difficulty, cost and risk analytics. Investors need to first determine if the execution is suitable for algorithmic trading, and if so, which algorithm and algorithmic parameter are most consistent with the overall investment objective. All too often, funds incur unnecessary

## Emerging trends and future direction

slippage due to improper selection of execution strategy, which translates directly to the bottom line in terms of decreased returns.

### Performance enhancing algorithms

Increasingly, clients will also demand flexibility with algorithmic parameters such as volume limits, adjustments for special trading days such as half-day trading sessions or FOMC days, or dynamic market adjustments based on price momentum and other variables. Refinements in the core of these algorithms, whether they are called Limit Order Models or Micro-Order Submission Models, will also provide improved trading results.

Another area for active development will be to prevent information leakage and algorithmic gaming. Even experienced traders risk unintentionally signalling their order to the marketplace, whether they are using an algorithm or not. They can see it in slippage or feel it in the pattern and delays in fills. As algorithms have become more popular, information leakage and gaming have become part of the broader debate about algorithms and the benchmarks to which they are often tied. In fact, the default benchmark for many traders, VWAP, has often been criticised because of the ‘push’ associated with the dis-

“Information leakage and gaming have become part of the broader debate about algorithms and the benchmarks to which they are often tied.”

ciplined bucket trading, no matter how much the venue, size and time between trades is randomised. One of the areas of algorithmic development that has received little press coverage is the increased amount of work being undertaken on algorithms to reduce information leakage.

Algorithmic trading requires investors to specify rules on a macro level while each micro-order is automatically determined by whatever parameters the Optimisation sets the algorithm to. For example, on the macro level investors are required to specify their benchmark price (e.g., Decision Price, Arrival Price, etc.), choice of algorithm and set of parameters. While price benchmark is tied closely to the portfolio manager’s investment goal, algorithm and parameters should adapt to changing market conditions and prices. It is more difficult to ascertain how the algorithm should adapt to changing market condition and prices. Micro level decisions govern the price of limit

## Emerging trends and future direction

“Algorithmic developers are racing to adapt new and existing algorithms to handle new market complexities, ranging from regulatory missives to capital commitment to illiquid stocks.”

orders, frequency of market orders, randomness of size and quantity, intervals between order submission, and appropriate trading venue. These micro level rules are in place to ensure that actual transactions follow the optimally prescribed strategies.

One popular parameter uniquely available to JP Morgan’s Implementation Shortfall algorithm is the ability to change the distributional characteristics versus the price benchmark. An important point is that with any adaptation strategy (e.g., adjust participation rates based on price ‘moneyness’), traders need to be comfortable with the changing cost profile to ensure potential costs are consistent with the investment objectives. For example, an adaptation strategy that becomes more aggressive in times of favorable prices and less aggressive in times of adverse price movement (e.g., Aggressive In-the-Money, ‘AIM’) will incur better prices on average but increases negative risk exposures (e.g., the

probability of realising unfavorable prices). An adaptation strategy that becomes more passive in times of favourable price movement and more aggressive in times of adverse price movement (e.g., Passive In-the-Money, ‘PIM’) will incur less favourable prices on average but with reduced downside risk.

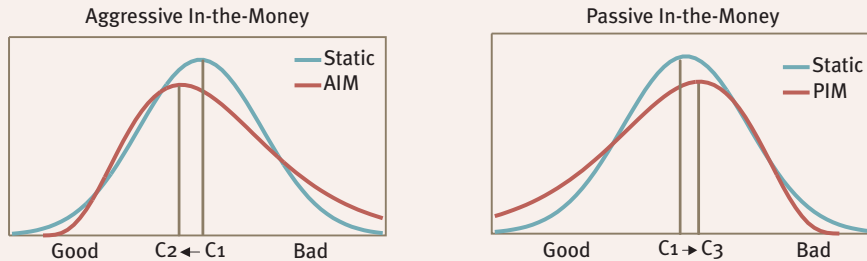
Potential shifts in cost profile are shown in Figure 1 against a normal ‘no adaptation tactic’.

In 2006, hedge funds and sophisticated asset managers will start to use new kinds of algorithms that are not tied to a traditional benchmark. For example, JPMorgan has released a smart market algorithm (SMARKET) that tries to improve the price of sending a market order by dividing an order into multiple, but aggressively priced, limit orders that will convert to market orders if the orders expire without being filled.

Algorithmic developers are racing to adapt new and existing algorithms to handle new market complexities, ranging from regulatory missives to capital commitment to illiquid stocks. New protected quote and fast/slow market handling will imply additional complexity for smart order routers and algorithms. The rise of NYSE flow in crossing engines and other third market venues will increase the need for algorithms to consolidate the disparate pools of liquidity, leveraging

## Emerging trends and future direction

**Figure 1**



fill rates and latency information accordingly. Similarly, increased capital use for small and mid caps will be increasingly automated by algorithmic market making.

### Portfolio algorithmic trading in 2006

Portfolio algorithmic trading is likely to emerge as the most significant algorithmic capability in the market. Several market participants have announced portfolio algorithmic offerings. Some market participants will mimic the single stock paradigm of sending orders via FIX directly to a portfolio algorithm, while others will use a combination of FIX and rich web interfaces to provide extended capabilities.

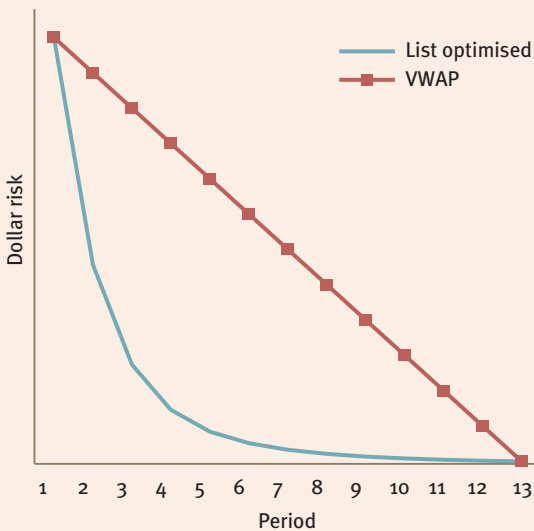
Are single stock algorithms appropriate for portfolios? While ‘algorithm conjurers’ have developed systems to trade and track benchmarks like VWAP and Arrival Price or the current Close

or a specific targeted volume percentage – all of these algorithms were developed to work with single stocks in mind. However, single stock algorithms are cumbersome and unwieldy when applied to portfolios. The trader needs to minimise information leakage across the list, which is generally a bigger challenge than working a single name. When a portfolio is traded, the trader will typically want to apply basket level constraints such as setting the maximum share as a percentage of ADV for any individual name. Not every trader has the same risk tolerances. When the market starts to drop, in order to limit unintended risk (i.e., sector, dollar, or beta skews) the trader must more actively manage the execution of the basket, which greatly increases the potential of information leakage.

Some industry experts have described the emergence of a new

## Emerging trends and future direction

FIGURE 2



class of algorithmic trading for portfolios as the ‘algorithm-of-algorithms’. While a lofty moniker for an algorithm, it conveys the essence of a higher order intelligence controlling an array of algorithms. Figure 2 compares the reduction in risk achieved from an optimal algorithm-of-algorithms approach to a VWAP strategy for a long/short basket. The optimal approach should reduce the risk of adverse price movement much more quickly than trading the portfolio by merely applying VWAP across all tickers to reduce market impact costs alone. A VWAP strategy only provides a linear reduction in risk, whereas an optimal strategy provides a rapid

non-linear risk reduction for a small increase in market impact costs. The individual names in a basket do not trade independently of the market or each other – they are inherently correlated.

A new type of tool is needed that provides a much richer framework for optimally working a portfolio and aligning the execution process with the portfolio construction process. At the core of this new tool would be an optimiser that would determine the efficient trajectory to: reduce trading costs, resulting from market impact cost and price appreciation (alpha decay); manage intraday risk, resulting from price volatility and covariance of price movement across all names in the portfolio; and manage liquidity risk, the uncertainty associated with daily volumes and intraday volume profile. In this context, a trading optimiser does not generate a trade schedule like traditional investment optimisers, but rather dynamically translates the intraday trading trajectory directly into algorithm parameters.

### The TAO of trading

JPMorgan is currently using an optimal algorithm-of-algorithms in its portfolio trading business and a modified version of it in its algorithmic market making effort. The system is called TAO (‘Trading

## Emerging trends and future direction

Algorithmic Optimizer’). TAO has been designed to reduce trading costs and manage risk and liquidity intraday, as outlined above. It will be available to trading clients later this year. TAO is an algorithmic trading system for portfolios that incorporates an interactive web page which can integrate directly into the traders OMS. TAO allows the trader to review pre-trade analytics, configure algorithmic parameters, optimise to an optimal ‘Efficient Trading Frontier’ list of algorithms, and monitor execution performance against multiple benchmarks in realtime, all from one web screen.

TAO will dynamically readjust all of the algorithms and their

parameters based on trader-supplied constraints, the system’s knowledge of the portfolio composition, what has been traded, market prices and any other information it can derive or obtain. Now imagine if there was some optimal level of trading for each ticker. In this scenario, the optimal algorithm-of-algorithms would rebalance the portfolio and all of its worker algorithms according to centralised information and intelligence, but executed in a distributed fashion. ■



The information contained herein is provided for information only, and any views or opinions expressed herein are solely those of the individual authors and may differ from the views and opinions expressed by other departments or divisions of JPMorgan and its affiliates.

JPMorgan is the marketing name for JPMorgan Chase & Co. and its subsidiaries and affiliates worldwide. J.P. Morgan Securities Inc. is a member of NASD, NYSE and SIPC. The JPMorgan Chase Bank is a member of the FDIC. J.P. Morgan Futures Inc. is a member of the NFA. J.P. Morgan Securities Ltd. is authorized by the FSA. J.P. Morgan Securities Asia Pte Ltd., (JPMSA) and J.P. Morgan Securities (Asia Pacific) Limited, are regulated by the Hong Kong Securities & Futures Commission. JPMSA is regulated by the Monetary Authority of Singapore and the Financial Services Agency in Japan. Issued and approved for distribution in the UK and the European Economic Area by J.P. Morgan Securities

Ltd., J.P. Morgan Europe Limited and J.P. Morgan plc, members of the London Stock Exchange and regulated by the Financial Services Authority. Issued and distributed in Australia by J.P. Morgan Australia Limited and J.P. Morgan Markets Australia Pte. Securities Limited which accept responsibility for its contents and are regulated by the Australian Securities and Investments Commission. J.P. Morgan Markets Australia Pty. Ltd. is a licensed investment advisor and a futures broker, and it is a member of the Sydney Futures Exchange. J.P. Morgan Securities (Far East) Limited Seoul Branch is a member of the Korean Stock Exchange and J.P. Morgan Futures (Korea) Limited is a member of the Korean Futures Exchange. In the UK and other EEA countries, this commentary is not available for distribution to persons regarded as private customers (or equivalent) in their home jurisdiction. Copyright 2005 JPMorgan Chase & Co. All rights reserved.

# The TRADE guide to broker algorithms

115

Reprinted from The TRADE, Issue 3, Jan-Mar 2005

## Banc of America Securities Electronic Trading Services™ (ETS)

The Electronic Trading Services™ (ETS) group, part of Banc of America Securities' global equities platform, was formed in February 2004. ETS is dedicated to developing and delivering a suite of electronic trading products to institutional investors. The formation of ETS followed the 2003 acquisition of Vector Partners, a quantitatively driven broker-dealer providing algorithmic, block and portfolio trading technology, which served as a foundation for the development of new client solutions. Shortly after ETS was launched, the acquisition of Direct Access Financial Corp. (DAFC) was announced, a provider of direct access technology, extending ETS' technology platform. Today, ETS offers a comprehensive algorithmic toolkit and has hundreds of clients subscribing to its algorithmic trading services.

ETS' consultative approach to sales ensures that clients are 'couriered' through the system by experienced professionals who are accountable at every stage of the customer cycle. ETS has a team focused on improving the performance of its algorithms. New anticipated product introductions include average price stop, enhanced transaction analysis tools and broader connectivity options.

### Trading benchmarks

ETS has both agency and principal strategies with both single stock and list capabilities. Eight strategies are currently offered to clients: VWAP, TWAP, TVOL, Razor, Market on Close, Arrival Price, Market Call and Premier Block Trading™ (PBT), an electronic and anonymous block liquidity utility for orders up to \$20 million for the entire Russell 1000 stock universe.

### Flexibility & customisation

Algorithms have different settings (passive, neutral and aggressive) to create distinct execution profiles for each trade. ETS is committed to understanding its clients trading objectives and providing the tools to achieve their goals. To this end, it partners with clients to customise existing algorithms, as well as to develop proprietary models – a feature which many clients take advantage of.

### Performance measurement

Performance measurement is seen as critically important and ETS offers a comprehensive range of post-trade data and analytics.

### Connectivity options

Clients can connect via Bloomberg front end and a variety of trade and order management systems. These include Advent, BRASS, Charles River, Fidessa, FlexTrade, InstaQuote, LatentZero, LongView and Macgregor. In February 2005, ETS added Reuters to the list of third party connections. ETS is also available via FIX connections.

## BNY Brokerage

### Direct Execution Services (DExSM)

**A**lgorithmic trading is an important growth area for BNY Brokerage overall and for its DExsm (Direct Execution Services) platform, launched in the third quarter of 2004. Delivering the benefits of algorithmic trading to clients has been part of an ongoing effort and clients have access to the same platform and trading tools that BNY has used on its trading desk for years. Whether a client delivers algorithmic orders to the program trading desk or works algorithmic orders into the marketplace themselves, a ‘pure agency posture’ means that BNY’s services are ‘conflict-free’.

Today, 60% of its clients make use of its algorithms. BNY reports increased usage of algorithms as part of its clients’ trading strategies and anticipates a steady rate of at least 30% growth in the next year. As part of its development plans, BNY is looking to integrate pre- and post-trade reporting into its DMA platform.

---

#### Trading benchmarks

BNY does not place benchmark constraints on its algorithmic offering. Algorithms can be executed across a ‘myriad’ of customer-driven benchmarks.

---

#### Flexibility & customisation

Clients can customise the behaviour of algorithms by setting parameter values. Using the DEx platform clients can also create their own algorithms. Customisation remains an area of differentiation for BNY and it plans to continue to focus on providing clients with bespoke algorithms.

---

#### Performance measurement

Clients are provided with same day execution quality reports, as well as customised pre- and post-trade reports, which include impact studies, liquidity screens, confidence intervals and straightforward P&L.

---

#### Connectivity options

BNY is regularly expanding its connectivity to the third party provider used by its clients. Connections have been established with all the leading OMS and network providers, including Bloomberg, Macgregor, Charles River, LongView, Eze Castle and, most recently, since January 2005, SunGuard Transaction Network (STN). Traditional means of connectivity via FTP, VPN, email and the internet are also available. BNY is fully FIX compliant.

## Citigroup

### Alternative Execution

Algorithmic trading is a ‘critical’ component of Citigroup’s brokerage business. In 2004, it established its Alternative Execution division. There are now over 30 institutions connected in Europe alone using its algorithms. Citigroup has backed its commitment in this area with high levels of investment. In 2004, it acquired Lava Trading, a provider of high-performance trading solutions, to enhance its capability in all aspects of electronic trading.

Algorithmic models are built to take into account idiosyncrasies at market and single stock level and are ‘extensively’ tested on internal flow before being made available to clients. When designing the core components of its algorithms, stealth is as much a concern as performance and reliability. Clients are provided with the same algorithms that are used on the algorithmic trading execution desk.

Inherent in the design of Citigroup’s algorithmic solutions is ‘the requirement to improve the trading process.’ To this end, a premium is placed, now and in the future, on offering clients a comprehensive consultancy service to enable them to select algorithms to best suit their trading strategies.

#### Trading benchmarks

There are four core benchmarks: VWAP, TWAP, MOC and Participation. Clients can choose one of these or create a hybrid of a standard benchmark.

#### Flexibility & customisation

Clients have ‘full control’ of orders, which can be modified in real time. The algorithmic models are designed to be flexible. This flexibility enables templates to be designed for clients, which allow them to select benchmarks to fit individual trading strategies. Algorithms are also tailored in line with market dynamics, ensuring that an algorithm built for a highly liquid market is not used to trade in a low liquidity environment, for example.

#### Performance measurement

In early 2004, Citigroup acquired Best Execution Consulting Services (BECS), an independent web-based provider of transaction cost analysis. Through this service clients can evaluate the performance of Citigroup relative to other brokers.

#### Connectivity options

Anyone with a FIX compliant system can connect with Citigroup’s algorithms. This includes the majority of order management systems in use around the world. Clients who are not FIX compliant can access Citigroup’s algorithms via Citigroup’s Algorithmic Trading execution desk, or via Bloomberg front end.

**CSFB****Advanced Execution Services (AES™)**

CSFB launched its Advanced Execution Services (AES™) in 2002, making it the first major broker to offer an algorithmic trading service. Today, AES operates consistently in over 20 countries across Europe, US and Asia. With close to 400 clients using AES directly in 2005, CSFB remains one of the principal providers of algorithms to the buy-side and extends ‘best of breed’ algorithms to clients, as used by in-house traders.

Algorithmic trading is a major component of equity trading revenue, with a number of CSFB’s large clients currently aiming to direct 25% to 35% of their order flow to algorithms.

Client anonymity is given the highest priority and CSFB prides itself in protecting AES users from any form of information leakage. Orders are processed without manual intervention, protecting the identity of AES’ clients. CSFB has approached external auditors to discuss the feasibility of third party verification of the anonymity that AES offers clients.

To retain and attract clients, CSFB seeks to continually improve execution performance. One way of doing this will be to take advantage of internal crossing. Service enhancements will be introduced in such a way to ensure that anonymity is never compromised.

**Trading benchmarks**

AES tactics are designed to work towards a number of benchmarks. The main ones used are Slippage from Arrival Price, reducing market impact, VWAP and In Line with Volume. More complex algorithms are being made available such as PhD, which is designed to optimise program trades.

**Flexibility & customisation**

Algorithms are optimised to work with default settings designed to produce best performance. However, parameters can be adjusted to fit a client’s trading style, allowing for a more aggressive strategy, for example. If necessary, CSFB will build unique algorithms for a client.

**Performance measurement**

CSFB can provide clients with same day execution performance for their AES trades. An internal execution performance analysis tool, ExPRT, is used to measure execution performance against a range of data points including start, mid and interval VWAP. Performance can be measured on an order-by-order basis or overall by ticket size, sector, market, tactic etc. A feature called ‘storyboard’ provides clients with real-time information on events in the stock they are trading.

**Connectivity options**

Clients can access AES via any FIX-enabled OMS. A large number of vendors, including Bloomberg and Reuters, have developed full AES functionality on their order entry tickets, allowing clients to adjust the variable parameters available for an AES tactic.

## Goldman Sachs

### Goldman Sachs Algorithmic Trading (GSATsm)

Goldman Sachs was one of the first brokers to enter the algorithmic trading space following their acquisition of Spear, Leeds & Kellogg. GSAT views algorithmic trading as integral to the growth of its equity business and expects buy-side demand in this area to increase steadily. Currently, over 35% of Goldman Sachs' equity flow on any day is executed through their algorithmic trading desk and the firm expects the combined volume of equity trade run through algorithms, program trades and electronic trading to increase to as much as 65% by 2006.

In terms of product development, GSAT is focused on deepening its market coverage through a global, multi-asset offering. And it is committed to creating 'smarter' algorithms that give clients a broad range of customisable parameters to trade ever more complex benchmarks.

#### Trading benchmarks

The prevailing benchmarks of choice used by clients are VWAP and Implementation Shortfall. Other commonly available benchmarks include Piccolo (Small Order Spread Capture algorithm) and TWAP. GSAT's newest algorithm, 4CAST, explicitly balances market impact against opportunity cost.

A number of customised algorithms have been created to match unique, customer-driven requirements and GSAT intends to widen its focus to meet other benchmarks as identified by clients.

#### Flexibility & customisation

By adjusting a wide range of available trading parameters, GSAT says that a 'significant' degree of customisation can be undertaken to fit a particular execution style. GSAT occasionally develops customised solutions for its 'best clients' as required.

#### Performance measurement

Goldman Sachs' electronic trading platform and order entry system, REDIPlus®, offers a range of analytical tools for order performance monitoring (pre-trade, real time and post-trade), encompassed in a system entitled 'The Guide'. This system also provides trading estimates from GSAT's proprietary cost model and other statistics to help the user understand what the algorithm is thinking prior to submitting the order.

#### Connectivity options

REDIPlus provides clients with access to GSAT's algorithms. The models are also accessible via third party OMS vendors, FIX connections or Bloomberg.

## Instinet

### Algorithmic Trading Group

Instinet believes that its ‘unconflicted’ agency-only business model leaves it well positioned in the algorithmic space. Its algorithmic trading platform provides access to 40 markets worldwide and is utilised by over 1,500 clients in North America, Europe and Asia. The rules-based trading solutions offered by Instinet allow clients to select and use those rules which meet their specific trading requirements. As an agency-only broker, there is no proprietary trading and thus no risk to the client of information leakage benefiting an internal trading desk. Externally, trading performance is constantly monitored and adjustments undertaken as necessary to ensure there is no ‘front running’ in the market.

In the future, Instinet intends to expand the range of rules in order to reduce the ‘true’ total cost of trading for clients (implicit and explicit). And leveraging its unconflicted business model, increasing emphasis will be placed on customised solutions. Instinet concurs with industry estimates and expects institutions’ use of algorithmic trading to double by 2006.

#### Trading benchmarks

Algorithms meet the following benchmarks: VWAP, TWAP, TVOL, Arrival Price, Risk Arbitrage, Pegging, Discretion and Spread (Pairs) Trading.

#### Flexibility & customisation

Algorithms are configurable through multiple rules-based parameters. In a pairs trade, for example, through Instinet’s risk arbitrage pairs rule a client can specify a variety of settings including the cash component of a deal, the cash improvement they are seeking or the percentage improvement.

Instinet works with clients to create customised algorithms to suit particular investment strategies and minimise transaction costs.

#### Performance measurement

Instinet’s proprietary Newport™ portfolio trading system allows intra-day and post-trade analysis to multiple benchmarks. Clients are also encouraged to make use of reports from third-party transaction cost specialists such as Plexus Group and Abel/Noser, who measure the execution quality of hundreds of brokers.

#### Connectivity options

Instinet’s algorithmic trading service is accessible via FIX connection, Newport and the Instinet Trading Portal® front end, in addition to many third-party order management systems.

## Investment Technology Group (ITG)

### SmartServer™

As an agency-only provider of quantitative trading solutions, ITG avoids conflicts of interest arising in connection with proprietary trading. Algorithms are available via ITG's SmartServer™ service. ITG describes its SmartServer strategies as 'intelligent trading destinations that auto-execute trades according to a pre-defined trading strategy.' Currently around 150 clients across the globe use ITG's algorithms. Between 30 and 40 million shares a day are traded via these algorithms, representing approximately 40% of ITG's total trading volume. The company anticipates that this will climb to as high as 80% of its overall volume in the next five years.

Clients have access to the liquidity of ITG's POSIT®, the intra-day equity crossing system. A proprietary front-end system, TRITON™, meanwhile, offers a complete set of integrated execution and analytics tools. It allows clients to route orders to more than 75 destinations and access ITG's proprietary pre-trade, execution and post-trade analytics.

#### Trading benchmarks

The standard benchmarks offered by ITG's SmartServer service include VWAP, TWAP, Implementation Shortfall (Decision Price) and Market Close. However, SmartServer users are not constrained by these and can apply customised benchmarks, giving traders the ability to switch between different strategies in response to changes in market conditions.

#### Flexibility & customisation

ITG offers strategy customisation on both client desktops as well as the server side. Using SmartServer and TRITON, clients are able to modify strategy parameters and distributions in real time. TRITON allows clients to customise further on top of a 'black box' strategy and write their own trading rules and algorithms to auto-trade. Custom strategy servers are built for specific clients.

#### Performance measurement

A variety of tools are available to measure the performance of SmartServer algorithms. These include a performance attribution tool that monitors execution, strategy profile deviation and execution price deviation. Clients using TRITON have access to ITG ACE® for pre-trade cost estimation and ITG Risk™ for predicting and managing volatility. Clients can use ITG eXtra real-time performance measurement or ITG TCA® for post-trade measurement across multiple destinations, markets and brokers.

#### Connectivity options

SmartServer can be accessed directly via a FIX connection from users' order management systems and via the TRITON trading interface.

## JPMorgan

### Electronic Execution Services

JPMorgan considers algorithmic trading a core part of its business strategy, both for internal trading and client distribution services. A ‘highly quantitative focus and pedigree’ has had a major impact on product development, which has been steered by its proprietary statistical arbitrage group. There are currently around 50 clients globally using the company’s algorithms. The focus with this client group is on equipping them with an understanding and approach that will help them use algorithms to best effect, not just as a ‘black box’ trading tool.

The focus moving forward is on building a comprehensive trading toolset, encompassing strategies for execution along with tools for trade optimisation and decision support. Considerable emphasis is placed on developing a ‘more pervasive, flexible and transparent product’ that is integrated seamlessly into the trader’s workflow. A significant increase in algorithmic trading is anticipated in the next two to five years.

#### Trading benchmarks

A ‘strong concentration’ on flexibility, permits both complex and simplified ‘parameterisation’ based on client preference. Strategies target a variety of benchmarks, including VWAP and Implementation Shortfall (Arrival Price, Close Price) and a ‘trader pre-defined benchmark.’

#### Flexibility & customisation

The quantitative team works with clients to create customised algorithmic and connectivity solutions specific to their requirements. JPMorgan’s development effort has concentrated on expanding upon its core limit order model or ‘micro-placement’ strategy. Algorithms are built as ‘wrappers’ around this model for use alongside clients’ existing benchmarks.

#### Performance measurement

End of day reports are sent to clients on an order-by-order basis, supported by benchmark performance statistics. Online post-trade tools, which allow clients to independently verify any trade that is undertaken intra-day against a range of benchmarks, are also provided.

In February 2005, JPMorgan announced that it would be launching a pre-trade analytics service accessible via Bloomberg’s Execution Management Service. The service will allow clients to select the algorithm best suited to meet their trading objective.

#### Connectivity options

JPMorgan is connected to all the major third-party order and trade management systems for order and algorithmic routing.

## Lehman Brothers

### LMX™

Lehman Brothers' LMX™ was launched in 2004. LMX users receive the benefit of Lehman Brothers' 'one firm' philosophy, which allows clients to maximise the efficiency and effectiveness of their relationship with the company. Lehman Brothers seeks to differentiate itself through its distribution and service models, leveraging its existing sales and support channels. Hundreds of clients benefit from the use of LMX algorithms, either directly via its Direct To Model™ access channel, or indirectly through its Execution Service platform. On average, over \$3 billion a day is executed globally using LMX strategies.

LMX was established in response to client demand and its future direction will also be shaped by that demand. There are two areas of enhancement that users of its algorithms have highlighted: better guidance around strategy and strategy parameter selection, and tighter analytic integration before, during and after the trade. Lehman Brothers is in the process of building new functionality to complement its strategies in these areas.

#### Trading benchmarks

LMX strategies support all major trading benchmarks, including VWAP, TWAP, Arrival Price (Implementation Shortfall) and Closing Price.

#### Flexibility & customisation

The recently released strategy concept, Conditional Autotrading, permits LMX users to customise their strategies 'on the fly' as well as to save 'favourite' strategies for easy re-use. It provides traders with a 'toolkit of algorithmic building blocks' that can be assembled to create hybrid

strategies. For clients whose needs are not met by the new concept, Lehman Brothers' team of strategy engineers can work with them to create bespoke strategies.

#### Performance measurement

Standardised and customised execution cost analysis services are available globally on both a self-service and a full-service basis. Lehman Brothers' cost analysis capability is driven by Portfolio WebBench, a web-based toolkit for pre-trade, intra-trade and post-trade analysis.

#### Connectivity options

Direct to Model is an algorithm connectivity solutions suite, which allows clients to directly access LMX strategies from a wide variety of front ends, including proprietary or third party OMS or execution management systems such as LehmanLive® LINKS™.

Recently formed alliances with major OMS vendors such as Macgregor and Neovest demonstrate Lehman Brothers' continuing resolve to bring its product to buy-side traders' desks.

## Merrill Lynch

### Merrill Lynch Execution via Algorithm and Computer-based Trading (ML X-ACTSM)

Merrill Lynch went live with ML X-ACTSM, its algorithmic and computer-based equity trading platform, in the third quarter of 2003, extending access to clients in the first quarter of 2004. Originally designed for US equities, as strategies have been added it has expanded its coverage to Europe and, most recently, Asia, and now offers its institutional clients access to over 40 markets.

The X-ACT algorithmic trading engines have been developed in-house and utilise a variety of benchmark-related strategies driven from a single architecture, which, at its core, is based on market microstructure research and extensive quantitative data infrastructure. All ML X-ACT strategies are based on this structure to minimise transaction costs. Each strategy uses historical and forecasted stock-specific statistics to determine when, how much and how frequently to trade.

#### Trading benchmarks

Strategies are continuously re-calibrated in response to real-time market data, execution costs and benchmark relative performance. ML X-ACT strategies aim to achieve or outperform a number of defined benchmarks: OPL (Optimal), QMOC, VWAP, CLOCK (a TWAP engine), POV (Percentage of Volume) and TWIN (trades two stocks based on a price per ratio or spread).

#### Flexibility & customisation

Using ML X-ACT's integrated, interactive screens, clients can customise their orders by setting a number of input parameters and constraints, including start and end times, target participation rate, maximum participation rate and risk aggressiveness factors, which determine the level of risk and aggressiveness versus the benchmark.

#### Performance measurement

Merrill Lynch's Global Equity Analytics (GEA) application provides portfolio analytics and trading tools that combine proprietary quantitative data models with both real-time and historical data from Bloomberg.

#### Connectivity options

Clients can connect to ML X-ACT through three primary channels: via an equity sales trader, direct through a two-way FIX connection, or from their desktop through a third-party OMS or front-end system.

## Morgan Stanley

### Benchmark Execution Strategies (BXS)

**A**lgorithmic trading is a key element of Morgan Stanley's electronic trading business and central to its overall equity operation. The same tools that are available to clients are also used by internal traders in the client businesses and form an important part of the overall execution platform for Morgan Stanley's traditional cash business, portfolio trading business and futures business.

The Benchmark Execution Strategies (BXS) algorithmic trading platform was developed in 1996 as a tool for Morgan Stanley's portfolio trading desk and was extended to clients in 2001. BXS focuses on minimising transaction costs and impact to relevant trading benchmarks. Consulting with clients throughout the trade life cycle ensures implementation methodology and investment objectives are aligned for optimal execution. Over 500 individual client organisations utilise BXS algorithms.

Plans include the further development of its global platform, increasing the range of products offered across asset classes and improving execution.

---

#### Trading benchmarks

Algorithms are constrained to meet a number of benchmarks, including VWAP, Arrival Price (Implementation Shortfall), Close and Target Percentage of Volume.

---

#### Flexibility & customisation

The BXS platform allows for customisation of a number of parameters such as duration, trading aggressiveness, limit prices and volume limits.

---

#### Performance measurement

Two levels of performance measurement are offered. The first is a daily 'ScoreCard' of all trades executed electronically, which analyses trades against a series of benchmarks and applies internal statistics to each trade. Second is a product called Execution Performance Attribution (EPA), a web-based tool that allows a client to perform interactive analysis of all their trades across multiple brokers. Using EPA, clients gain further insights into their trading costs by segmenting trades by broker, sector, trader and portfolio manager.

---

#### Connectivity options

BXS is accessible via Passport, Morgan Stanley's trading portal, a front end that is accessible via the internet or Microsoft Excel. Access is also available via customised FIX connections to proprietary OMS and vendor OMS. Well-established partnerships with leading OMS vendors such as Charles River and Macgregor ensure that BXS is easily accessible to clients.

## Piper Jaffray

Piper Jaffray seeks to deliver the most ‘advantageous execution price’ for its clients’ orders. It lists a number of key features that help achieve this objective: price predictive modelling technology, customised execution strategies and order types, a highly automated trading process and easily scalable infrastructure. Together this contributes to minimise information leakage and overall market impact.

In 2004, Piper Jaffray acquired Vie Securities, a provider of algorithm-based, electronic execution services. The acquisition, which included proprietary algorithms, direct market access systems and licensed trading technology, was undertaken to help meet increasing client demand for automated, cost-effective execution capabilities and, in particular, requests for ‘value-added’, algorithm-based trading services.

Algorithms employ short-term predictive signalling techniques to determine the optimal execution timing, trading period, size, price and execution venues, while minimising market impact. In terms of future development, work is ongoing to improve the performance of the algorithms, with a focus on building greater speed and predictive capability.

### Trading benchmarks

Algorithms are constrained to the following benchmarks: Implementation Shortfall (Arrival Price), guaranteed VWAP, best efforts VWAP, TWAP, Market on Open (MOO) and Market on Close (MOC).

### Flexibility & customisation

Piper Jaffray collaborates with clients to achieve the best execution for each order,

providing customised solutions and tailored trading strategies to meet specific client benchmarks.

### Performance measurement

Pre- and post-trade analytics are used to optimise execution performance. Real-time updates are available on all executions. By applying real-time analysis across a range of market factors, a model can be formulated of the expected price and volume for a given stock in one to three minutes. Execution reports and status updates are delivered to clients upon request and/or when market activity suggests an adjustment in trading approach could yield improved results.

Independent, third party, post-trade analytics are also available for all trades detailing market impact and performance against all major benchmarks. This is considered a ‘vital feedback loop’ in helping refine trading strategies to maximise execution performance and minimise risk.

### Connectivity options

A team of communication and software engineers is on hand to assist clients with connectivity from all order management systems through FIX, FTP, email or Instant Messaging. Customised FIX connections have been created that support advanced order types and algorithmic trading.

## UBS Investment Bank

### Direct Strategy Access (DSA)

**D**irect Strategy Access (DSA) forms a core part of UBS Investment Bank's execution offering. DSA is offered to clients as part of UBS' sales trading-based service. Clients also have the option to trade completely anonymously.

To facilitate access to liquidity, UBS has built iXt (intelligent eXecution technologies), which locates the best possible price across multiple exchanges, ECNs or internally within UBS Investment Bank. Its proprietary strategy tools have been designed to predict trading trends, combining historical tick data with real-time market data analysis and quantitative models, to provide optimal execution.

UBS highlights its commitment to the continuing development of its electronic execution products. As part of its algorithmic offering, UBS intends to develop new and customised strategies, as well as providing more analytics tools and reporting, open new markets and expand into derivatives.

#### Trading benchmarks

The following strategies are available: VWAP, TWAP, INLINE, HIDDEN, PIN, MOC, PRISM (Implementation Shortfall). UBS' strategy engine uses a variety of benchmarks to achieve best execution; for example, a VWAP strategy, whilst trying to achieve a VWAP benchmark, will also monitor other benchmarks such as volume change and price movement.

#### Flexibility & customisation

Algorithms are 'fully customisable' and support start/stop times, volume targets and volume caps. Price limits and use of all the exchange order types where applicable.

#### Performance measurement

UBS Equity Trader, a web-based electronic trading platform, provides real-time updates. Clients that want to conduct their own post-trade analysis can use UBS Strategy Console, a real-time monitoring and graphing tool, for this purpose.

#### Connectivity options

Clients can connect to DSA directly from their order management systems using the FIX protocol. UBS deploys an advanced FIX infrastructure, which supports three different options for defining a strategy in a FIX New Order single message: '847' making use of the FIX 4.4 algorithmic tags, as well as Tag 57 and 6000 options. Algorithms can be accessed directly from a third party vendor such as Bloomberg or from UBS Equity Trader. Through a combination of OMS and UBS Equity Trader, clients can enjoy the functionality of Equity Trader without having to re-key orders or executions back into their OMS.

## Contacts

### *Part 1: Market and mechanics*

Chapter 1: Algorithmic trading –  
Upping the ante in a more competitive marketplace

#### **TABB Group**

Contact:

Wendy Garcia, analyst, TABB Group  
Tel: +1 203 535 3668  
email: wgarcia@tabbgroup.com  
www.tabbgroup.com

Chapter 2: Understanding how algorithms work

#### **Citigroup**

Contact:

Dr Tom Middleton, head of European Algorithmic Trading  
Tel : + 44 20 7986 0196  
Email: algo@citigroup.com  
www.citigroup.com

Chapter 3: Build or buy?

#### **Inforeach**

Contact:

Allen Zaydlin, CEO, Inforeach  
Tel: +1 312 332 7740 ext. 2000  
email: allen.zaydlin@inforeachinc.com  
www.in4reach.com

### *Part 2: Honing an algorithmic trading strategy*

Chapter 4: Choosing the right algorithm for your trading strategy

#### **UBS Investment Bank**

Contacts:

Tracy Black, executive director, European Sales Trading  
Tel: +44 20 7568 4869  
Mob: +44 7884 111478  
Email: tracy.black@ubs.com

&

Owain Self, executive director – Equities  
Tel: +44 20 7568 4961  
Email: owain.self@ubs.com  
www.ubs.com/directstrategyaccess

Chapter 5: Anonymity and stealth

#### **CSFB**

Chapter 6: Customising the broker's algorithms

#### **CSFB**

Contact:

Samantha Ward, Electronic Trading & AES™ Sales  
Tel: +44 20 7888 4368  
Email: samantha.ward@csfb.com  
www.csfb.com

### *Part 3: Quantifying and enhancing value*

Chapter 7: Measuring and interpreting the performance of broker algorithms

#### **ITG**

Contacts:

Ian Domowitz, managing director and global head of Research  
Email: ian\_domowitz@itginc.com  
&  
Henry Yegerman, director of Research Product Management  
email: hyegerma@itginc.com  
www.itginc.com

Chapter 8: Making the most of third-party transaction analysis: the why, when, what and how?

#### **GSCS Information Services**

Contact:

Jo Turnbull, Sales & Marketing  
Tel: +44 1932568488  
email: jturnbull@gscs.info  
www.gscs.info

Chapter 9: Enhancing market access

#### **Nexa Technologies**

Contacts:

Mark Muñoz, senior vice president, Corporate Development  
Tel: +1 949 885 2177  
email: mmnuoz@nexatech.com  
&  
Mark Ponthier, director – Engineering, Automated Trading Systems  
Tel: +1 972 747 8860; m: +1 214 578 3676  
email: mponthier@nexatech.com  
www.nexatech.com

### *Part 4: Emerging trends and future direction*

Chapter 10: Basket algorithms – The next generation

#### **Miletus Trading**

Contacts:

Anna Bystrik, PhD, research analyst  
email: anna.bystrik@miletustrading.com  
&  
Richard Johnson, senior vice president, Product Sales  
email: richard.johnson@miletustrading.com  
Tel: +1 212 825 1707  
www.miletustrading.com

Chapter 11: The future of algorithmic trading

#### **JP Morgan Securities**

Contacts:

Carl Carrie, head of Algorithmic Trading, USA  
Tel: +1 212 622 6419  
Email: carl.d.carrie@jpmorgan.com  
&  
Andrew Freyre-Sanders, head of Algorithmic Trading, EMEA  
Tel: +44 20 7779 2117  
Email: andrew.freyre-sanders@jpmorgan.com  
&  
Robert Kissell, vice president, Global Execution Services  
Tel: +1 212 622 5700  
Email: robert.kissell@jpmchase.com  
www.jpmorganonsite.com



Published by

**THE TRADE**  
WORKING FOR THE BUY-SIDE

1 Sekforde Street  
London  
EC1R 0BE  
UK

[www.thetrade.ltd.uk](http://www.thetrade.ltd.uk)

Tel: +44 (0) 20 7075 6115