



FX EXECUTION ALGORITHMS

2018/2019

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T S Y Z E S D C O R Y L
G J T U T P A E X K F S
X H **O V E R V I E W** I V
Q E O H F X K S B F N C
S R L B J D Q Y G K P M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[MARKET SIZE]** R Z E J E B Y D
 F H R M Y D A **Approx. \$35bn to \$70bn ADV** R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

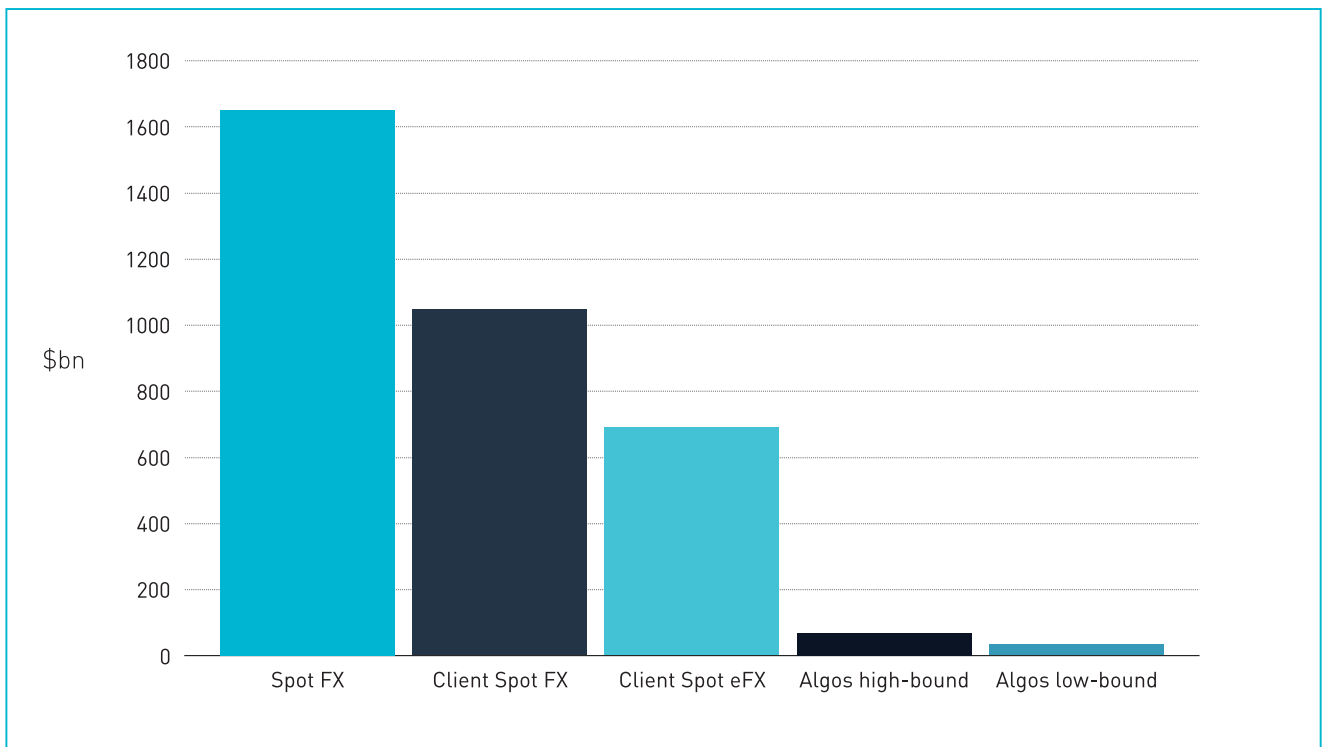
Whilst meaningful, **FX Execution Algo** trading is a small percentage of overall market activity.

Estimation arrived at by combining the following estimates.

- Customer eFX ADV of \$692bn from Butz and Oomen (2018).
- Industry Surveys: Penetration of Algorithmic Trading (Greenwich; 2018).
- This places the figure at circa 10%.

NOTE: Consider 10% an upper bound: Greenwich focuses on large LPs and clients who are early adopters.

- Real estimate likely sits between 5-10% (\$35-70bn).



Data from various sources, per above

There are relatively few distinct categories of Execution Algorithms.

TYPE	EXAMPLE	BEHAVIOUR	POTENTIAL CONCERNS
Pegged	Mid peg; exchange best bid/offer (EBBO) float	Peg to a reference bid/mid/offer	Adverse selection e.g. bids are filled faster in a falling market than a rising market
Time-sliced	TWAP	Schedule execution into smaller clips, each to be executed during a set time window	Performance constrained*
Volume-sliced	VWAP; Percentage participation	Schedule execution to match some metric of market volume (internal or external)	Performance constrained*
Limit-based	Sweep	Aggress all liquidity on all venues at or below a specified price level	High market impact and spread paid
Implementation shortfall	Arrival price targeting	Varied approaches, aiming to reduce slippage to arrival mid	Decision logic of algo more opaque

***EXAMPLE OF TIME/PARTICIPATION CONSTRAINT AFFECTING PERFORMANCE**

- Consider a buy order of 500mio EURUSD that is split into 100 60-second windows of 5mio. If a mid-market offer arrives for 200mio EURUSD a trader may well wish to take that volume, but a TWAP cannot do so without veering off schedule. Equally, during a given window price conditions may be poor and the optimal decision may be not to trade; however a TWAP must eventually trade in order to stay true to its weighted average execution methodology.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S U **[TRADE - OFF]** R Z E J E B Y D
F H R M Y D **Market impact versus market drift** X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Typically resolved by allowing for speed settings within the Execution Algo.

EXAMPLE

- Executing slower helps reduce market impact but will conversely increase the risk of market drift.
- Market drift may* be higher during longer execution windows.
- Practical observations: Quantitative Brokers (2018).
- Formal papers: Almgren and Chriss (1999) or Menkveld et al. (2013).

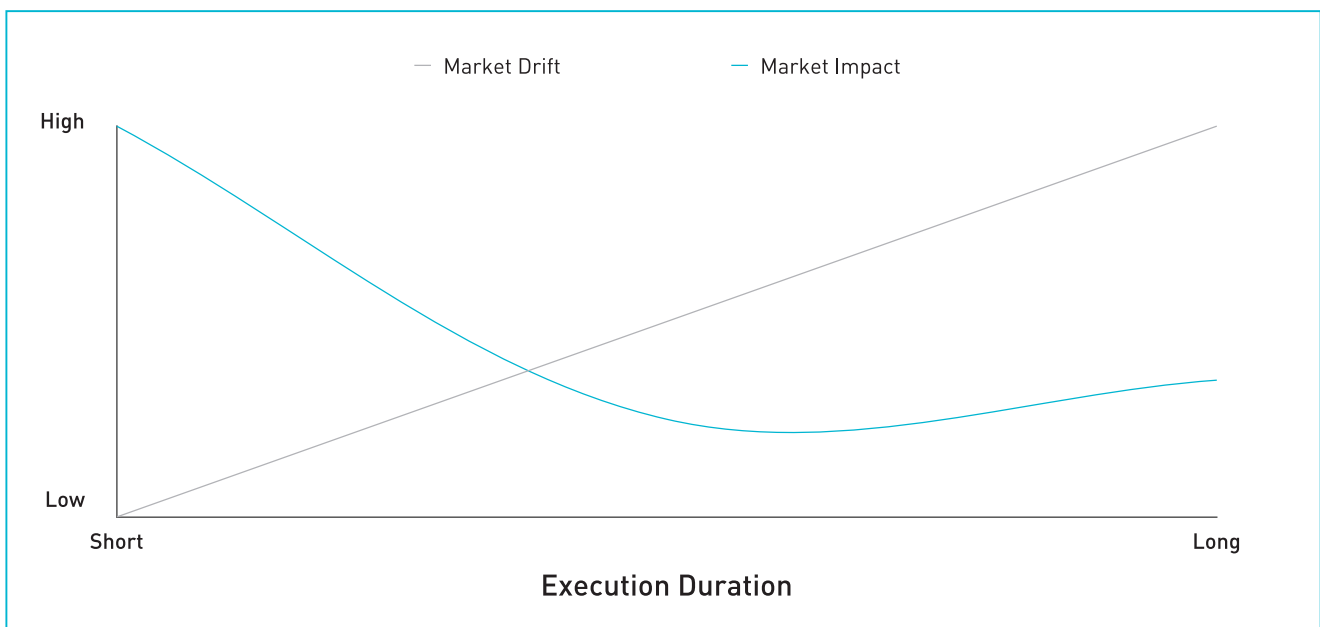


Figure is purely illustrative and not based on real data

* In theory market drift over such periods might be neutral but this ignores the fact that many participants may have similar investment methodologies and thus similar orders may cluster. Centralised execution desks may also serve diverse and autonomous portfolio managers and thus cannot average out individual executions across different clients. Such traders may therefore opt to reduce the likelihood of extreme outcomes on individual orders by trading slightly faster than would be optimal for the average outcome.

T S Y Z E S D C O R Y L
G J **L I Q U I D I T Y** S
X H **S O U R C E S &** Z V
Q E **C U R A T I O N** N C
S R L B J D Q Y G K P M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S U Y **[LIQUIDITY]** H R Z E J E B Y D
F H R **Not all providers have access to the same liquidity** G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

There are four main sources of liquidity.

- CLOBs which are public venues.
- ECNs which are public venues.
- Franchise (i.e. hedging via clients) which is bespoke to each provider.
- Principal liquidity which is bespoke to each provider.

Even in the case of publicly available ECNs the venues are highly configurable (as we'll explore later) and participants may have entirely different pools and experiences on the same ECN.

Franchise liquidity pools vary greatly in both scale and in quality.

Proxy for franchise size.

- Spot/Fwd FX - Euromoney (2018).
- Over 1,792 institutions polled.

Global market share by product: Spot/Forward

2018	2017	Liquidity Provider	%Market share
1	1	JPMorgan	13.35%
2	4	XTX Markets	9.55%
3	5	UBS	6.89%
4	3	Bank of America Merrill Lynch	6.77%
5	7	Goldman Sachs	6.03%
6	2	Citi	5.84%
7	6	Deutsche Bank	5.56%
8	8	HSBC	5.23%
9	10	Standard Chartered	4.20%
10	-	HCTech	3.96%
11	9	Barclays	3.75%
12	11	State Street	3.36%
13	12	BNP Paribas	3.31%
14	20	Jump Trading	3.08%
15	14	Morgan Stanley	2.25%
16	19	Commerzbank	2.16%
17	15	Credit Suisse	1.76%
18	16	Citadel Securities	1.54%
19	13	NatWest	1.54%
20	18	Nomura	1.36%

Data from the Euromoney FX Survey 2018

[INTERNALISATION]

Just a buzzword until verified

Internalisation means different things to different people.

Truest form: Flow from client A is used to hedge flow from Client B.

- Broadly this is assumed to be positive as a natural hedge has occurred in the 'dark' and thus market impact should be minimised.
- However: dealers may/may not include interbank mid-matching into these figures.

REMEMBER: skew directly affects internalisation ratios.

EXAMPLE

- Consider a 10 / 20 Market. A dealer, who is short, shows 18 / 20 and a HFT client sells at 18.
- Officially the dealer has 'Internalised' but with an HFT at a price that is worse than interbank mid!

MORE RELEVANT: MARKET IMPACT CHARTS

- Provide a clear understanding of each dealer's holistic hedging behaviour.
- Internalisation is merely one input into the Market Impact result.
- Discussion in Oomen (2018).

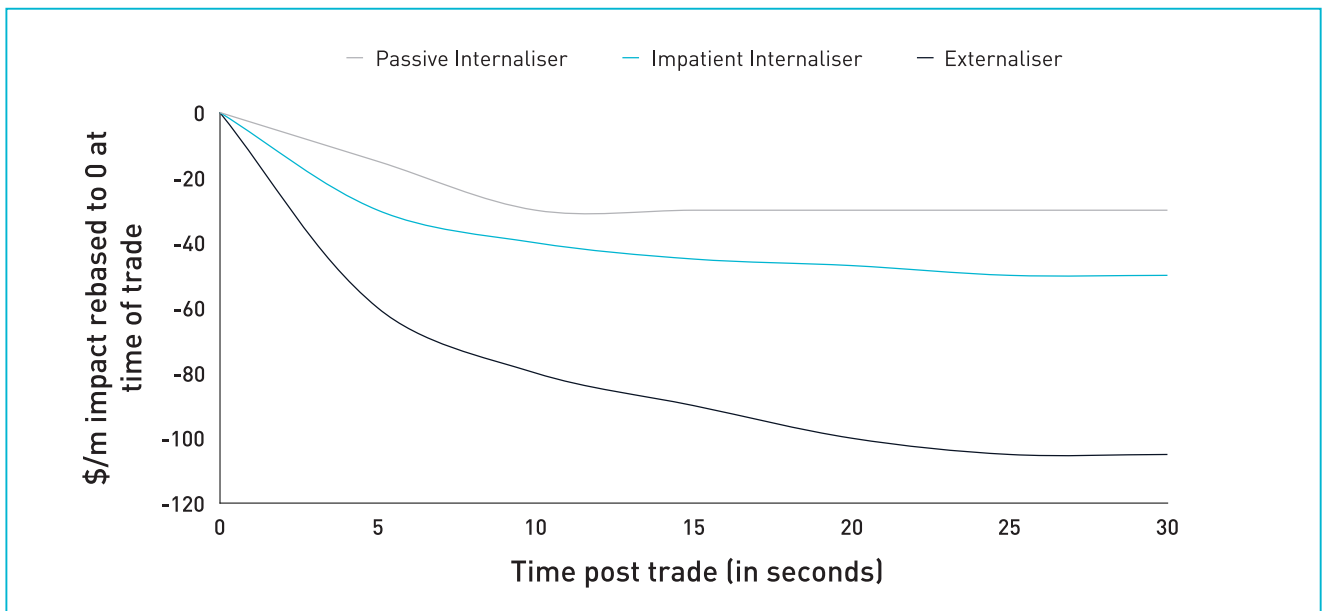


Figure is created by XTX Markets, inspired from Oomen (2018)

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
[SKEW LEAKAGE]
 B Y N D E Q S **Large signalling risk** P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

FX markets are highly interrelated and price discovery propagates through bilateral connections and lit ECN 'hubs' of connectivity.

- Accordingly it is necessary to have robust, always-on, systematic infrastructure to detect skew leakage and remove skew from such streams.
- In the absence of such protections, any large order is at serious risk of signalling intention to the market.

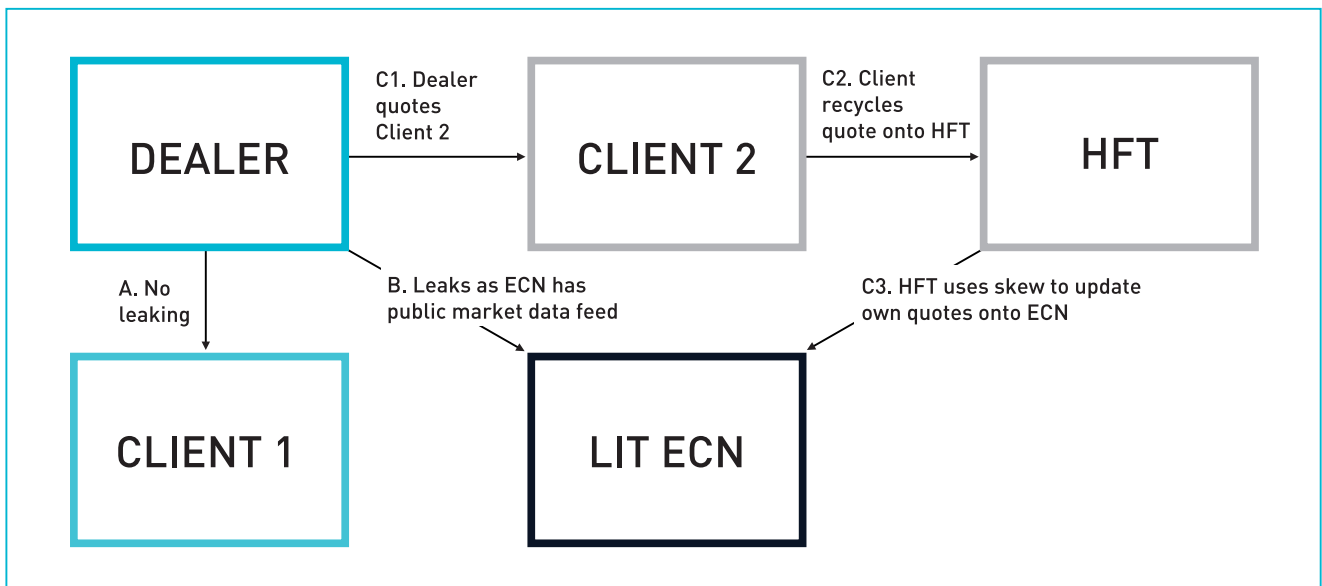


Figure is purely illustrative

EXAMPLE

- Imagine working an algo order to buy 200mio USDZAR. In this example the algo provider starts quoting a skewed bid rate across all its streams to attract fills.
- Leaky streams that receive this will recycle the bid skew to the wider market – including lit ECNs whose market data help determine the mid of major liquidity providers – and participants will adjust their USDZAR mid higher, making buying more expensive.
- In some cases HFT who receive the skew (directly or indirectly) may use the skew data as a signal to aggressively buy, also pushing the market against the order.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S [**CONNECTIVITY**] Z E J E B Y D
 F H R M Y D A [**CRAFTSMANSHIP**] R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Providers of Execution Algos will connect to the primary FX CLOBs, large secondary ECNs, and the CME.

Secondary ECNs are highly configurable, meaning each provider will have different access to liquidity at the same time.

CLOBs (Central Limit Order Books): EBS, Reuters and the CME.

- Credit-permitting, firms should be accessing the same order book.
- However, considerable craftsmanship is needed when considering the microstructure and quirks of each venue.

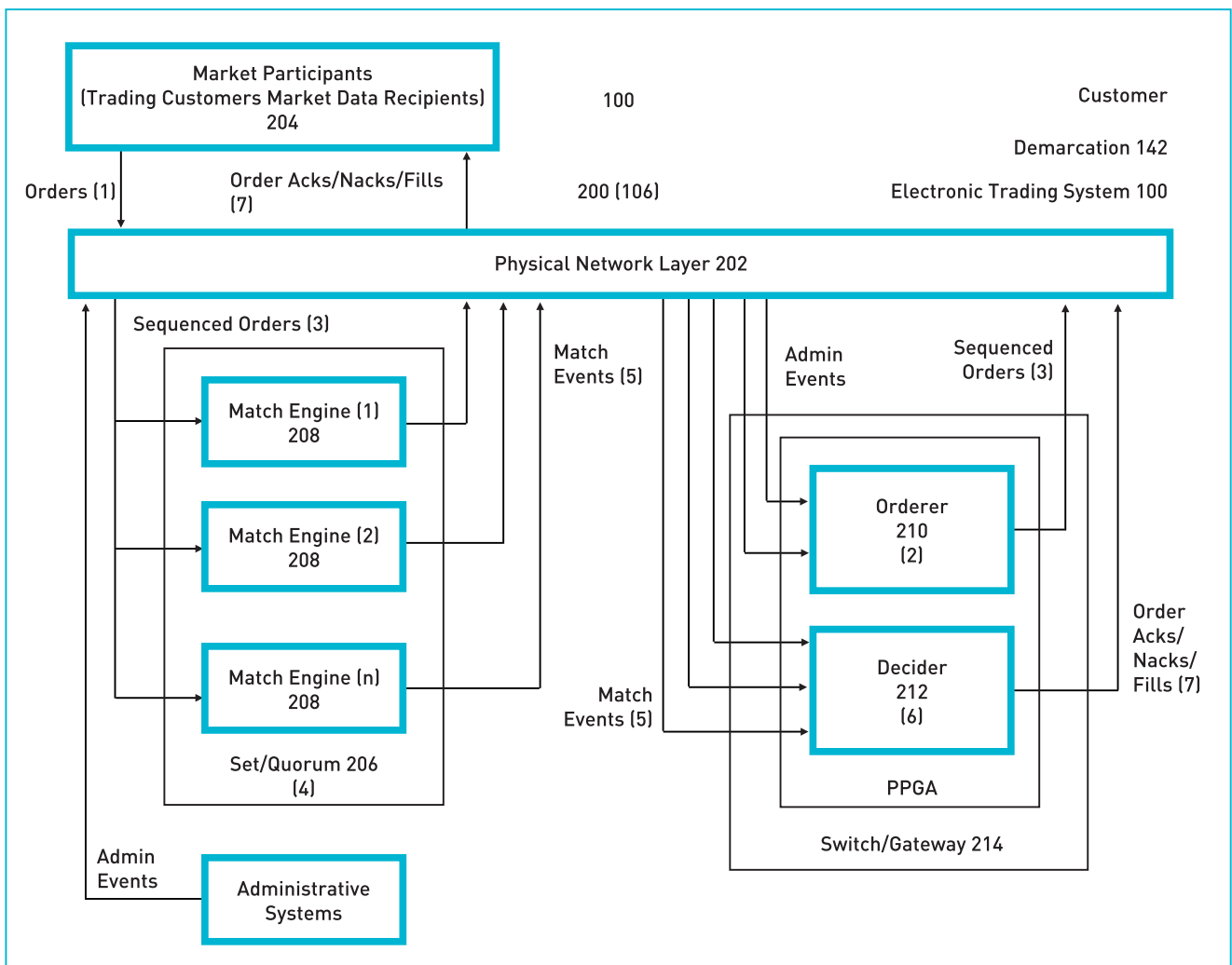


Figure is purely illustrative

Last look windows are still common in FX markets.

- Defined as the option held by liquidity providers to artificially hold an incoming trade request for a period of time, typically 50-100ms, before deciding whether to accept or reject it.

In common pairs such as EURUSD or USDJPY the primary market data refreshes every 5ms.

- Additionally, the futures market and secondary markets such as LMAX, Currenex, Fastmatch, Hotspot, 360t are all real-time.
- This means that e.g. for a EURUSD trade in 50ms a liquidity provider has multiple primary updates alongside many secondary updates to view before deciding whether to accept or reject the trade request.

ANY ORDER EXPOSED TO THIS LAST LOOK WINDOW SUFFERS FROM HEAVY ADVERSE SELECTION AS THE LIQUIDITY PROVIDER CAN SEE MANY UPDATES INTO THE FUTURE BEFORE IT EXERCISES ITS OPTION TO ACCEPT OR REJECT THE ORDER.

EURUSD average market updates in 100ms

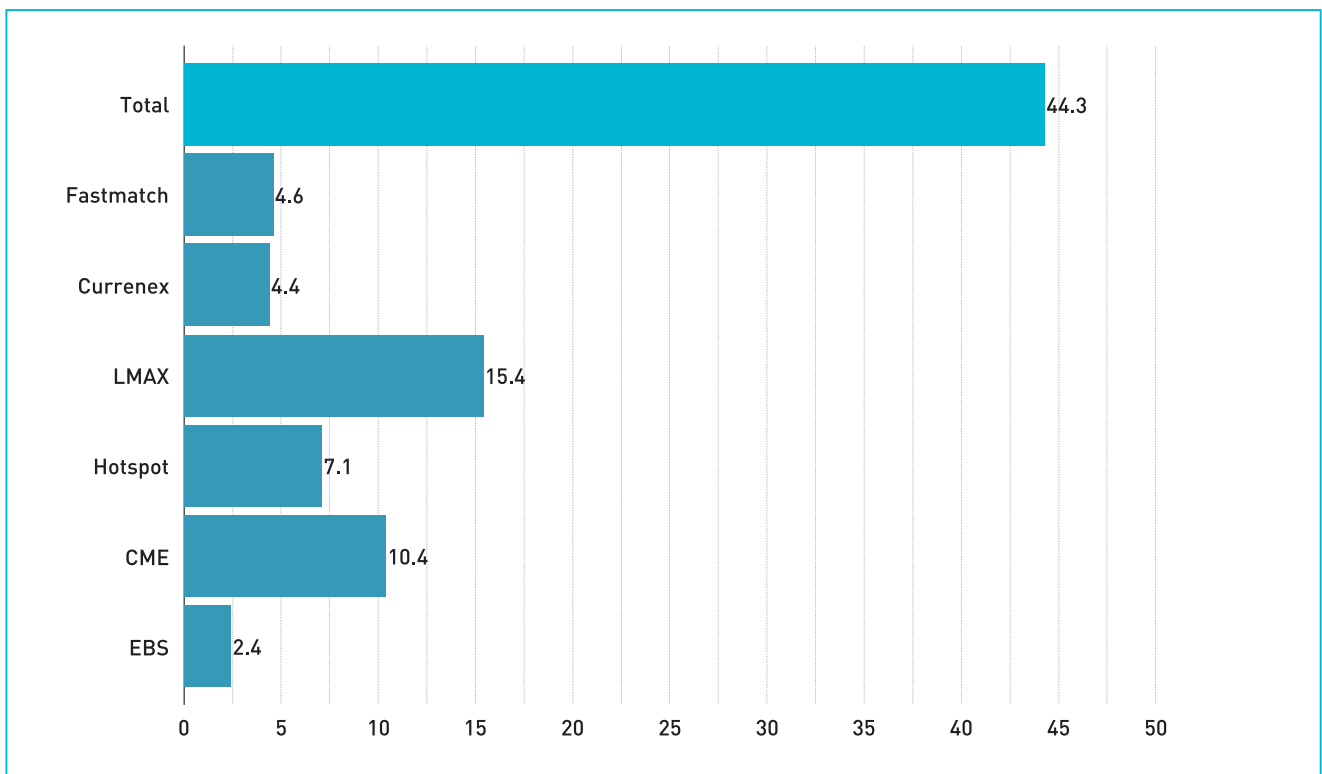


Figure is derived from ECN data (06:00 - 16:00 30/07/2018-26/10/2018)

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[PRE-HEDGING]** R Z E J E B Y D
 F H R M Y D A **During Last Look window** R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

One must decide, especially when transacting on anonymous ECN, whether one wishes to consume liquidity on last look streams.

- Given the lack of disclosures on anonymous ECNs - it is impossible since the liquidity providers are, after all, anonymous - to know whether a provider utilizes pre-hedging, asymmetric last look or other such practices.

Some anonymous liquidity providers may consider it reasonable to pre-hedge your order.

- i.e. to hold your order, try to hedge it on other venues during the holding window, and - if filled at a better rate - filling you and locking in a risk-free profit; if unfilled, rejecting you and leaving you to re-try at a now-worse price due to the impact of their unfilled orders.

LAST LOOK OFFERS TIGHT VISIBLE SPREADS BUT MAY RESULT IN WORSE EFFECTIVE SPREADS AND YOUR ALGORITHM PROVIDER SHOULD BE ABLE TO EXPLAIN THEIR ECN LIQUIDITY CURATION PHILOSOPHY TO YOU IN DETAIL. CONSIDER ASKING YOUR PROVIDER TO CURATE THEIR ECNS TO AVOID LAST LOOK LIQUIDITY FOR YOUR ORDERS.

Pre-hedging example in a 10/12 market

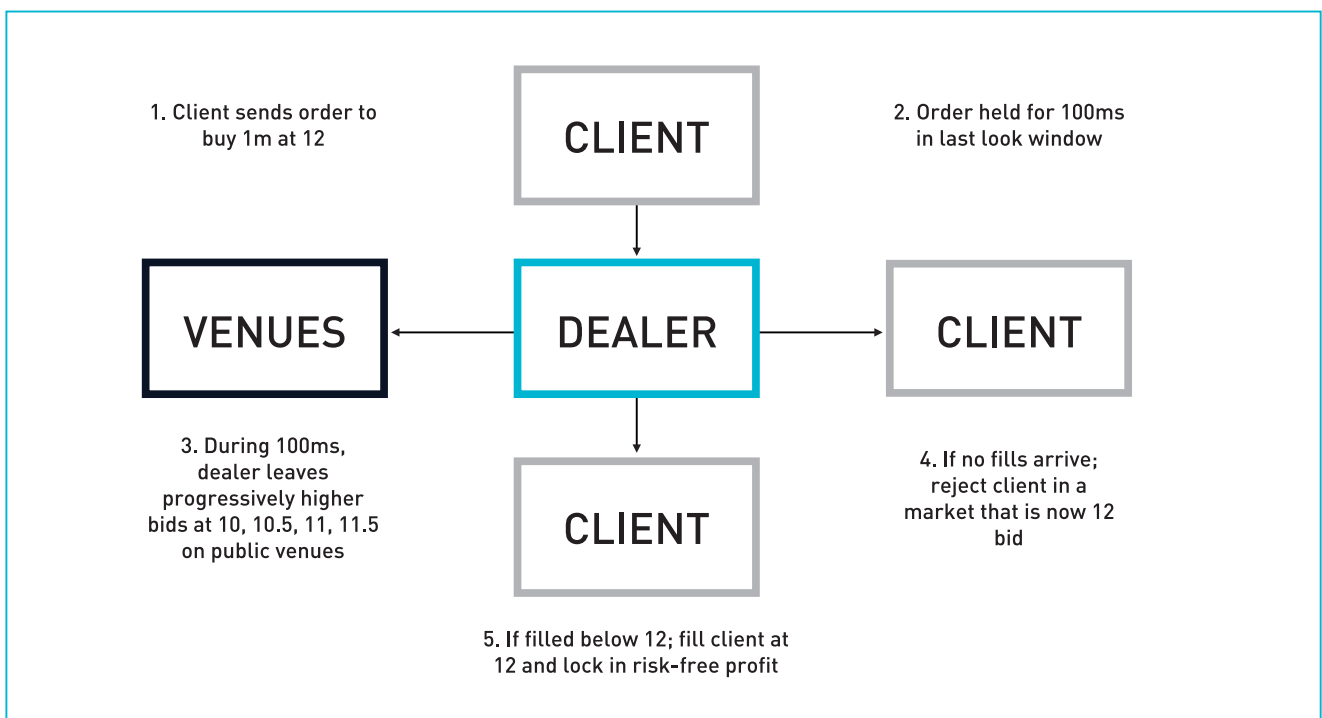


Figure is purely illustrative

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S U **[ANONYMITY]** R Z E J E B Y D
 F H R M Y D A B Q T X U V D L O P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

CLOBs are the most strictly anonymous public venues.

- They provide only the code of the credit bank or, in the case of the CME, which has central clearing, nothing at all.

Secondary ECNs offer varying degrees of anonymity.

- All participants - liquidity providers and consumers - are assigned static “Tags” e.g. 14253266.
- These tags are necessary in order to allow liquidity providers to observe the behaviour of each tag and map them to the appropriate pricing stream; equally they allow liquidity consumers to observe the behaviour of each liquidity provider and block them if they behave in a less than optimal way.

Each ECN has different defaults for tag sharing.

- Some only share tags with the liquidity provider at end of day: this means that, during the day and even after an order has been filled, the liquidity provider is unsure which tag he has traded against.
- From a client perspective, this may be their preferred option.

Sample ECN unfilled order blotter

Order ID	Venue	Time	Side	Amount	Pair	Rate	Source	Status
10241	ECN A	12:03:04.450	B	100,000	USDZAR	14.1256	-	Pending...
51251	ECN B	13:03:04.452	S	1,500,000	EURUSD	1.16436	7525	Pending...
52016	ECN C	14:03:04.455	B	200,000	USDJPY	113.694	-	Pending...

Figure is purely illustrative

Tags released before end of day may introduce signalling risk.

- The liquidity provider can - and almost certainly will - record the historic market impact of each tag and may generate a trading signal on the back of the filled child order.

Market impact will often look like this (see below).

- This recognisable pattern allows HFTs to anticipate follow-on orders.

Predictable mark-out curve, typical of a time-sliced order

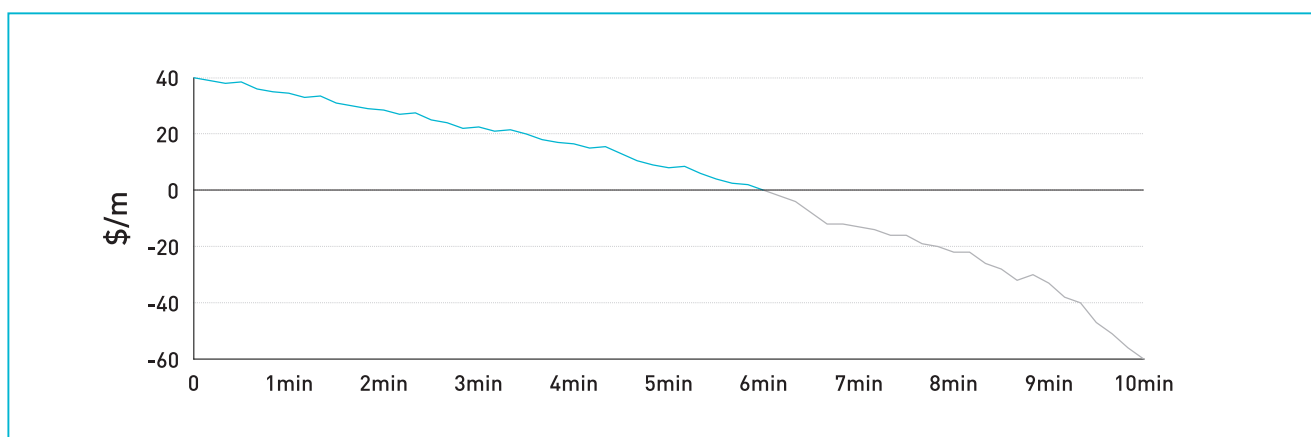


Figure is purely illustrative and not based on real data.

Some ECNs by default provide tags to the liquidity provider even before the trade is filled.

- This could be problematic as the liquidity provider knows the tag which has sent the order before they have even committed to filling the order.
- Indeed they may well ultimately reject the order but retain the information.

Some ECNs allow clients to opt-in or out of these defaults.

- Understanding in detail the settings on each ECN and making appropriate choices is important for any algorithm provider.

Consider asking your provider to find out which ECNs send tags pre trade, during the last look window, and consider asking them to remove any venues which concern you for your orders.

- The visible top of book spread may increase when certain pools of liquidity are removed but the risk of signalling has been reduced, which is likely a good trade-off for large and long-run orders.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S **[CANARY ORDERS]** Z E J E B Y D
 F H R M Y D A B **Can be hard to spot** P R X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

A potential tactic used by HFTs is to layer orders, often firm, of very small size just outside the top of book price.

- Whenever a small order is hit the HFT can infer a sweep must be occurring – because top of book has been exhausted – and they will rush to consume liquidity in greater quantity on firm venues.

These HFTs may reach geographically distant firm venues faster than the sender of original orders, due to heavy investment in proprietary microwave networks.

Detecting and avoiding canary orders is effortful but important.

Common protections are to ensure:

- Taking orders are subject to a minimum size constraint.
- Any participants that exhibit unusually high market impact immediately post trade are monitored and/or blocked

BID		OFFER	
10m	1.1645	1.1647	8m
5m	1.1644	1.1648	6m
100k	1.1643	1.1649	3m

Figure is purely illustrative and not based on real data.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q **[PAID/GIVEN TICKERS]** E J E B Y D
F H R M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

On a small number of ECNs, platform trades are published (without delay) to a paid/given feed, which broadcasts the trade event information -- even to participants who did not participate in the trade.

This means HFTs can observe other market participant's trading activity, without having to trade, and try to detect large multi-venue sweeps or long-run time-sliced orders from the pattern of fills.

- Many ECNs do not produce such feeds at all.
- Some ECNs sell this real-time data.
- Some ECNs give it to participants for free.
- Some ECNs delay the publication of trades before sharing them.

Consider asking your provider to find out the ticker policy for each ECN and remove from your orders any venues whose policies concern you.

+2mio EURUSD @ 1.14076
(11:02:01.205).

-5mio USDTRY @ 5.4361 (11:02:02.750).

+3mio NZDUSD @ 0.67113
(11:02:02.798).

T S Y Z E S D C O R Y L
G J T U T P A E X K F S
X H D **A L P H A** E O Z V
Q E O H F X K S B F N C
S R L B J D Q Y G K P M

[FORECASTING MID]

Hard to do

The holy grail of every market participant is to have the ability to reliably forecast the future price at a given horizon.

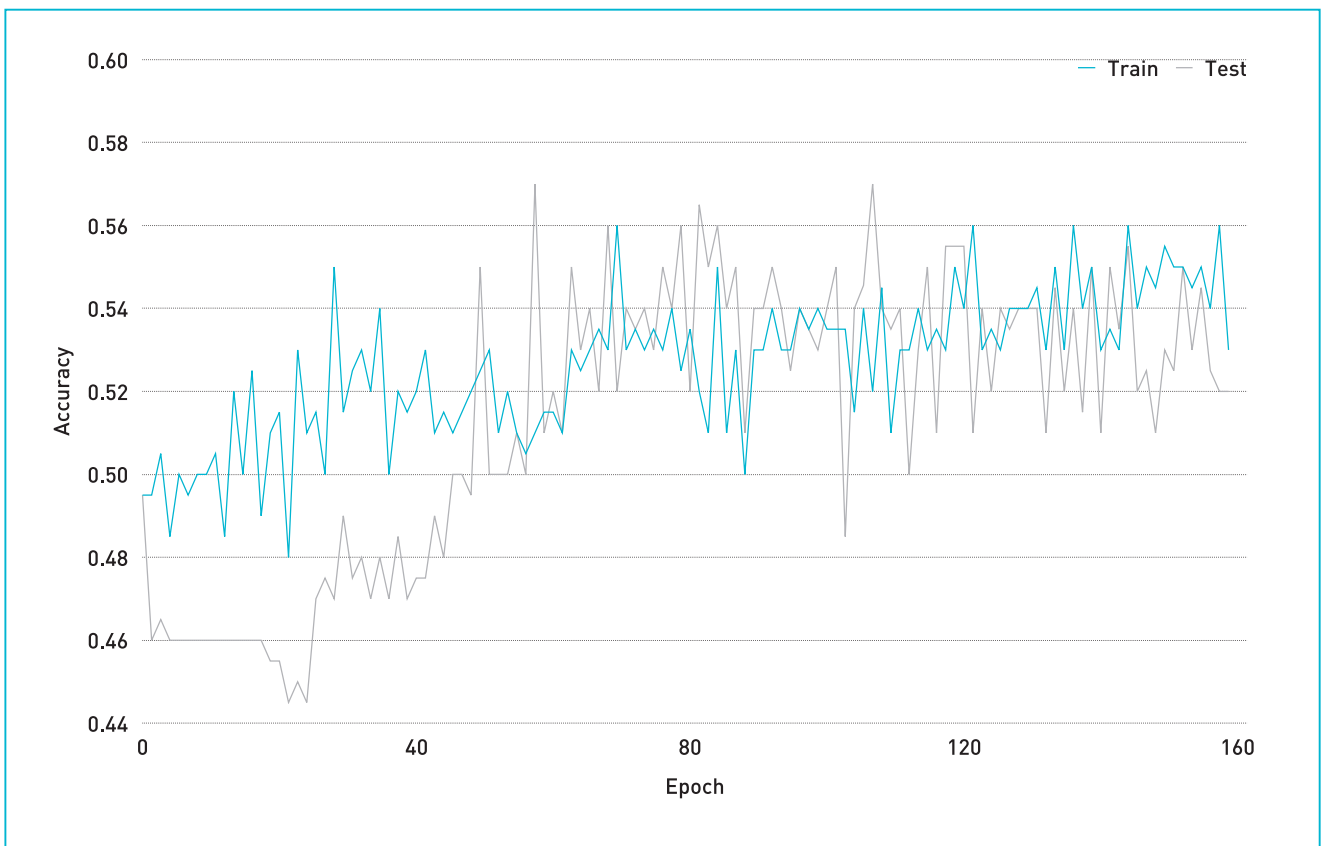
This involves a huge amount of research.

- Few succeed.
- This is referred to by market makers as 'alpha'.

The few firms who have alpha i.e. a reliable ability to buy at or below mid and sell at or above mid are likely to use it to trade (not just hedge) onto CLOBs since alpha makes this a profitable activity. Hence the scale of a firm's activity on CLOBs may commonly be understood as indicative of the strength of its alpha.

Alpha is also the key ingredient for any Implementation Shortfall algorithm since it allows for efficient fills for each child order – see example on the next page – reducing the arrival price slippage for the whole algorithm.

Model accuracy



Illustrative example created by XTX Markets.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X [**ADVERSE SELECTION**] R N Q K E X
B Y N D E Q [**& PASSIVE FILLS**] E J E B Y D
F H R M Y D **What does passive really mean?** X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

It is common to record ratios of passive/aggressive fills with the widely held assumption that passive fills are better than aggressive fills.

- This is of course true in a market which doesn't move.
- In real life, however, passive fills are subject to adverse selection.
- That is – you end up buying or selling at the precise time you wish you hadn't.
- The only way to avoid adverse selection is to accurately forecast mid, which requires having alpha.

EXAMPLE: CONSIDER THE BELOW PRICE ACTION. ARE YOU HAPPIER WITH THE PASSIVE OR AGGRESSIVE BUY?

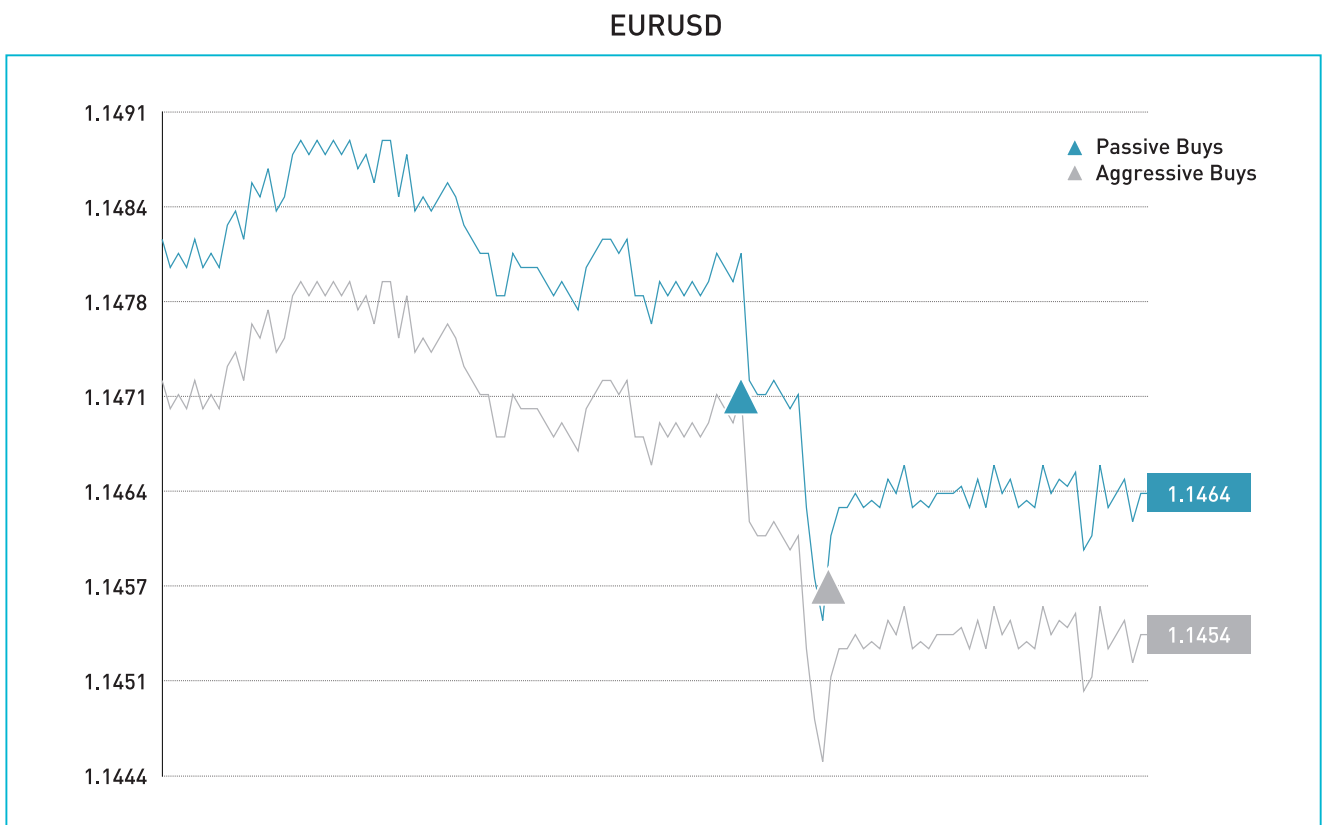


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T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S **[PRIMARY MARKET]** Z E J E B Y D
F H R M Y D A B Q **Great benchmark** O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

The ultimate test of a market maker's execution skill and underlying alpha is to be effective i.e. large in scale and consistently profitable on the primary markets.

On primary markets all informed participants are effectively in competition - large banks, HFT, systematic funds – in a venue where there is no last look and no one can block one another.

- This is the purest environment for FX trading competition.

Ask your algorithm provider where they rank on primary markets.

- A top provider may be more likely to be more expert in navigating the interbank effectively than a provider with less experience and less proven track record in this arena.

T S Y Z E S D C O R Y L
G J T U T P A E X K F S
T R A N S P A R E N C Y
Q E O H F X K S B F N C
S R L B J D Q Y G K P M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S **[ORDER POLICIES]** Z E J E B Y D
F H R M Y D A B Q **Worth knowing** O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Design decisions and trade-offs have to be taken when writing order policies. Ideally an algorithm provider will be able to explain their thinking behind their policy with tangible examples.

- There are many reasonable outcomes – not a single ‘correct’ approach – and it is simply important to have an understanding of the choices made by each provider so you know what to expect.

💬 If two clients have opposite interest, should they match and when?

Consider Client A enters an order to buy 200m EURUSD and Client B enters an order to sell 50m EURUSD. Most would agree they should match at mid for 50m. However, an instant match benefits the client with the larger order most since the imbalance in size suggests the market would be higher as the orders progress; delaying the match may also be problematic as Client B might have wanted the fill.

💬 If two clients have the same interest, how are fills apportioned?

Consider Client A enters an order to buy 200m EURUSD and Client B enters an order to buy 50m EURUSD. If 10m is filled how should it be split? 1:1? 4:1 to match their overall quantity? Determined by urgency setting? FIFO? All of these approaches have positives/negatives worth considering in detail.

💬 Visibility within the firm

Similarly, it is worth understanding each provider’s approach to visibility of orders within the organization: can discretionary traders or sales-traders who provide ‘market colour’ see them?

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K [**REAL-TIME**] O R N Q K E X
B Y N D E Q S [**VISUALIZATIONS**] Z E J E B Y D
F H R M Y **Common requirement at Tier 1 dealers** H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Tier1 dealers have long used real-time visualisations to monitor their own hedging behaviour.

- Typically plot paid/givens overlaid against the primary market and any incoming client orders and hedging trades.

Such tools are likely to be extended to the buy-side over time to provide them with an understanding of an algorithm's behaviour and wider market context so they can amend settings mid execution.

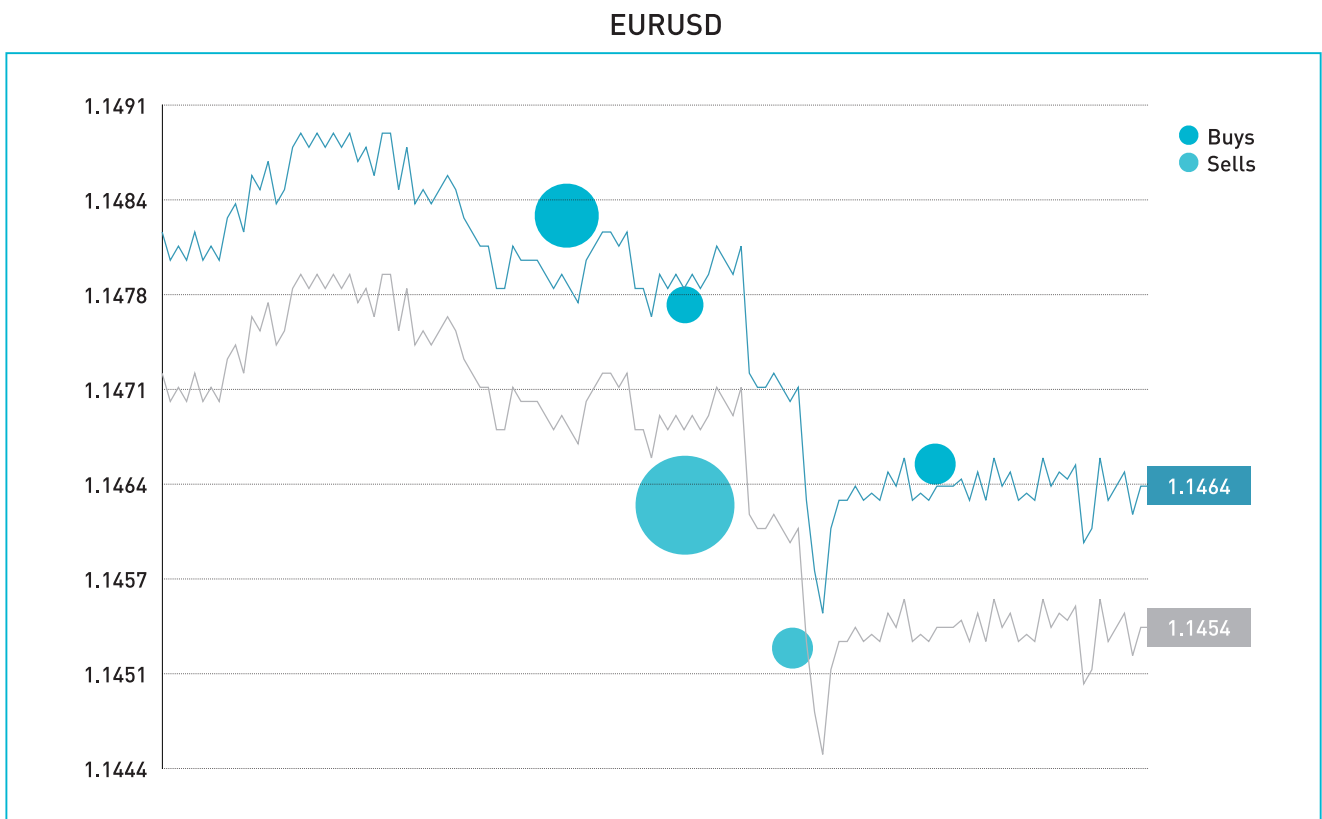


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T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D E Q S U Y X **[TCA]** P H R Z E J E B Y D
 F H R M Y D **Tends to be third-party nowadays** X H K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Post trade TCA has rapidly iterated to third-party analysis.

- This has the benefit of allowing clients to compare algorithms from different providers with the same benchmarks in the same place, known as a 'peer universe' tool.
- The independence of such providers – i.e. the fact that they do not offer their own algorithms – may be reassuring in terms of the objectivity of the analysis.

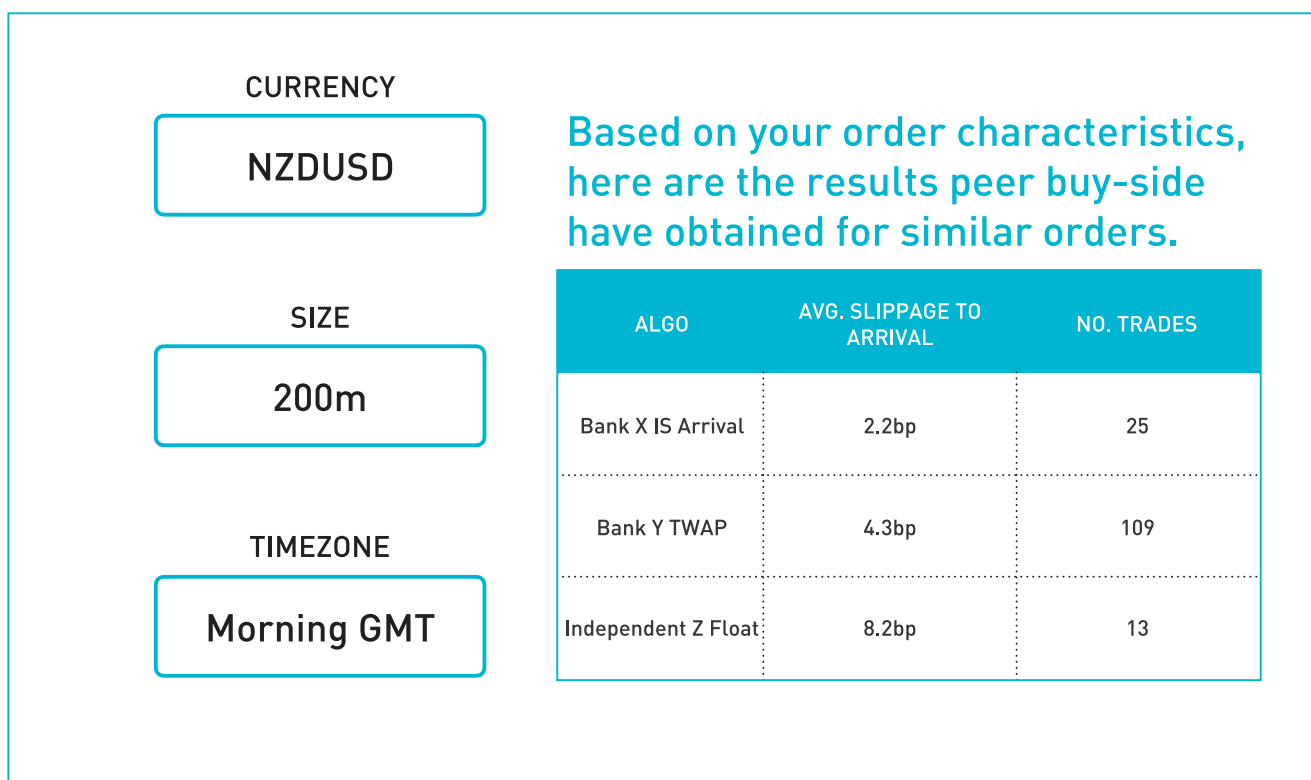


Figure is purely illustrative.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
 Q E O H F X K S G O T Y Z E S D C O R N Q K E X
 B Y N D [**SIGNIFICANT CHALLENGE**] E B Y D
 F H R M [**FOR MARKET PARTICIPANTS**] K G T R
 D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Many on the buy side say their biggest challenge is knowing which algorithm to use and when.

- It is not practical for a single client to try five algorithms from ten providers, sampling each algorithm one hundred times, to build up enough historical data to make statistically representative evaluations.

Fortunately third-party TCA companies have begun to offer opt-in 'peer universe' products.

- Using anonymised execution meta data, allowing clients to pool experience and see how an algorithm has performed over a large sample size with other clients.
- This allows them to try new algorithms with a reasonable degree of confidence in their quality.

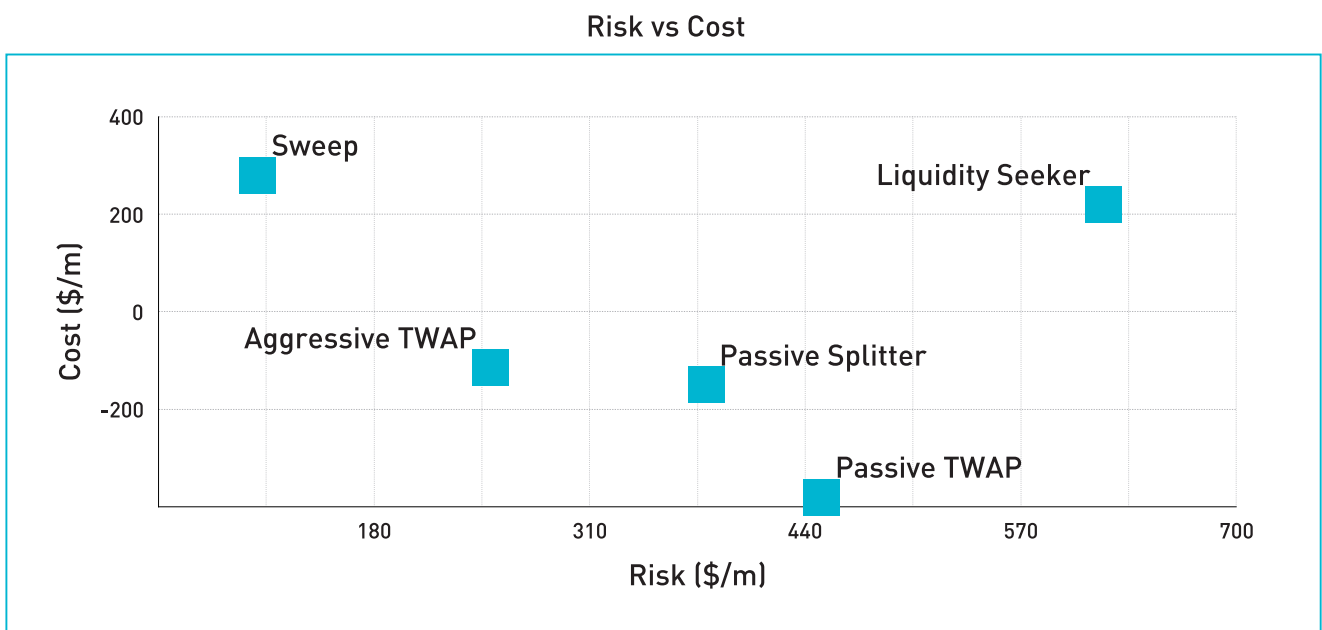


Figure is purely illustrative and not based on real data.

T S Y Z E S D C O R Y L
G J T U T P A E X K F S
X **C O N C L U S I O N** V
Q E O H F X K S B F N C
S R L B J D Q Y G K P M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D **[WHAT MAY HAPPEN NEXT?]** E B Y D
F H R M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

1. The arrival of third-party 'peer universe' algorithm comparisons is a big deal. Clients will start to use third-party TCA vendors to monitor slippage vs arrival mid for all algorithms and will choose those with the best results, ignoring marketing buzzwords and sales campaigns in favour of objective data, once readily available.
2. Consequently, we believe there will be a trend away from pegged, time/volume-sliced algorithms towards implementation shortfall/arrival price targeting algorithms.
3. There will be a concentration in market share and a handful of the best performing providers will take the majority of flow, as is already the case in the principal risk-transfer market.
4. This may lead to credit concentration issues and we are likely to see the unbundling of workflow (EMS), execution (best performing providers) and credit (most attractive credit banks). Consider an instance whereby a client may trade on Bank A's algo via a third-party EMS but settling and booking against Bank B's credit and performing TCA on a third-party system.
5. NDFs are rapidly becoming electronic and are highly suitable for algorithmic trading given the wide bid-ask spreads and nascent availability of electronic CLOBs.
6. Importantly the overall share of eFX flow that is traded via algorithms is expected to rise ([Greenwich; 2018](#)). Even at 15-20% of overall eFX client flow it would represent a sizeable shift in market structure.

T S Y Z E S D C O R Y L
G J **W O R K F L O W** F S
X H **A D D E N D U M** Z V
Q E O H F X K S B F N C
S R L B J D Q Y G K P M

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S U Y **[O M S / E M S]** H R Z E J E B Y D
F H R M Y D **Integration is increasingly important** X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

It is not the most thrilling aspect of trading but workflow integration has proven to be a key determinant of commercial success, especially for brokers dealing with real money clients who have strict execution policies.

It is more and more common to see real money clients eliminate 'keying risk' i.e. entering the wrong size or direction by processing orders straight through from the OMS into an EMS from where they can be sent to algorithm providers.

It is likely that the majority of orders will be staged in this way going forward rather than manually entered into single dealer platforms (SDPs). SDPs may be used to visualise the algorithm mid-order and to update certain trader settings such as urgency, but the order origination is likely to come via an EMS.

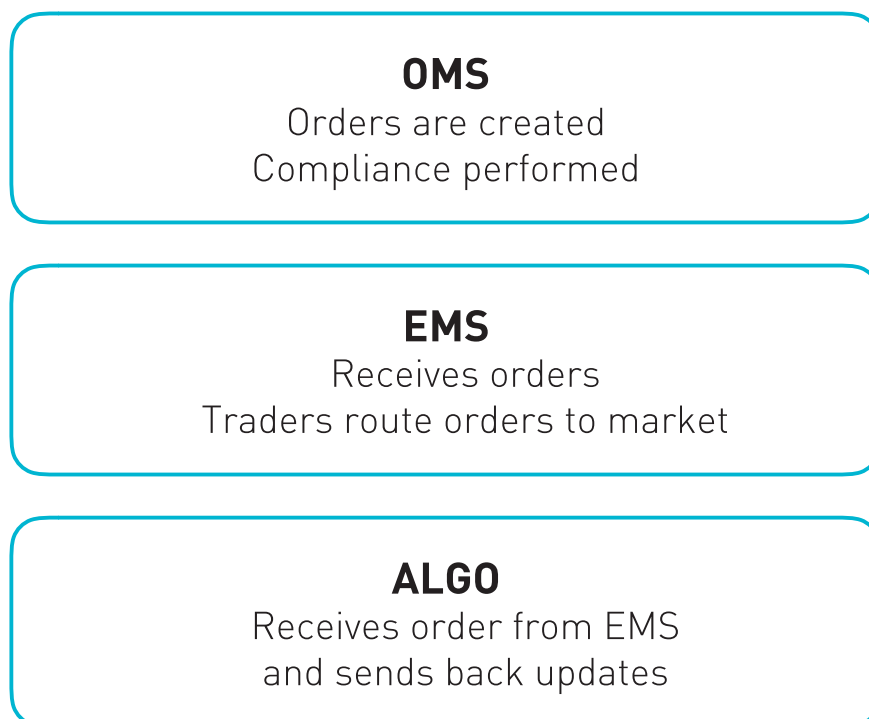


Figure is purely illustrative.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N **[SIMPLICITY REDUCES ERRORS]** B Y D
F H R M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

Algorithm order entry tickets are often quite complex and unintuitive, offering offering many options, which results in a significant barrier to entry for traders who may use multiple providers and may even trade multiple asset classes.

- Users should not have to remember the idiosyncrasies of each provider.

Equally, increased options and configurable settings detract from performance.

- Faced with many micro parameters, traders may feel they are obliged to modify something and run the risk of increased errors or mismatches in expectations: “I didn’t expect it to do that.”

As execution algorithms mature, there may be more focus on elegant and intuitive interfaces that simplify decisions for market participants.

T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q S **[BIBLIOGRAPHY]** Z E J E B Y D
F H R M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

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T S Y Z E A D C O R Y L G J U T K E X P A F S Z
Q E O H F X K S G O T Y Z E S D C O R N Q K E X
B Y N D E Q **[DISCLOSURES PAGE]** E J E B Y D
F H R M Y D A B Q T X U V D L O P R X H K G T R
D R Y X J R S D F B Q L Y E N T K Z X A F X O V

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