

EUROPEAN DATA CONSOLIDATION

WHITE PAPER



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Chapter 1 Executive Summary

Competition between European equities trading venues has intensified in the wake of MiFID. This competition has enhanced the efficiency and reduced the costs of equities trading in Europe. However, one of the by-products of a newly competitive landscape is an increasing fragmentation of liquidity across markets. This fragmentation inevitably leads to demands for a consolidated view of EU equities markets.

As CESR noted in its recent review on the impact of MiFID, concerns over the effectiveness of data consolidation have been voiced, particularly from the institutional buy-side. There continues to be much debate on this topic and some common concerns have emerged.

In order to gain clarity over the exact nature of these concerns we have consulted with representatives of over 20 buy-side firms to understand their issues and how they might be addressed and this paper details our findings

We have identified 14 concrete proposals for improving the compilation of consolidated data and a call to action on parties to find solutions. Thomson Reuters has already introduced some of these proposals, and we have plans to implement others. Our intention is that these proposals should be considered as an input to establishing common standards for adoption across information vendors and the firms they serve.

This White Paper will cover the following:

- **The buy side considers the cumulative cost of fees charged by exchanges, and trade reporting services is a significant barrier to adoption of a consolidated tape, and a detriment to overall transparency.** We suggest there should be a more modular approach to data pricing that is underpinned by regulatory intervention.
- **The coverage and quality controls around MiFID trade publication need to be formalized and enforced to instil market confidence and trust.** We make several suggestions to improve trade publication. To be successful, the institutional buy-side, brokers and trade reporting services will need to reach agreement on standards, and these rules will need to be codified through MiFID 2 regulation.
- **Best execution monitoring has been hampered by shortcomings in the provision of the source data contributing to a consolidated tape and by inconsistencies of approach to benchmark calculation between information vendors.** In this document, we openly share our TCA formulas and methodology. We now call upon other vendors to join in defining industry standards for data consolidation and TCA measurement.

Through continued dialogue, industry collaboration and regulatory support, all of these issues are solvable.

Chapter 2 Types and Usage of Consolidated Data

Debates on MiFID consolidation often assume that the purpose of consolidation is self-evident. However, market participants use consolidated data in a number of ways to serve different purposes, which will vary depending on the type of trading activity they engage in. There is no 'one size fits all' solution that will be suitable for all purposes.

First, it is important to understand the two key types of consolidated data available:

- A Consolidated Quote is the Best Bid and Offer available for a stock from an open order book across competing exchanges and MTFs. A consolidated quote comprises pre-trade data and is analogous to the National Best Bid & Offer (NBBO) in the U.S. It provides reference pricing information and is seen by the primary exchanges as the most valuable element of the data they publish, as it is essential to price formation in a share.
- A Consolidated Trade Tape (trade history) is a comprehensive record of all trades executed, in synchronized chronological order. It details the price, volume, execution venue, date and time of each trade. A consolidated tape comprises post-trade data only and is analogous to the Consolidated Tape Plan in the U.S., It provides information about the liquidity in a share, i.e. where it is trading and in what volume.

Different users have different priorities and requirements for consolidated data. Whilst there are many different types of users, for simplicity, we have grouped them into the three types below.

Retail Brokerage and Wealth Management

These market participants will generally receive and execute smaller order sizes on an exchange's or MTF's order book at the prevailing market price or at the point a target price is achievable. In some cases, as in the UK where retail brokers use Retail Service Providers (RSPs), execution is performed away from the exchange order book but at a price that is at, or an improvement on, the price visible on the order book. For this type of business, the provision of a consolidated quote and trade history through desktop applications is required – for which low-latency (ultra fast) data feeds are not a key requirement.

In addition, such firms are also under pressure by their customers to deploy at least a basic form of Transaction Cost Analysis (TCA) to evidence that they have complied with MiFID Best Execution obligations. Most TCA services tend to deliver reports the following trading day, or even monthly or quarterly, and so do not depend on rapid real time delivery of consolidated market data – but they do require access to "full tick" data, i.e. a complete history of competing quotes and related trades across all relevant markets.

Institutional Fund Management

These market participants will generally trade larger orders on behalf of the funds they service and will want to understand where liquidity is in the stocks they have an interest in, which is not always readily apparent on transparent order books. So whilst they need to know where the current price in a stock is, it is equally important to be able to monitor the traded activity in that stock so that they can understand where they may be able to trade in the size they need, while minimizing the impact of that order on the prevailing market price. This data is delivered through desktop applications for which low latency delivery is not a key requirement.

These firms frequently deploy sophisticated TCA tools for MiFID Best Execution monitoring, and to monitor execution performance across brokers, algos, trading desks and underlying execution venues. Most of these firms are satisfied with TCA services that deliver reports the following trading day or even monthly or quarterly. So real-time delivery of the data is not required, whereas access to "full tick" data across all relevant markets is essential.

Large Brokerage firms servicing both retail and institutional order flow

These market participants continue to invest in the automation of their execution services for their customers as part of their competitive differentiation. They deploy both Algo trading engines and Smart Order Routers which utilize full-tick, low-latency data feeds from the competing exchanges and MTFs and data vendors. From this they often have also generated their own consolidated data for consumption and display in their desktop applications.

These firms often operate their own TCA tools which can be fed by low-latency feeds to provide real-time analytics as well as the next trading day. They actively use TCA to monitor the execution performance of their algos, trading desks and execution venues at firm and client level. This information is then used to improve and promote their own service to their largest institutional clients.

Firms that require real-time low latency full-tick data cannot and will not rely on a centralized standardized consolidated quote for the following reasons:

- The consolidation process itself would add additional latency to those of the individual feeds.
- The nature of these businesses is that they are all competing to access the data faster than their competitors, thus making the concept of a standardized quote redundant to these users. Standardization would stifle the development of new, faster, more efficient solutions.

Chapter 3 Making Transparency Cost-Effective

Thomson Reuters and other data vendors already supply a Consolidated Quote and Consolidated Trade Tape to the market but numerous issues have impeded their usefulness and broad adoption to date. These issues and the Thomson Reuters proposals to address them are outlined below.

Issue: Rising market data costs have reduced attractiveness of consolidated tape, reducing overall transparency.

The current data pricing models of the exchanges bundle both quote and trade data together, across a broad range of stocks. Most of this cost reflects the perceived commercial value of the quote data, as this is what drives price formation and discovery.

Because of the bundled quoted and trade model, coupled with the incremental cost of new OTC trade reporting facilities, buy-side firms argue that the cost of a consolidated tape is too high for most potential users. Relatively few firms subscribe to the OTC reporting services due to these cost pressures.

As a result, the buy-side firms for whom a consolidated trade tape would provide the most benefit believe the market is less transparent now than it was before MiFID, when most trade reporting was performed through the primary exchanges. They are calling for a more cost-effective model that properly reflects only the value of the trade data, not the quote and trade bundle.

Ideally, a revised model should be arrived at through commercial negotiation by data vendors with the different exchanges and Markit BOAT. However, the commercial interests of the various participants are not aligned, and initial discussions to date have made little progress.

Proposal 1: Ensure A Reasonable Cost for Consolidated Trade Data

To promote transparency, MiFID 2 should ensure that execution and trade publication venues make available their market data for inclusion in a real-time Consolidated Tape at a much lower price than is currently the case, ideally at marginal cost.

By contrast, the calculation and delivery mechanism of the Consolidated Trade Tape need not be imposed through regulation, as vendors can and do already provide this. Competition between vendors drives innovation to optimize data services supplied to financial markets. This will allow vendors the freedom to provide consolidated tape data segmented at country or regional level such as UK & Irish stocks, Euronext stocks, German stocks or Nordic stocks, as well as a single tape for all European Equities.

Chapter 4 Choosing the Optimal Stock/Venue Coverage for Consolidation

Issue: With growing market data volumes, a real-time consolidated quote across all European instruments and venues would pose a massive and unnecessary overhead for providers and be prohibitively expensive to consumers.

The consolidated quote need not cover all EU stocks. Competition between exchanges and MTFs in electronic trading on open order books has actually been focused in a small sub-set of the most liquid stocks; this comprises approximately 900 out of 6,750 stocks on CESR's list of "Shares Admitted to Trading on EU Regulated Markets". It is an even smaller percentage of the roughly 10,000 equities for which trades are reported by one or more venues across Europe as a whole.

Proposal 2: Simplify and Focus the Consolidated Quote

Simplify and focus the Consolidated Quote on just those stocks that exhibit sufficient fragmentation across transparent order books.

Limit this to only those stocks in which the MTFs choose to compete with the primary exchanges. Currently this represents just under 2,500 stocks, of which only about 900 actively trade on one or more of the MTFs.

Issue: Trade data is much more fragmented than pre-trade quote data and therefore requires far greater stock coverage.

In Europe, MiFID post-trade transparency obligations have created widespread fragmentation in trade publication. This has impacted not only the most liquid stocks covered by the MTFs but all European shares. Any constituent of the CESR list and beyond can be affected.

Proposal 3: Wider Stock Coverage for a Consolidated Tape

The stock coverage of the real-time Consolidated Trade Tape should include at least all CESR listed stocks.

Issue: OTC trade reports including Dark Pool trades have become a crucial ingredient of any consolidated tape.

Under MiFID, firms were obliged to publish all trades executed away from an exchange or MTF with the opportunity to publish them through different venues. As a consequence, MiFID Trade Reporting Services such as those operated by Markit BOAT and the main exchanges, have emerged; these currently represent about 33% of the turnover of all trades in European equities (source Thomson Reuters Equity Market Share Reporter).

In addition, another category of trading venue, Dark Pools, has also developed in Europe in the last two years. Some have developed from the internal matching business of the larger brokers such as Goldman's Sigma-X or Credit Suisse's Cross Finder and others have been launched as independent dark pools, such as Liquidnet and Posit. Whilst all publish their trades, generally through Markit BOAT, only the independent dark pools identify themselves within the feed.

Proposal 4: Wider Venue Coverage for a Consolidated Tape

A Consolidated Trade Tape should include coverage of not only the primary exchanges and the competing MTFs, but additionally the trade reporting services such as Markit BOAT and the dark pools operating as MTFs

Chapter 5 Enhancing Data Quality and Trust in Post-Trade Data

Issue: Shortcomings in trade reporting guidelines have led to unreliable data and actually lessened post-trade transparency.

The rules for determining what trades should qualify for publication are not clear. This has led to over-reporting by firms who believed that it was better to over-report than under-report. Also, there is no obligation on firms to classify the nature of the trades they publish. This has meant that specific types of trades, such as broker internal crossings, which are of particular interest, cannot be distinguished from other types, such as VWAP trades.

Proposal 5: Apply clear standards to Trade Reporting

The institutional buy-side, brokers and the MiFID trade reporting services must jointly come to an agreement on standards to minimize over-reporting of trades and to provide classification of trades to make the data more useful and the resulting standards should be formalized under MiFID regulation.

We understand that initiatives are already under way to reach agreement on these standards via working groups formed in the UK. Linking these trade reporting standards back to MiFID regulation will be critical to adoption and enforcement across the EU.

Issue: Many firms publish their trades to undisclosed venues or to proprietary web sites, further limiting post-trade transparency.

Current MiFID rules do not obligate firms to disclose where they are publishing their trades. This has led to uncertainty about which firms publish where, and have raised some concerns that firms may deliberately suppress transparency by reporting to obscure venues.

Moreover, current MiFID rules allow firms to publish trades to their own proprietary websites – while this might be convenient and cost-effective for the publishing firm, this data cannot be reliably incorporated into a Consolidated Tape.

Proposal 6: Limit Trade Reporting to Proprietary Websites

Firms should only publish to proprietary websites to meet their trade publication obligations where reporting via a MiFID trade publication service is not available at reasonable cost.

Proposal 7: Require Firms to be Transparent about Where they Trade Report

MiFID 2 should obligate firms to be transparent about what mechanism they have selected to meet their trade publication obligations and to identify to their regulators any occasions where they have chosen to use alternative means.

Issue: Errors in OTC trade reports are common, and no one is held accountable.

There is no mechanism for policing the quality of trade reports; and there is also no mechanism by which firms who report erroneous data can be held accountable for doing so. This has led to a poor standard of reporting at venues that do not apply quality checks, reducing the overall reliability and usefulness of OTC data.

Proposal 8: Regulatory Monitoring of the Quality of Trade Reporting

MiFID 2 should ensure proper monitoring of the quality of trade reporting by firms, either by requiring the OTC reporting services to provide it, or through regulators requiring firms to disclose statistics about the accuracy and timeliness of their reporting.

Issue: Given disparate symbologies across competing venues, how can one reliably link quotes and trades from different venues?

In representing a consolidated quote or consolidated trade tape, it is important to include data that represents not only the same line of stock as defined by a common ISIN code, but also where that stock trades in the same currency and where it settles in the same depository. Otherwise, the costs of FX conversion and of moving stock from one depository to another can turn an apparently superior quote in a stock to an inferior one in terms of total cost to trade. ISIN codes are not unique to the currency of trade or the settlement venue, so consolidation of data at ISIN code level is not sufficient.

SEDOLs are well established as a globally unique stock identifier. UMTF codes have been established by MTFs as a common identifier for the stocks they trade in.

Currently, the MiFID trade reporting services only identify stocks at the ISIN and currency level which leaves the data consolidator needing to default their reporting into a specific SEDOL. In the majority of stocks this would not be an issue, but for any stocks that trade in the same currency but settle differently like ST Micro & EADS, this could be inaccurate.

Proposal 9: Use Existing Unique Stock Identifiers

To ensure only comparable stocks are linked when computing a consolidated quote or trade tape, only include data with the same unique stock identifier, namely SEDOL or UMTF codes.

Proposal 10: Map all Trades to Unique Stock Identifiers

All MiFID OTC reporting services should provide a means to map trades they publish to SEDOL and/or UMTF codes.

Examples of stocks that require mapping at SEDOL or UMTF level are provided below.

Stock	ISIN	RIC	Currency	SEDOL	UMTF	Clearing & Settlement
ST Micro	NL0000226223	STM.PA	€	5962332	STMp	LCH Clearnet & Euroclear Paris
ST Micro	NL0000226223	STM.MI	€	5962343	STMm	Monte Titoli
EADS	NL000235190	EAD.PA	€	4012250	EADp	LCH Clearnet & Euroclear Paris
EADS	NL000235190	EAD.DE	€	4012346	EADd	Eurex & Clearstream
Royal Dutch Shell A	GB00B03MLX29	RDSa.L	£	B03MLX2	RDSAi	LCH Clearnet & Crest
Royal Dutch Shell A	GB00B03MLX29	RDSa.PA	€	BO9CBL4	RDSAa	LCH Clearnet & Euroclear Paris

Issue: Without complete and accurate trade time stamps, trade reports will distort a consolidated tape.

MiFID requires that all trades are published immediately and, in any case, within three minutes of execution. Where the size of a trade represents a multiple of Normal Market Size, firms are permitted to delay its publication by a matter of hours or even days. So the time of publication of OTC reported trades can differ substantially from the time of execution.

In representing these trades in a trade tape, it is important to identify the time of execution. Currently only Markit BOAT provides an execution timestamp on each published trade as well as a flag to identify trades whose reporting has been delayed.

Proposal 11: Mandatory Execution Timestamps

All reporting venues and MiFID OTC reporting services that publish trades for which the execution and publication times materially differ should provide an execution timestamp on the trades they publish as well as the time of publication as well as a flag identifying delayed reporting.

Chapter 6 Data Consolidation and Transaction Cost Analysis

Transaction Cost Analysis (TCA) is the comparison of the prices achieved in executing trades against a number of benchmarks calculated from quote and trade data in that stock in the relevant timeframe. Where the trading of a stock is fragmented across different trading venues, it is important that consolidated data is used in the calculation of these benchmarks.

There are two basic types of benchmark used.

Best Bid-Offer (BBO). Where an order can be executed immediately in the market, because it is a size that can be executed without impacting the market price, the benchmark generally used is the Best Bid-Offer (BBO) at the time the order was received. Where there is a difference between the price achieved and the BBO, this is often referred to as the “market impact” of the order.

Volume Weighted Average Price (VWAP). Where an order is of a larger size and would require to be executed over a longer period to limit the impact of the order on the market price, the benchmark generally used is the Volume Weighted Average Price (VWAP). The VWAP is a calculation of the average price of executed orders within a period of time relevant to that order, where the calculation adjusts for the size of the executed orders. There are many variants to the calculation of the VWAP based upon the timeframe used such as:

- Arrival to EOD VWAP – measured from the time of the order arrival to the end of the trading day
- Interval VWAP – measured from the time of the order arrival to the time of the completion of the order
- Volume Consumption VWAP – measured from the time of the order arrival to the time that the shares executed to reflect a specific percentage of the overall traded volume of shares such as 33%
- Day VWAP – the VWAP for a complete trading day

Establishing Open Standards for TCA

TCA vendors have developed variants of BBO & VWAP and other more complex benchmarks to try and address specific requirements of their clients and to differentiate their service.. This reflects that the TCA market is highly competitive.. However concerns have been raised about inconsistencies between vendors in the calculation of basic benchmarks.

Proposal 12: Standards for BBO & VWAP benchmarks

An agreement should be reached between vendors on standardizing the calculation and transparency of the basic consolidated BBO & VWAP benchmarks.

This standard should cover the following:

- The formulas used
- The types of venues used in consolidating the data
- The types of quote used in calculating a basic BBO (bid, offer, mid)
- The trade types used in calculating a basic VWAP (order-book, auction, dark, on-exchange reported, OTC)

In Appendix B we have provided the formulas Thomson Reuters uses in calculating our own basic BBO & VWAP benchmarks.

Proposal 13: Simplify and Focus Consolidated BBO

The BBO should reflect a real-time consolidated quote where the stock is subject to fragmentation across transparent order books from multiple venues. For those stocks in which there is only a single source of pricing, the BBO would be sourced from that venue.

Proposal 14: Two Consolidated VWAPs

We propose that there be two types of basic consolidated VWAPs.

- **Order Book VWAP.** This is based on order book trades only.
- **Total VWAP.** This is based on order book trades, auction trades, dark pool trades and trades that are reported on-exchange in real-time. This would exclude all MiFID OTC reported trades until these include trade classifications that would allow only relevant trades to be included.

In Appendix C we provide a description of the seven standard trade classifications into which all reported trades are mapped in our Equity Market Share Reporter (EMSR) on a global basis. We may well add to this list the additional trade types for OTC trades to be established. Within Thomson Reuters Global TCA service we are able to select from within this list of trade types when calculating different types of VWAP benchmark.

Appendix A Examples of the Cost of Complete Trade Data

Vodafone Reported Turnover by venue October 2009 - source Thomson Reuters Equity Market Share Reporter									
Trade Month	Venue	Transparent Order Book Non-Auction	Auction	Dark Order Book	On-Exchange Reported	Off-Exchange OTC	Grand total of Turnover EUR	Grand total of %	Cost of Real time L1 data per user per month
2009-10	LSE	€ 2,833,421,658	€ 829,699,064		€ 923,094,907	€ 267,778,822	€ 4,853,994,451	30.78%	£26.51 = €29.50
2009-10	BOAT					€ 4,630,412,844	€ 4,630,412,844	29.36%	€30 from January
2009-10	ENX Paris					€ 3,290,594,672	€ 3,290,594,672	20.87%	€7 for OTC data only
2009-10	CHI-X	€ 1,654,157,770		€ 45,174,503		€ 16,172,725	€ 1,715,504,997	10.88%	€ 0
2009-10	BATS	€ 657,912,837		€ 15,859,153		€ 0	€ 673,771,990	4.27%	€ 0
2009-10	Turquoise	€ 260,991,676		€ 21,633,910		€ 0	€ 282,625,585	1.79%	€ 0
2009-10	Nasdaq OMX	€ 201,465,023		€ 13,150,789		€ 0	€ 214,615,812	1.36%	€ 0
2009-10	Plus				€ 43,241,443	€ 0	€ 43,241,443	0.27%	£15 = €16.68
2009-10	Xetra	€ 17,764,216	€ 435,028			€ 20,271,288	€ 38,470,532	0.24%	€56 + €9 for OTC
2009-10	Frankfurt				€ 7,346,880	€ 0	€ 7,346,880	0.05%	Included in the package for Xetra data
2009-10	NYFIX			€ 6,974,594		€ 0	€ 6,974,594	0.04%	Included in BOAT data
2009-10	POSIT			€ 6,471,797		€ 0	€ 6,471,797	0.04%	Included in BOAT data
2009-10	Stuttgart				€ 302,438	€ 1,929,433	€ 2,231,871	0.01%	Included in the package for Xetra data
2009-10	Liquidnet			€ 1,863,792		€ 0	€ 1,863,792	0.01%	Included in BOAT data
2009-10	NYSE Arca	€ 963,599				€ 0	€ 963,599	0.01%	€ 0
2009-10	Smartpool			€ 138,440		€ 0	€ 138,440	0.00%	Included in Euronext OTC data
2009-10	Hamburg				€ 131,843	€ 0	€ 131,843	0.00%	Included in the package for Xetra data
2009-10	Munich				€ 36,401	€ 0	€ 36,401	0.00%	Included in the package for Xetra data
2009-10	Duesseldorf				€ 29,315	€ 0	€ 29,315	0.00%	Included in the package for Xetra data
2009-10	Equiduct	€ 9,053				€ 0	€ 9,053	0.00%	€ 10
2009-10	Stockholm					€ 5,386	€ 5,386	0.00%	€0 for OTC data only
2009-10	Berlin				€ 2,678	€ 0	€ 2,678	0.00%	Included in the package for Xetra data
Grand total	Grand total	€ 5,626,685,831	€ 830,134,092	€ 111,266,977	€ 974,185,905	€ 8,227,165,170	€ 15,769,437,975	100.00%	€ 157.18

BMW Reported Turnover by venue October 2009 - source Thomson Reuters Equity Market Share Reporter									
Venue	Transparent Order Book Non-Auction	Auction	Dark Order Book	On-Exchange Reported	Off-Exchange OTC	Grand total of Turnover EUR	Grand total of %	Cost of Real time L1 data per user per month	
Xetra	€ 1,674,584,779	€ 574,084	€ 296,504,675			€ 2,291,683,178	51.29%	€56	
BOAT					€ 320,019,640	€ 948,490,124	21.23%	€20 from January	
CHI-X	€ 539,476,377	€ 10,260,799			€ 948,490,124	€ 554,824,670	12.42%	€ 0	
ENX Paris					€ 230,731,293	€ 230,731,293	5.16%	€7 for OTC data only	
Turquoise	€ 141,206,314	€ 6,378,794				€ 147,585,107	3.30%	€ 0	
BATS	€ 99,231,269	€ 6,957,379				€ 106,188,648	2.38%	€ 0	
LSE				€ 53,323,376	€ 35,018,742	€ 88,342,117	1.98%	£3.50 + €3.90 for OTC data only	
Nasdaq OMX Europe	€ 41,742,190	€ 1,276,052				€ 43,018,242	0.96%	€ 0	
Stuttgart				€ 5,676,614	€ 26,411,040	€ 32,087,654	0.72%	Included in the package for Xetra data	
Frankfurt				€ 8,318,146		€ 8,318,146	0.19%	Included in the package for Xetra data	
Italy	€ 2,209,211		€ 17,060		€ 1,683,644	€ 3,909,915	0.09%	€ 12	
NYFIX		€ 3,320,343				€ 3,320,343	0.07%	Included in BOAT data	
Stockholm					€ 1,848,510	€ 1,848,510	0.04%	€0 for OTC data only	
Liquidnet		€ 1,542,532				€ 1,542,532	0.03%	Included in BOAT data	
Munich				€ 1,306,951		€ 1,306,951	0.03%	Included in the package for Xetra data	
POSIT		€ 1,232,576				€ 1,232,576	0.03%	Included in BOAT data	
NYSE Arca	€ 1,043,466					€ 1,043,466	0.02%	€ 0	
Hamburg				€ 818,603		€ 818,603	0.02%	Included in the package for Xetra data	
Duesseldorf				€ 779,218		€ 779,218	0.02%	Included in the package for Xetra data	
Swiss	€ 359,456		€ 202,022			€ 561,478	0.01%	CHF 15 = €9.93	
Hannover				€ 174,393		€ 174,393	0.00%	Included in the package for Xetra data	
Berlin				€ 157,648		€ 157,648	0.00%	Included in the package for Xetra data	
Vienna					€ 130,838	€ 130,838	0.00%	€10 for OTC data only	
Plus				€ 23,471		€ 23,471	0.00%	£15 = €16.68	
Grand total	€ 2,499,853,061	€ 31,542,559	€ 296,723,757	€ 70,578,420	€ 1,569,421,326	€ 4,468,119,123	100.00%	€ 135.51	

Carrefour Reported Turnover by venue October 2009 - source Thomson Reuters Equity Market Share Reporter									
Venue	Transparent Order Book Non-Auction	Auction	Dark Order Book	On-Exchange Reported	Off-Exchange OTC	Grand total of Turnover EUR	Grand total of %	Cost of Real time L1 data per user per month	
ENX Paris	1,691,840,911		442,283,331	69,088,545	452,610,543	2,655,823,330	56.19%	€59	
BOAT				0	1,187,700,774	1,187,700,774	25.13%	€20 from January	
CHI-X	468,012,276	7,571,715			4,585,427	480,169,418	10.16%	€ 0	
Turquoise	140,705,740	3,475,597			0	144,181,337	3.05%	€ 0	
BATS	93,008,004	7,356,375			0	100,364,379	2.12%	€ 0	
Nasdaq OMX Europe	54,221,187	908,898			0	55,130,085	1.17%	€ 0	
Xetra	1,673,242		38,521		43,179,201	44,890,964	0.95%	€56 + €9 for OTC	
LSE				31,803,011	6,042,127	37,845,139	0.80%	£3.50 + €3.90 for OTC data only	
Stuttgart				269,978	10,470,737	10,740,716	0.23%	Included in the package for Xetra data	
Italy	443,304		4,617		3,678,916	4,126,836	0.09%	€ 12	
NYFIX		2,952,187			0	2,952,187	0.06%	Included in BOAT data	
Stockholm					1,038,205	1,038,205	0.02%	€0 for OTC data only	
Frankfurt				853,535		853,535	0.02%	Included in the package for Xetra data	
POSIT		527,198			0	527,198	0.01%	Included in BOAT data	
Munich				131,554		131,554	0.00%	Included in the package for Xetra data	
Vienna					29,850	29,850	0.00%	€10 for OTC data only	
Duesseldorf				28,333		28,333	0.00%	Included in the package for Xetra data	
Plus				26,212		26,212	0.00%	£15 = €16.68	
Hamburg				1,528		1,528	0.00%	Included in the package for Xetra data	
Berlin				1,083		1,083	0.00%	Included in the package for Xetra data	
Grand total	2,449,904,663	22,791,971	442,326,469	102,203,780	1,709,335,780	4,726,562,663	100.00%	€ 183.90	

Appendix B Formulas for the Calculation of VWAP and BBO Benchmarks

The VWAP for a single market is the volume-weighted average trade price for all trades executed on a selected market.

$$VWAP(t_1, t_2) = \frac{\sum_{\text{all trades from } t_1 \dots t_2} \text{trade volume} \cdot \text{trade price}}{\sum_{\text{all trades from } t_1 \dots t_2} \text{trade volume}}$$

For example:

Time	Type	Price	Volume
10:00:00	Trade	10.56	300
10:02:00	Trade	10.62	500
10:03:00	Trade	10.59	1000

For the time period shown:

$$VWAP = (10.56 \cdot 300 + 10.62 \cdot 500 + 10.59 \cdot 1000) / (300 + 500 + 1000) = 10.5933$$

Arrival-to-EOD VWAP

Start – Arrival time

End – End of the trading day

Interval VWAP

Start – Arrival time

End – Time of the last trade

Volume Consumption VWAP (10%, 25%, 33% and 50%)

Start – Arrival time

End – whenever the client's executed shares represent x% of the overall traded volume on the reference market(s)

Day VWAP

Start – Start of the trading day

End – End of the trading day

Best Bid or Offer (BBO) compares the touch price at a particular point in time with the average execution price of the order or the execution price in case of a trade. The touch price is the market bid for a sell order and market offer for a buy order.

If there are no trades at the particular point in time, then the closest trade that happened before this time is used.

Appendix C Existing Thomson Reuters Trade Classifications

The following trade classification is used in the Thomson Reuters Equity Market Share Reporter and is accessible in the Thomson Reuters Global TCA service.

Transparent order book trades Non Auction. Trades generated by trading on electronic open limit order book excluding trades executed during an auction period.

Auction Trades. Trades executed during an auction period operated by electronic open limit order book.

Dark order book trades. Trades generated by a dark pool of liquidity.

Real time On exchange reported trades. Trades reported under the rules of an exchange which may be as a result of trading on quotes from market makers or just OTC trades reported under the rules of a regulated market or ATS/MTFs to which no delay in reporting has been applied.

Delayed On exchange reported trades. Trades reported under the rules of an exchange which may be as a result of trading on quotes from market makers or just OTC trades reported under the rules of a regulated market or ATS/MTFs to which a delay in reporting has been applied.

Real time Off Exchange (OTC). Trades reported through pure reporting venues like Markit BOAT or the equivalent services offered as off-exchange reporting by the exchanges such as Euronext or Nasdaq OMX to which no delay in reporting has been applied.

Delayed Off Exchange (OTC). Trades reported through pure reporting venues like Markit BOAT or the equivalent services offered as off-exchange reporting by the exchanges such as Euronext or Nasdaq OMX to which a delay in reporting has been applied.

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