

## ITG's Prism Methodology: Identifying Distinct Trading Styles | Bacidore, Berkow, Polidore and Saraiya



At the intersection of markets and technology, Insights provides ITG's global perspectives on market structure, analytics and research, and liquidity.

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High-touch traders actively move orders in and out of the market over time. Slicing “parent” orders into “child” orders, though, makes it difficult to deduce the underlying trading strategy of the parent order and evaluate its performance. Looking at the percent filled over time for a single parent order can give us insight into the trader's strategy and suggest appropriate benchmarks for that order. However, an aggregated progress chart for many parent orders may not be useful because it aggregates across the various types of strategies a trader may use. For example, a trader whose aggregated parent orders have the progress chart shown in Figure 1 may appear to be a VWAP trader since his average progress resembles VWAP. In reality, this trader may use several different strategies (e.g. target open, target close, participate at 5%) that resemble VWAP when viewed *in aggregate*, even if the trader had never targeted full-day VWAP on a single order.

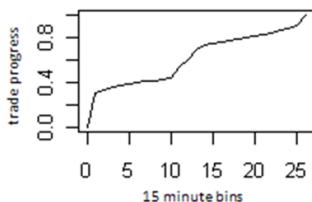
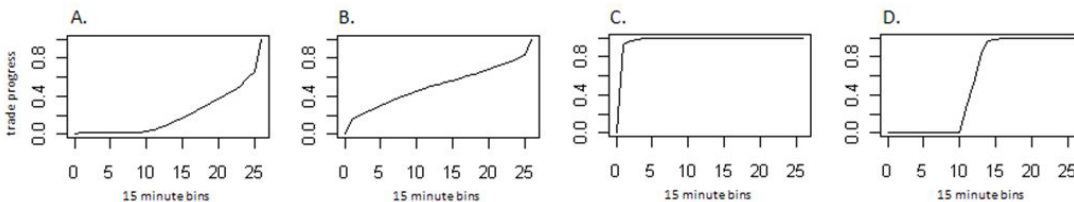


Figure 1. This is an example of the fill progress chart for all orders in a sample dataset aggregated together. The horizontal axis represents time from 9:30 AM – 9:45 AM (bin 1) to 3:45 PM – 4:00 PM (bin 26); the vertical axis represents percent of the order completed.

In this paper, we develop a methodology called ITG's prism methodology, which identifies a client's most distinct trading strategies. To do this, prism creates a progress chart for each order and uses a well-established clustering methodology called *k-means*<sup>1</sup> to group the curves into *k* distinct trading styles. We use a proprietary algorithm to determine the number of clusters represented in the dataset, as *k-means*<sup>1</sup> requires this specification prior to classification.

To demonstrate prism's potential, we present the analysis of a sample of full- and half-day market orders sent to VWAP and ACTIVE.<sup>2</sup> Our aim is to show that prism can distinguish the progress patterns of the distinct algorithms and trading horizons present in the sample. For this sample, prism has identified four trading styles and classified orders within them with remarkable accuracy. The results in Figure 2 show the four strategies<sup>3</sup> prism identified in the sample that create the VWAP-like aggregate progress chart shown in Figure 1. Figure 2A represents half-day VWAP orders; 99.7% of the corresponding sample orders were correctly assigned to strategy A. Figure 2B represents full-day VWAP orders; 99.5% of corresponding sample orders were assigned to strategy B. Figure 2C represents ACTIVE<sup>2</sup> orders starting before 9:40 AM; 98.5% of corresponding sample orders were assigned to strategy C. Figure 2D represents half-day ACTIVE orders (those starting between 12:00 and 12:50 PM); 98.2% of corresponding sample orders were assigned to strategy D.

Figure 2. Trading styles identified from ITG Algorithms data; example results for sample full- and half-day VWAP and ACTIVE orders.



<sup>1</sup>K-means clustering is a popular statistical methodology that groups observations on any number of variables into *k* distinct groups by iteratively minimizing the distance from each observation to its cluster's center. For more information, see: (1) Johnson, Richard A. and Dean W. Wichern. *Applied Multivariate Statistical Analysis*, Sixth Edition. Upper Saddle River, New Jersey: Pearson Prentice Hall, 2007. (2) MacQueen, J. B. "Some Methods for Classification and Analysis of Multivariate Observations." *Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability*, 1, Berkeley, CA: University of California Press (1967), 281-297.

<sup>2</sup>ACTIVE is ITG's implementation shortfall algorithm. The sample included full- and half-day VWAP and ACTIVE market orders of more than 500 shares between January 1, 2011 and September 31, 2011. Full-day sample orders begin before 9:40 AM; sample half-day orders begin between 12:00 and 12:50 PM. VWAP orders must end after 3:20 PM. ACTIVE orders began before 9:40 AM or between 12:00 and 12:50 PM and ended at anytime.

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ITG's prism methodology is powerful enough to detect distinct trading strategies; so how can we apply this methodology to analyze high-touch trading? First, we can use prism to identify underlying trading strategies for large client orders. Figure 3 shows the prism output for a hypothetical client. For this client, the output shows three distinct fill trajectories—trading into the close (3A), front-loaded trading (3B), and participation-based trading throughout the day (3C). Further, prism can uncover less dominant strategies where they may be otherwise missed (as is evidenced in Table 1, showing that only 5% of value was executed via strategy C). This gives traders the ability to experiment with trading strategies, letting prism recognize and evaluate them.

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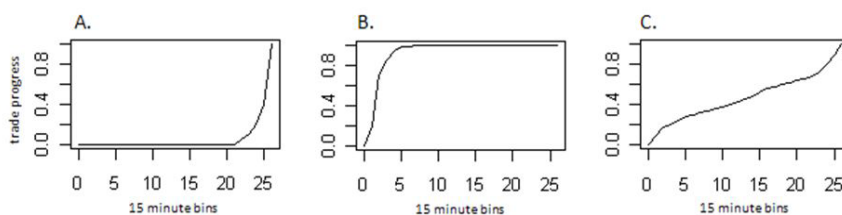
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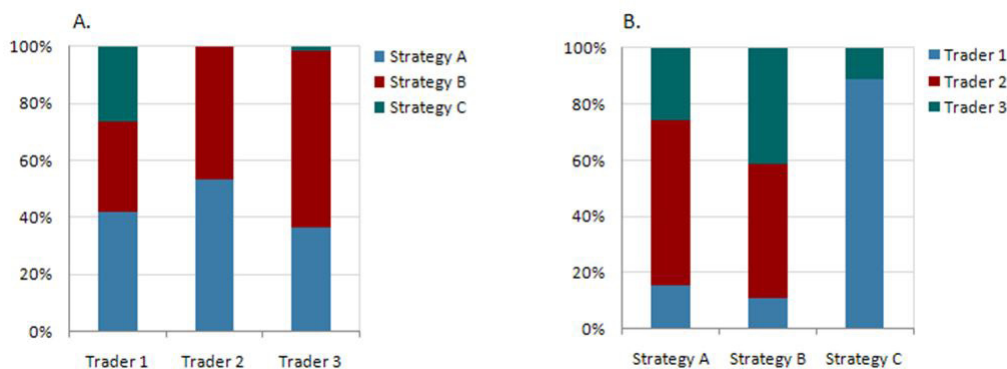
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**Figure 3. Hypothetical client trades aggregated over the day and grouped by style via k-means and ITG's proprietary cluster selection algorithm. Three distinct trading strategies emerge from the data.**



Second, for desks with multiple traders, prism can be used to characterize which traders use which strategies. The diagrams in Figure 4 show trader usage of the strategies identified by prism. For example, we can see that Trader 1 is the dominant user of strategy C, but C makes up only 25% of Trader 1's trading by value. Using prism, we can report how often each style was used and understand the trades composing each strategy—by trader, size, market capitalization, quarter, volatility group, and so on.

**Figure 4. Breakdown of trader usage of strategies for hypothetical client analysis shown in Figure 3 and Table 1. Traders within strategies (Figure 4B) and strategies within traders (Figure 4A).**



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<sup>3</sup>The representative fill progress chart for each cluster (trading style) shown in Figure 2 is each cluster's center, as defined by the k-means algorithm.

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Beyond usage patterns, ITG's prism methodology delivers the ability to evaluate trades according to appropriate benchmarks, identifying which strategies are most successful. Why compare all executions to the close benchmark if 10% of orders were actually front-loaded and 5% traded in a VWAP algorithm? Prism implicitly provides suggestions concerning the benchmark a given trader may have been targeting, which can help us better evaluate performance. For example, Trader 1 may use strategy A when benchmarked to close, B when benched to the open and C when benched to VWAP. Table 1 indicates that strategy A is performing well versus the close benchmark, strategy B is performing well versus arrival and open, and strategy C is performing well versus VWAP benchmarks. These results are intuitive since traders likely target different benchmarks across strategies. The ability to infer benchmarks is especially useful for traders whose systems do not permit benchmark information to flow to their post-trade databases.

**Table 1. Performance results for hypothetical client orders grouped into trading styles illustrated in Figure 1 by ITG's prism methodology.**

Strategy	Orders	Filled Shares	% Value	% Fill Rate	% POSIT	Arrival	Net ACE	Open	Close	Prev Close	Day VWAP	Interval VWAP
A	10,334	40,002,390	46%	78%	10%	-3	2	-1	1	1	-8	8
B	17,957	46,238,100	49%	68%	28%	-6	10	4	-2	-12	-2	2
C	3,940	3,834,795	5%	80%	32%	-17	-1	-13	-6	-9	2	1

Finally, prism can evaluate trader performance in the context of the underlying trading strategies. If a given trader is under- or outperforming his peers, prism can help identify the strategies driving relative performance. For example, if Trader 1 strongly underperforms his peers, it may be due to his overuse of strategy C, which Table 1 shows is the worst-performing strategy relative to the pre-trade ACE benchmark. More generally, Table 1 could show which strategies do best against each benchmark. ITG's prism methodology makes usage and performance metrics for high-touch trading relevant and useful by helping traders and portfolio managers understand their underlying trading styles, suggesting suitable performance benchmarks, and identifying tactics for improvement.

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