Implementation of Hedge Fund Strategies

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A hedge fund's principals spend countless hours developing their investment strategy. After extensive backtesting and simulated trading, they finally "go live"—only to discover that actual performance falls far short of their return expectations.

How many times has this scenario played out? It's an all too common occurrence. Important as it is to have a sound strategy for generating alpha, implementation of that strategy is just as critical. After all, actual returns aren't solely the product of a manager's investment ideas; they also reflect the costs incurred in the process of implementing those ideas.

This article discusses practical solutions hedge fund managers can use to increase returns and manage risk through the careful implementation of investment ideas. I focus primarily on equities, although the discussion applies equally well to other asset classes.

For all investment managers, the challenge is to produce superior *realized* returns relative to a given benchmark within specified levels of risk tolerance. But hedge funds face particular implementation pitfalls, due partly to the nature of their trading strategies. Those whose strategies entail high turnover and aggressive trading on short-lived information are the most likely to incur onerous transaction costs. As many managers have learned, transaction costs can substantially reduce—and sometimes even eliminate—the notional or paper returns to an investment strategy.

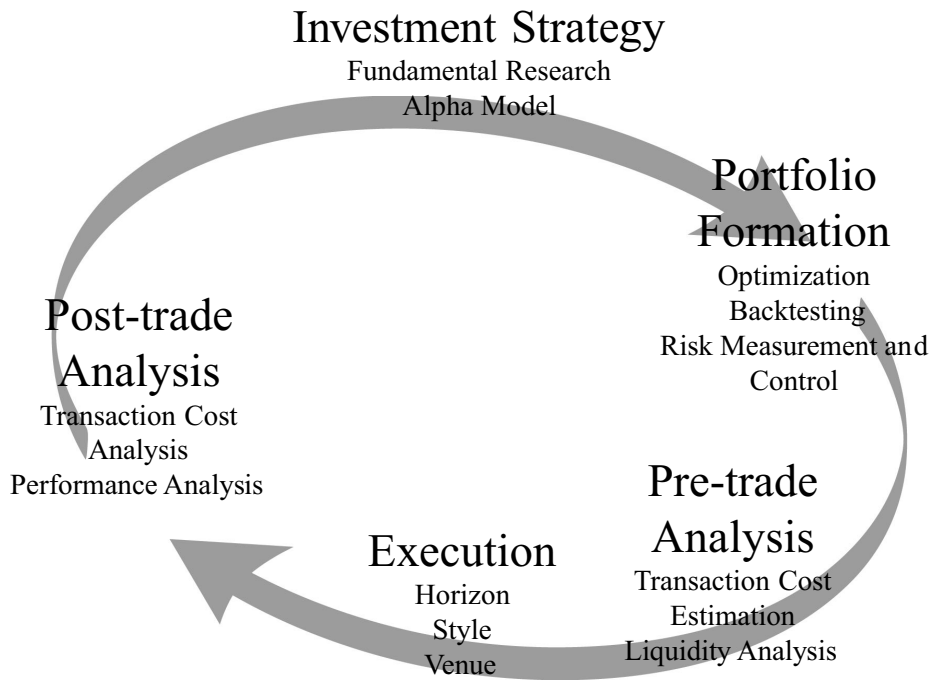
Many hedge fund managers view transaction costs as simply part of the price of doing business—a tax that must be paid. In reality, they have many options for reducing implementation costs, from automation of routine trading tasks to intelligent discovery of liquidity to analysis of hidden cost factors. Such measures can also help to leverage human capital by increasing productivity. Performance can be further enhanced by the use of tools factoring in tax and risk awareness. Finally, post-trade analysis can point to areas for improvement by highlighting avoidable mistakes. Hedge fund managers can generally significantly increase net alpha by focusing attention on all steps in the investment cycle.

THE INVESTMENT CYCLE

As hedge fund managers develop and refine their methods, they typically focus most attention on the formulation of an investment strategy and the use of fundamental research or alpha models as aids in stock selection or tactical asset allocation. As illustrated in Exhibit 1, the investment process can be conceptualized as a cycle in which the development of investment strategies and ideas is only the beginning.

The *implementation* of investment ideas encompasses multiple steps—portfolio formation, pre-trade analysis, actual execution, and post-trade analysis. The last step provides input for the reformulation of the underlying invest-

EXHIBIT 1
Investment Cycle



ment and trading strategies, taking us back to the very beginning of the process.

The key point is that the formulation of investment ideas is a critical element of the overall process, but by no means the only element. Once equipped with the conceptual framework shown in Exhibit 1, we can ask how managers can better implement their investment ideas.

PORTFOLIO OPTIMIZATION AND RISK CONTROL

Implementation begins when investment ideas are translated into desired portfolios. For managers involved in list trading, portfolio optimizers and risk models are two essential tools for efficient balancing of the risk-return trade-off at the portfolio level.

Portfolio Optimizers

Many hedge fund managers use portfolio optimizers to create mean-variance-efficient portfolios that strike the appropriate balance between risk and return. These optimizers might be run once a month or used throughout the trading day. Other fund managers do not feel that tools like optimizers or risk models are necessary. Event-driven strategies, for example, usually do not involve large numbers of securities and do not necessitate complex analysis.

Often investment managers believe they can neutralize risk by building long and short positions in stocks matched by industry or sector, even for large portfolios. This approach is especially popular with managers pursuing statistical arbitrage strategies (e.g., pairs, long/short). Optimizers, however, can provide better hedges than simple matching approaches; by achieving lower risk for the same expected return, they can allow managers to have their cake and eat it too.

Rathjens [2001] makes this point with an excellent example. He notes that a position long Microsoft and short Cisco might have more risk (through exposure to a momentum factor) than a position long Aegon (a Dutch insurance company) and short the National Bank of Belgium (a Belgian bank), even though the latter position involves both country and industry risk.

Optimizers are also essential tools for tax-aware investing, a point of considerable importance, given the recent Securities and Exchange Commission guidelines concerning after-tax return reporting. Loss harvesting, for example, can produce superior after-tax returns. Optimizers can help identify these opportunities much faster

EXHIBIT 2
Desirable Features of Portfolio Optimizers

Feature	Description
Exact Modeling	Precisely models the portfolio risk-return trade-off including integer constraints imposed by minimum trade or position count, minimum position weights, or taxes. Many optimizers simply provide approximations using quadratic methods.
Objective Function	Should allow terms to be added as needed, as opposed to fixed or prespecified objectives.
Dual-Benchmark	Permits optimization relative to two benchmarks simultaneously; useful for portfolio transitions.
Long/Short	Allows user to control exposures on each side separately.
Taxes	Exactly model, e.g., the tax code, wash sales, accounting rules.
International	Should allow multicountry, multicurrency, choice of numeraire currency.
Transaction Cost Models	Incorporate explicit and implicit costs, non-linear transaction cost models.
Backtesting	Direct extension of single optimization. Dependent on data and corporate actions data.
Automation	Full scripting and scheduling of all events.
Risk Models	Should allow the use of any risk model; hedge funds need models calibrated to their trading horizons.

and more efficiently than conventional methods. Finally, portfolio optimizers can factor in transaction costs and also help in historical backtesting of strategies.

A manager's choice of optimizer can affect results, as optimizers are by no means all alike, differing in important respects. Some of the optimizer features most important for hedge funds to consider are described in Exhibit 2.

While many hedge funds use home-grown systems, these rarely have the feature set of a proprietary model such as those offered by several services. For smaller funds, the lack of certain features may not be a limitation, but as portfolios grow in size and complexity, investment in a more robust solution is worthwhile. Often, the barrier to such an upgrade is not so much inertia, or a lack of appreciation of the value of a commercial optimizer, but rather the difficulty of replacing a home-grown system that is integrated into a fund's current processes.

Risk Models

Risk modeling is the other essential tool for a large portfolio. Risk models are vital for hedge funds because they often take sizable active bets and use extensive leverage. These models are used both to forecast future risk (help in measuring and control) and to understand the past (explain the risks taken to achieve previous returns). Also, optimizers need risk models as inputs to accurately balance return against risk.

Risk models are also useful on the trading desk. Strategies involving rapid trading of large lists of stocks require monitoring to ensure that risk exposures (such as to sectors, industries, or factors) are within tolerance bounds. Risk models also help traders to ensure that their risk controls are appropriately matched to their trading horizons. For example, a hedge fund with a high daily turnover should compute risks over horizons of days or

a week, because return volatility for such a fund is primarily stock-specific.

PRE-TRADE ANALYSIS

Once a desired portfolio has been constructed, the next stage of the cycle is pre-trade analysis. This means estimating the costs of achieving the desired positions, formulating trading strategies, and assessing the liquidity in the assets to be traded.

Transaction costs include not only explicit costs such as commissions but also implicit costs, most importantly the market impact of the trade and the opportunity costs of failing to execute in a timely manner. See, for example, Perold [1988] and Lert [2001]. Empirical studies surveyed in Keim and Madhavan [1998] show that the costs of trading are economically significant. Costs in foreign markets are even higher on average than in U.S. markets, as shown by Domowitz, Glen, and Madhavan [2001].

For hedge funds, the drag on performance induced by costs is compounded by the fact that style is a major determinant of costs, as documented by Keim and Madhavan [1997]. Hedge funds following momentum or arbitrage strategies are more likely than traditional value players to use aggressive strategies (market orders, shorter trading horizons, less order breakup), and this can imply major differences in cost.

Transaction costs are also of special concern for hedge funds with high turnover; indeed, for some hedge funds, turnover rates exceed 50% per day. But even for less active funds, the drag on returns induced by trading costs can be significant.

To see this more clearly, note that realized portfolio performance or net alpha, before management fees, is:

$$\alpha = r^p - r^b - 2 \times T \times C$$

where r^p is the notional or paper return (a function of leverage), r^b is the benchmark return, T is percent turnover, and C is the one-way average trading cost as a percentage of value. Observe that the impact of costs on return is proportional to turnover.

Consider, for example, an active portfolio with an expected annual (notional) return of 15%, portfolio turnover of 600%, and trading costs of 0.75% of value. Total costs are 0.75% × 2 × 600% = 9% of portfolio value. Net alpha is 15% – 9% = 6%, which is only two-thirds of the cost of trading. A reduction in costs of just 5 basis points (0.05%) implies alpha rises to 6.6%, improving bottom-line performance by 10%.

Trading also affects volatility, a point generally not well understood. The standard deviation or volatility of net alpha is:

$$\sigma[\alpha] = \sqrt{\sigma^2[NTE] + (4 \times T \times Cov(NTE, C)) + (4 \times T^2 \times \sigma^2[C])}$$

where $\sigma[.]$ denotes standard deviation, *NTE* is the notional tracking error (i.e., the difference between paper and benchmark returns), and *Cov(NTE, C)* is the covariance between costs and tracking error.

Recall that trading costs include both explicit and implicit costs. While there is little variation in explicit costs (like commissions and taxes), implicit costs are much more volatile. Occasional gaps in liquidity can result in large market impact costs. Similarly, opportunity costs exhibit considerable variation across assets and time. Turnover can greatly magnify the contribution of variance in costs to overall return volatility.

Consider again the example portfolio. Suppose further that the standard deviations of trading costs and notional tracking error are 0.75% and 4%, respectively. Further assume that the covariance between costs and tracking error is negligible. Then, overall portfolio volatility is 21.9% for an expected Sharpe ratio of 0.27. This is probably a conservative estimate, since the covariance term is likely to be positive.

Intuitively, managers are probably more cost-conscious when they fall short of their benchmarks than when they exceed them. Of the total volatility, roughly 40% is attributable to costs, and the remainder to return variation arising from active bets relative to the benchmark portfolio.

Pre-trade analysis is an aspect of implementation that often receives too little attention from hedge fund managers. For example, some fund managers prefer to trade at the close, especially because some broker-dealers offer them market-on-close pricing at very favorable commission rates. For small trades in active securities, this is a very reasonable strategy, but many managers are unaware of the hidden costs of trading at the close.

Cushing and Madhavan [2002] show that market impact costs increase, on average, toward the close because market makers demand a premium to bear risk overnight. Further, they document sizable reversals in returns overnight and the next day associated with imbalances at the close.

EXECUTION

The examples point to the importance of pre-trade analysis. When that analysis has been completed and positions are taken in the execution stage, the trader or manager must make several decisions affecting transaction costs and, hence, net alpha—that is, *horizon* (one day, closing, opening), *style* (limit versus market orders), and *venue* (electronic communications network or market maker).

For hedge funds, what practical steps can be taken to improve execution quality? I focus on two specific steps appropriate for hedge funds: 1) automation, and 2) seeking liquidity.

Automation

Let's begin by reviewing the hedge fund strategies commonly adopted by equity funds. Typically these involve aspects of statistical arbitrage; that is, balancing a long position in one security against short positions in others. Examples include:

- Long/short strategies
- Pairs trading
- Merger/risk arbitrage
- Index arbitrage
- Exchange-traded fund or basket arbitrage

A common feature of these strategies is the need to simultaneously trade in more than one security. Pairs traders, for example, might monitor several thousand pairs of stocks, buying and selling when the price ratio deviates from some target range. Often these funds use so-called auto-trading systems to achieve their goals. Auto-trading systems can be programmed to send orders to the market according to a prespecified algorithm. For hedge funds with personnel constraints, auto-trading is a natural choice for routine tasks, allowing traders to focus on difficult trades where they can best add value.

As much as automated tools empower traders, they should always have a backup (in the event of a failure) in the form of a real brokerage desk. It is also true that automation tools can vary widely in features and capabilities. Good tools should benefit from smart trading heuristics and the latest research.

For example, some participation strategies break up orders over the day to mimic the day's volume pattern in the security. Several vendors offer such "slice and dice" auto-trading. But, if not properly designed, pure software solutions may not trade intelligently.

For example, they might send large market orders (that exceed the displayed depth at the prevailing quotes), resulting in high market impact costs. Or they might use naive historical volume patterns (as opposed to dynamic forecasts of the volume smile) to predict how best to trade over the day. This can result in errors such as, for example, trading too slowly relative to actual volume, and thereby missing the benchmark.

Given the role of costs in return volatility, the ability to correct a strategy in light of new market circumstances is a particularly important feature of auto-trading solutions, but this requires sophisticated monitoring tools that are often unavailable. Other features differentiating auto-trading systems include dynamic symbol universe, the ability to add symbols or pairs on the fly during trading, and editable trading algorithms that allow users to easily build and modify trading algorithms.

Seeking Liquidity

Less active funds that trade passively might benefit from searching for liquidity. U.S. equity markets are currently fragmented, as are the corporate bond markets. Accessing liquidity thus takes effort, but too many fund managers assume that searching for liquidity is not worthwhile. In reality, when even relatively modest decreases in trading cost can improve performance substantially, actively searching for liquidity is certainly worth the effort.

How can this be done? If the strategy is not based on information with a half-life in minutes, trading passively (using limit orders) provides an opportunity to earn negative trading costs. Using features such as reserve books, traders can conceal their intentions without displaying all their desired size. Even if passive trading is not desirable, breaking up orders over a longer horizon can substantially reduce trading cost.

Venue also makes a difference. Alternative trading systems represent valuable pools of liquidity. For example, POSIT®, an external crossing system, matches buyers and sellers eight times a day at the prevailing midquote. While crossing systems have traditionally appealed to large, passive institutional traders, today sophisticated hedge funds are among the most active users of this system, as it allows both parties to save on spread and market impact costs.

Smart trading technology can also overcome market fragmentation. For example, there are trading tools that allow a trader to "sweep" the over-the-counter market to capture all the liquidity across diverse execution venues.

EXHIBIT 3
Attributes Needed Transaction Cost Analysis

Feature	Description
Reporting Frequency	Ideally real-time or next-day reporting.
Cost Basis Benchmarks	Should be user-defined to appropriately match the trading style of the fund; common benchmarks include midpoint of bid-offer spread, volume-weighted average price over trade horizon, close, open.
Pre-Trade Benchmarks	Used to handicap actual trading costs. It is valuable if the pre-trade cost estimate used in optimization is also used to benchmark trading performance. Otherwise, peer group benchmarks computed by investment style are often used.
Reporting Features	Should permit drill-down to isolate underperformance; sort by common categories (buy/sell, exchange/OTC) or user-defined categories.

POST-TRADE ANALYSIS

The final step in the implementation process, post-trade analysis helps isolate poor trading strategies or brokers and illuminate the sources of over- or underperformance. Post-trade analysis is critical to reformulation of the underlying investment strategy and the way it is executed through trading. After the trade, return and transaction cost analyses are important tools to improve future realized performance.

Ideally, a manager should understand the sources of outperformance at a portfolio level. Hedge funds do this routinely using a variety of performance analysis methods, typically including stratification, style analysis, and risk analysis. Stratification, for example, allows a fund manager to decompose return into portions attributable to various categories (exchange rate movements, sectors), while risk analysis examines the source of over- or underperformance relative to the historical risks incurred.

Far fewer funds, however, devote the same attention to an analysis of their trading, again reflecting the assumption (implicit or otherwise) that transaction costs are not significant. Yet, systematic post-trade analysis is valuable in a number of respects. It can highlight problems with particular traders or brokers, leading to changes that increase net alpha. Formal post-trade analysis is also the basis for more informed compensation discussions with traders because their value can be better isolated.

Exhibit 3 describes the features desirable in post-trade analytical systems.

SUMMARY

Hedge funds expend considerable time and energy in developing investment strategies to generate alpha. Implementation of these ideas is of critical importance. There is now growing awareness that transaction costs can substantially reduce, perhaps even eliminate, the paper returns to a particular strategy. High turnover and aggressive trading on short-lived information exacerbate these problems for hedge funds.

I have isolated the essential elements of implementing hedge fund strategies, focusing on 1) risk control and portfolio optimization, 2) automation of routine trading tasks, and 3) transaction cost analysis. A concerted effort to improve implementation through all elements of the investment cycle can significantly increase net alpha.

ENDNOTE

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