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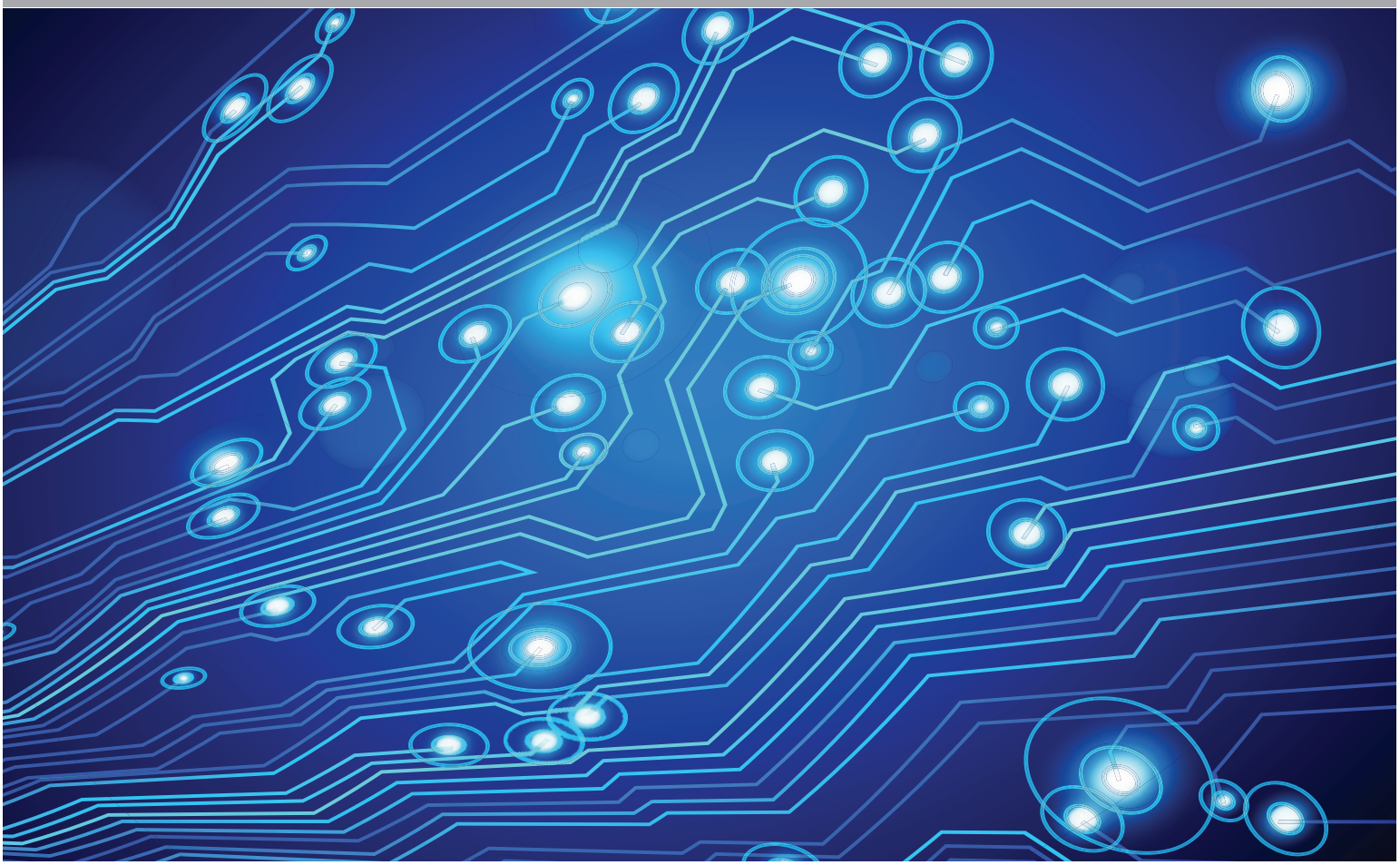
Citi Prime Finance

Managing Your Hedge Fund IT Spend to Achieve Differentiation

2011 Citi Prime Finance IT Trends & Benchmark Survey
A Prime Finance Business Advisory Services Publication



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Key Findings

Hedge fund IT spend in 2011 is forecast at $2.09 billion USD, equivalent to ~9 basis points of the industry's total AUM; while the bulk of these costs are charged back to the hedge funds' management company, the largest managers in the industry allocate up to 30% of this expense at the fund level.

- On average, hedge funds will allocate ~9 basis points of their underlying AUM toward covering their IT spend in 2011. This includes hardware, software, data and IT personnel.
- This equates to industry-wide IT spend of ~$2.09 billion USD in 2011. Franchise-sized firms with AUM in excess of $5.0 billion are expected to spend, on average, $7.9 million on technology in 2011—more than 13x the spend forecast for small funds with AUM less than $500 million.
- Small hedge funds charge nearly this entire amount of IT expense to their management company. As a manager's AUM grows, more of these expenses begin to be charged back at the fund level. The largest hedge funds are able to charge 20% to 30% of these costs back to the fund.
- The allocation of more costs to the fund rather than the management company can be considered an additional expense investors may have to pay to access capacity at these managers and reflects the ability for the largest funds to absorb these expenses without significantly impacting performance.

The threshold at which hedge funds will choose to "Buy" versus "Build" their desired software has shifted extensively in recent years as better solutions come to market; at present, hedge funds are focusing custom development work on risk management applications and on data management platforms that help with compliance and investment decision-making tools.

- Software innovation in the hedge fund industry has been driven by a set of large hedge fund managers who pioneer their own platforms when commercially available options fail to meet their complex requirements.
- Over time, these platforms, built for cutting-edge funds, become commercialized and ultimately commoditized, resulting in distinct "customization" waves in the hedge fund industry. The unfolding of this cycle informs when new capabilities become commercially available and thus influence a fund's buy-versus-build decisions.
- Foundational functions such as portfolio management and trading, part of the first wave of hedge fund technology investment, are now crowded with a multitude of vendors and outsourced service providers, as once-differentiated capabilities are now commoditized.
- With the industry's second wave now cresting, the availability of risk, finance and collateral management solutions that drive capital efficiency and optimization are increasing, offering a greater number of hedge fund managers more options on how to realize these capabilities.
- A new, third wave of hedge fund technology investment is beginning to form. Managers are contracting with specialty consultants to build unified data management platforms that consolidate the fund's reporting capabilities across formerly disparate functions.
- These emerging platforms provide hedge funds the flexibility they require to address evolving investor transparency and regulatory compliance demands. They also provide opportunities to create robust investment decision support tools that help managers focus on their alpha creation.
- Interest in such platforms is likely to continue to grow as specialty consultants spread best practices across the industry.

Infrastructure providers are leveraging new delivery models and cloud technology to offer emerging managers off-premises hosting abilities, allowing these funds to more quickly implement capabilities with less capital outlay; this marks a completely new model for the hedge fund industry, which we've dubbed "Hedge Fund 3.0."

- As has been the case for several years, hedge funds of all sizes will continue to leverage off-premises data centers to host their disaster recovery environments and suit their continuity of business needs.
- What has changed in recent years, however, is the emergence of a new breed of managed service providers focusing almost exclusively on the hedge fund space that are looking to leverage cloud computing technologies in order to offer "infrastructure-as-a-service."
- By utilizing these offerings, new funds looking to launch can speed their time to market while minimizing their capital expenditure. Having this option available also gives established hedge funds new opportunities to rethink their approach as certain trigger events occur.
- Growing funds will increasingly look to the "software-as-a-service" model for installing new applications, choosing whether to access these systems via the vendor's own hosted data center or via the infrastructure the manager itself rents from a managed service provider.
- Other funds will consider transferring pieces of their infrastructure to data centers as on-site hardware becomes obsolete and needs to be replaced.
- The largest funds, however, having an entrenched on-site data center model, are unlikely to adopt these technologies as cost savings are unlikely to balance the lost opportunities and disruptive potential that a massive migration project would entail.

Methodology

Welcome to the first annual Citi Prime Finance Hedge Fund IT Trends & Benchmark survey. The intent of this paper is twofold: to provide an independent set of metrics that offer insight into hedge funds' IT spend and approach, and to understand how those metrics are likely to shift over time given key IT trends and how they've shaped the industry in recent years.

The focus of this inaugural report is on hedge fund managers in the U.S. and Europe, and on those possessing a global footprint. Citi Prime Finance will release a separate IT survey on managers in the Asian-Pacific region later this year to better focus on the trends in that region.

To ensure that the data presented in this report is relevant to all of our clients and prospects, we have engineered a comprehensive approach to collecting information.

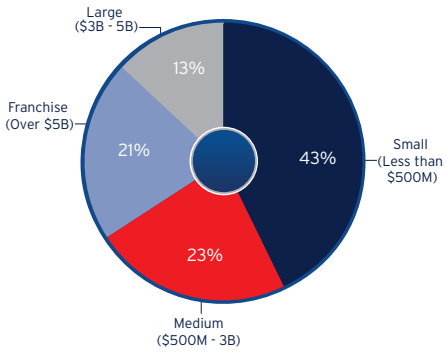
Three methods were used: an online survey captured information directly from IT decision makers at a representative set of hedge funds covering various AUM bands, strategies and vintages; primary interviews were conducted with a sample set of hedge fund CTOs, CFOs and COOs to discuss their IT plans and experiences; and primary interviews were done across a broad set of hedge fund IT vendors and service providers to understand their client interactions and concerns.

Triangulating quantitative and qualitative data from these three sources garnered us a holistic and broad view of the hedge fund technology landscape. In total, Citi Prime Finance collected information from more than 75 hedge funds and 15 vendors to formulate the findings in this report.

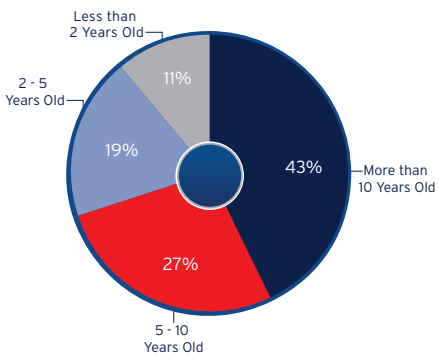
The profile of the 53 hedge funds providing actual benchmark data is highlighted below. AUM thresholds used to define the hedge fund segments cited in this report (small, medium, large and franchise) were based on research presented earlier this year by Citi Prime Finance in our publication entitled *Pension and Sovereign Wealth Fund Investment in Hedge Funds: The Growth and Impact of Direct Investing*. These categories relate to important institutional investor perceptions about the hedge fund market and align to how these increasingly dominant providers of capital determine many of their allocation decisions.

Profile of Survey Respondents

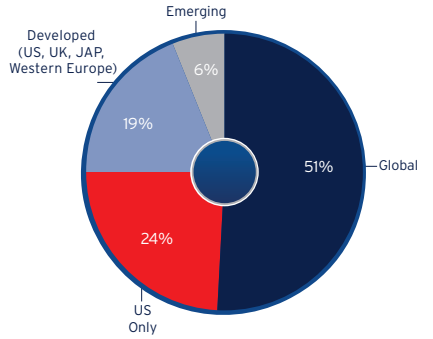
Profile of Survey Respondent AUM



Vintage of Survey Respondents



Geographic Investment Focus



Source: Citi Prime Finance

Introduction

By examining metrics provided by survey respondents, we project total hedge fund industry IT spend to be $2.09 billion in 2011. This figure covers IT personnel, hardware / networks, software and data costs. While this spend averages ~9 basis points of total industry AUM, hedge fund IT spending accounts for only a small portion (2.8%) of total securities and investment industry spend (estimated at $75.1 billion in 2011 according to Celent).

Although relatively small in dollar terms, hedge fund IT investments have a disproportionately large impact on advancing the capabilities of the overall financial services industry.

Hedge funds' innovative influence on investment strategies is well documented, but not as much attention is given to the dramatic impact hedge funds have had in driving financial services technology evolution. As organizations that succeed upon the strength of their investment returns, hedge funds are always on the lookout for opportunities that offer them an "edge."

For many of the industry's leading hedge funds, their technology investments were seen as helping them capture such edge as they sought to exploit divergence between what standard industry platforms offered and what the hedge fund itself felt that it could accomplish with technology through their own customizations.

Since this is our inaugural publication, **one goal of this report is to provide an overview of the evolution of hedge fund software** and discuss how a few pioneer managers' pursuit of differentiation through their IT investments have had a profound impact in transforming the offerings available to the entire capital markets landscape. We will also focus on where today's hedge funds are looking to differentiate themselves and spend money on IT customizations.

Since 2000, we at Citi Prime Finance have identified three distinct waves of technology innovation driven by hedge funds seeking differentiated capabilities. As will be shown, while the impact of these innovations has been extreme, the duration of such benefits for the fund itself is often limited. Efforts to commercialize their technology investment and commoditization pressures quickly erode the edge such firms enjoy. The result is the emergence of new service providers and more robust systems that offer previously discrete capabilities more broadly across the entire hedge fund manager community.

Understanding these waves will help a manager determine the right approach in spending their IT dollars. For functions that have become commoditized, managers should look to buy systems or take advantage of outsourcing options that already incorporate advanced functionality defined by earlier generations of hedge fund pioneers. These systems or services can typically be adapted with few upgrades to meet a new manager's specific needs.

Custom development or "build" dollars should be focused on those functions where broadly available systems do not meet the hedge fund threshold or on new types of data management tools that evolve the manager's entire approach and ability to manipulate and combine information to achieve unique insights.

The second goal of this paper is to show how cloud technologies offer up a completely new model for a hedge fund on how to establish and support their core infrastructure. Cheaper bandwidth, exploding availability of data centers and the rise of managed service providers is creating a foundational shift in the way start-up or spin out hedge funds establish their infrastructures and build their core capabilities. Cloud or off-premises technologies are offering hedge funds a light-weight, nimble approach to market that matches their organizational intent to be small, entrepreneurial low-cost businesses. These innovations also offer established funds new paths to realize cost savings and efficiencies in upgrading or replacing their legacy platforms. We have dubbed this important shift in approach as "Hedge Fund 3.0."

The final goal of the paper is to provide a look through to the actual metrics that inform hedge fund IT investments in 2011 and to understand how these metrics vary by the size and the vintage of the fund. These benchmarks should provide each reader an opportunity to assess their own organization's approach relative to their peers.

By repeating this survey each year, we hope to provide our hedge fund clients insight that helps them maximize their focus and spend on IT related matters and provide them relevant metrics they can cite in explaining their IT approach to interested investors.relevant metrics they can cite in explaining their IT approach to interested investors.

Analysis of the benchmark data provided by survey respondents shows that, as a whole, the hedge fund industry is likely to spend $2.09 billion on IT-related categories in 2011, the equivalent of about ~9 basis points relative to total industry AUM. This outlay includes money spent on hardware, software, data and IT personnel.

IT Spend Accelerates Sharply as Hedge Funds AUM Grows

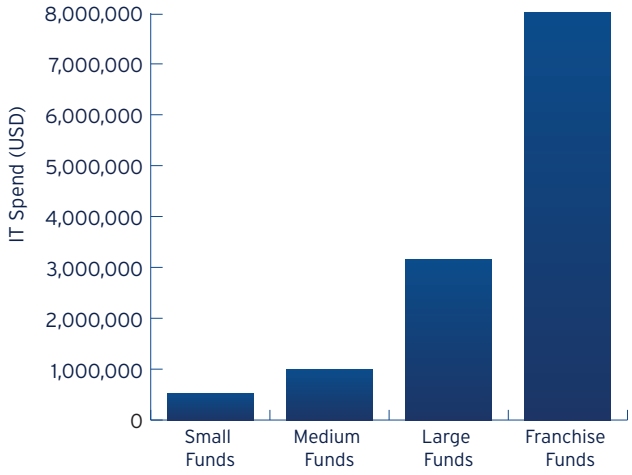
On average, small hedge funds (< $500 million AUM) expect to spend just under $600,000 on IT-related costs in 2011 as highlighted in Chart 1. This spend is fairly evenly broken out across key categories with 32% of those dollars allocated to IT personnel; 23% to hardware and networks; 27% to software and 18% to data. Because of their relatively low AUM, this level of IT investment equates to nearly 12 basis points for small managers. As illustrated in Chart 2, that figure is higher than for all other segments. This reflects the high baseline costs of running a hedge fund.

IT spending from medium-sized hedge funds ($500 million to $3.0 billion AUM) is expected to average just over $900,000 in 2011. Medium-sized funds maintain a large investment in IT personnel (35% of total spend), but reduce their proportionate outlays to both hardware (19%) and software (15%). Data costs rise substantially as a share of expense (31%). Although these firms increase their IT outlay by just over 50% relative to small hedge funds, the impact of such spending is muted by higher AUM. On average, IT spend by medium-sized funds is seen as equating to only ~6 basis points. This reflects their ability to realize cost efficiencies as they leverage their initial infrastructure to service a growing asset base.

Proportionately, large funds ($3.0 billion to $5.0 billion AUM) divide their IT spend in a similar manner to medium-sized funds with 31% allocated to IT personnel, 18% to hardware, 18% to software and 33% to data. Yet, the amount of money spent in each of these categories is significantly larger. On average, these hedge funds expect to spend just over $3.1 million on IT in 2011, more than triple the amount medium-sized funds plan to spend. From a basis point perspective, this outlay is seen as accounting for ~8 basis points. These are the managers most likely to have begun receiving institutional investor outlays, requiring them to upgrade their capabilities to meet the more stringent reporting and oversight demands of this audience.

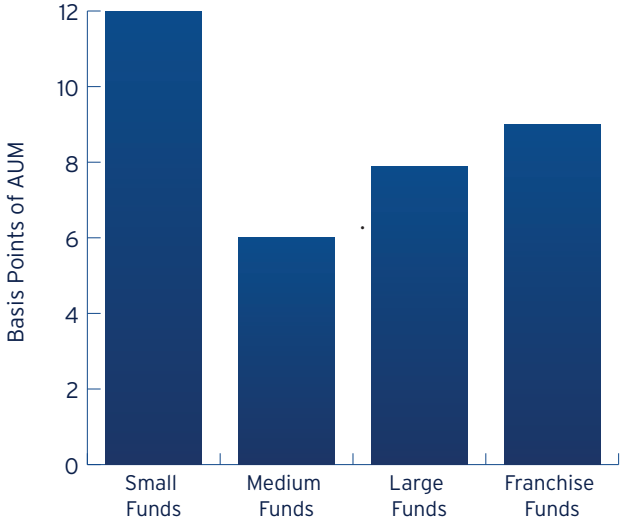
Dramatic gains in IT spending continue as hedge funds reach franchise status (> $5.0 billion AUM). Managers' spend in this category is projected to average $7.9 million in 2011, more than 13x the average spend forecast by the industry's smallest funds. This reflects the expansion of these organizations both regionally and by strategy. Slightly more of this money will be spent proportionately on software and slightly less on data when compared to large funds. Franchise funds plan to split their IT spending out as follows: 32% to IT personnel, 18% to hardware, 22% to software and 28% on data. Because of their higher AUM, franchise funds can realize these expenditures and keep their relative outlay to only ~10 basis points.

Chart 1: IT Spend by Fund Type: Dollars



Source: Citi Prime Finance

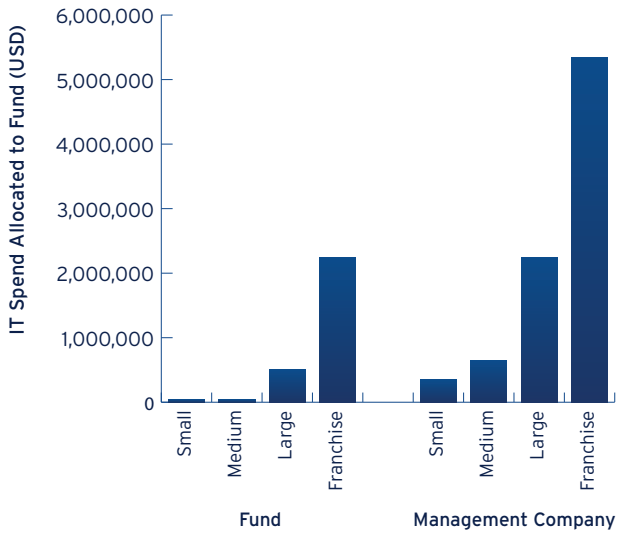
Chart 2: Average IT Spend by Fund Type: Basis Points



Source: Citi Prime Finance

Larger Managers Charge Back More IT Expenses at the Fund Level

Chart 3: Average Charge Back of Hedge Fund Expenses



Source: Citi Prime Finance

In accounting for their IT spending, there is a noticeable change in approach as a hedge fund manager's AUM rises. Chart 3 shows the amount of expense being charged back to both the fund and the management company.

Small and medium-sized hedge funds charge only a small portion of their IT expense back at the fund level. Nearly their entire IT spend is absorbed by their management company. As AUM grows that approach begins to change.

Large hedge funds report that they allocate 20% of their IT costs back to the fund level. On average, this equates to about $630,000 annually. Franchise firms charge 30% of their IT spending out to the fund level or about $2.4 million on average annually.

The increased willingness of these managers to charge back IT costs to the fund (where these figures get factored into the calculation of the performance fee) can be seen as an additional expense investors pay in order to have access to the capacity these managers offer. Moreover, the ability of the fund to absorb these costs without significantly impacting performance is much greater than for smaller managers.

Ratio of Internal to External IT Personnel Sourcing Changes as Funds Mature

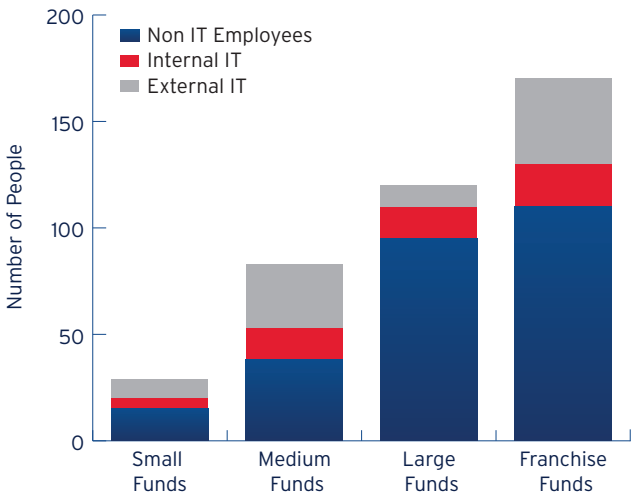
Chart 4 provides insight into the size of a manager's overall hedge fund organization and to the share of such resources focused exclusively on IT. Several points stand out in these figures.

As would be anticipated, the numbers confirm that hedge funds do indeed run large amounts of money with extremely small teams. The average number of employees for each size hedge fund is listed as follows: small hedge funds, 11 employees; medium-sized firms, 68; large firms, 121 and franchise firms, 163.

For both small and medium-sized hedge funds, IT resources equate to about 1/3 of the total organization's size. This figure declines for large funds and then returns toward this 1/3 threshold as firms enter the franchise stage. To understand why this pattern changes for large funds, it is important to look at the mix of internal to external personnel.

For small and medium-size firms, the ratio of internal to external IT resources is nearly 1:2 as managers look to limit their fixed IT personnel expense. Small hedge funds on average have only one dedicated IT resource and 2 external IT resources whose services they contract. Medium-sized managers that are rapidly accumulating assets grow their internal IT teams significantly, increasing to an average of 8 resources, but they continue to contract nearly double that figure externally. By leveraging outside resources to augment their internal IT resources, these hedge funds can obtain specialized expertise and interim manpower to create advanced capabilities without committing to long-term obligations.

Chart 4: Average Number of Employees: IT & Non-IT



Source: Citi Prime Finance

This pattern shifts for large hedge funds as the ratio of internal to external IT personnel moves to just over 2:1. This change reflects both the desire of these managers to "internalize" control over their IT infrastructure and the stabilization of their platform as capabilities they had contracted outside resources to build come online and the need for external expertise diminishes. Indeed, large funds on average expand their internal IT resources modestly to 9 resources, but their use of external personnel drops from an average 14 to only 4 resources.

Franchise funds find that the ratio of their internal to external IT resources reverts back to that of the small and medium-sized funds at a 1:2. This reflects a desire to control costs and move back to a more flexible sourcing model. It also reflects the need for a larger IT team to handle the increasing complexity of the manager's platform that must service investment teams that are typically spread across multiple geographies and often across numerous funds and investment strategies. Benchmark data shows that the average IT team size at a franchise firm is 49 individuals—16 internal resources and 33 external.

The breakdown of IT personnel across the hedge fund industry shows that 38% of resources focus on software development, integration and support whereas 62% are network engineers or network support personnel. The ratio of infrastructure resources increases as AUM grows, reflecting the need for the largest funds to bolster the building and maintenance of their expanding infrastructure.

Clear Buy vs. Build Preferences Emerge for Main Software Applications

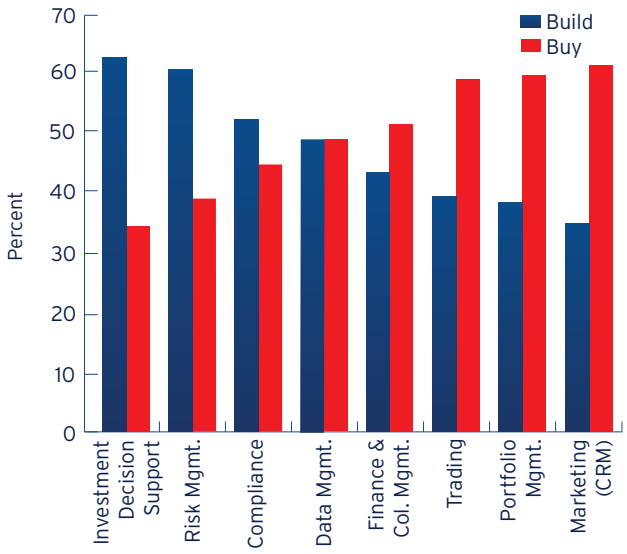
In looking at the types of software hedge funds will be investing in during 2011, there was a definite mix in approach. In some instances, there was a clear preference to "buy" that functionality, either by licensing it directly from an established market vendor or by approaching an outsourced service provider. For other functions there was a bias toward taking a "build" approach where the manger would either have internal developers or specialized consultants work with them to create their own customized platform. Benchmarks around where these buy-versus-build preferences lay in 2011 are shown in Chart 5.

Investment decision-making support tools, risk management and compliance platforms were the areas where hedge funds were most likely to "build" their required capabilities in 2011. As will be discussed, these are the areas where hedge fund managers are still looking to align standard industry offerings to their more complex investment strategies and specialized portfolio needs or, in the case of compliance, adjust to rapidly shifting regulatory mandates.

Hedge fund managers showed a more mixed approach with regards to data management platforms, financing and collateral management systems. Upgrades to core vendor platforms realized in recent years and the emergence of new services, such as collateral management outsourcing, have created offerings that serve the needs of small and medium-sized firms. Large and franchise firms are likely to still have complexities in these areas that make it easier for them to custom build their applications.

Portfolio management, trading and marketing / CRM platforms are those that hedge funds are most likely to buy. These are the platforms that are either the most generic (CRM) or that have become the most fully aligned to the specialized needs of the hedge fund industry (trading and portfolio management). Understanding the story behind how these platforms came to be sufficiently standardized to allow the majority of managers to buy such capabilities provides important insights into how these buy-versus-build decisions are likely to shift in the future, and insights into how a set of large, franchise-sized pioneer hedge funds look to use technology as a differentiator and create an edge in their investment strategies.

Chart 5: Software Approach (Across All Funds)



Source: Citi Prime Finance

A decade ago, hedge funds could almost be considered a cottage industry, making do with a patchwork of vendor solutions that catered to the long-only asset manager. From a vendor's perspective, the hedge fund industry was not an attractive enough target to warrant the development of focused offerings. In 2000, HFR estimates that total hedge fund industry AUM was only $490 billion. This compared to ICI's estimate of worldwide net assets held in mutual funds of $11.9 trillion.

Specialized Hedge Fund Needs Trigger Successive Waves of Investment

The systems designed for these long-only managers were poorly suited to cover the more expansive trading profile employed by leading hedge funds of the time. As the most successful funds of this vintage sought solutions to handle both their long and short positions and became more complex in terms of their use of varied listed and OTC instruments, they were compelled to build their own core multi-asset trading and portfolio management systems to accommodate specialized functionality that vendors and service providers could not provide. Creating these capabilities was seen as offering an edge to hedge funds of the time, helping them to better attract and retain investor capital. This set of circumstances drove what we now consider to be Wave 1 of hedge fund IT investment focus.

A similar pattern has emerged repeatedly in the hedge fund industry in recent years. Divergence between the existing system offerings and the needs of the highly specialized hedge fund industry prompt hedge funds to build customized solutions.

Chart 6: Hedge Fund IT Investment Focus: 2000 to Present

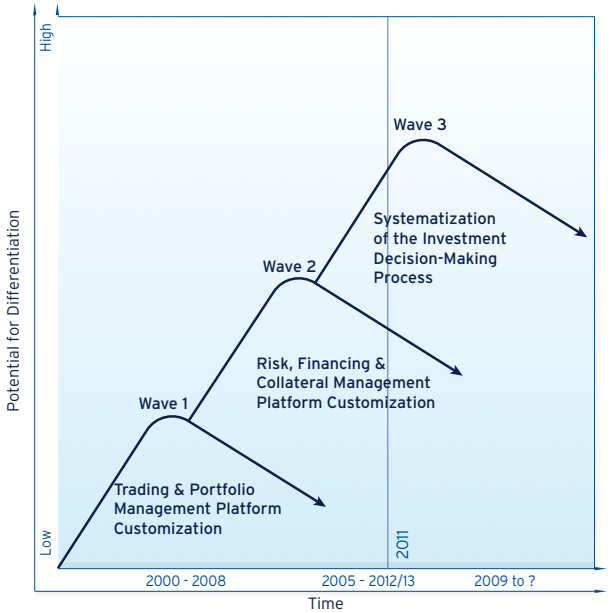
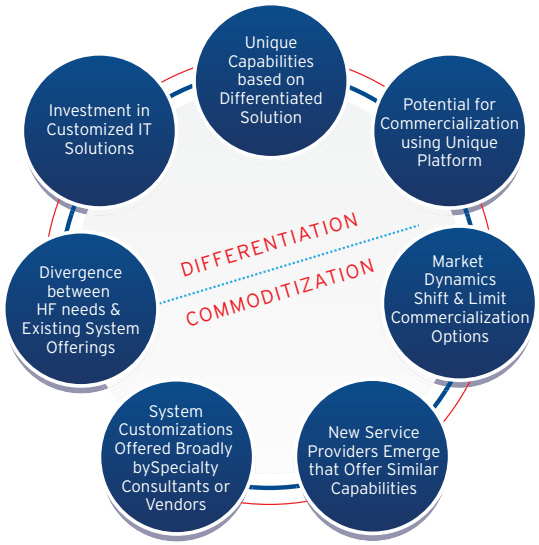


Chart 7: Hedge Fund IT Wave Cycle



The investment in these customized solutions is viewed as establishing a perceived edge over competing firms. The types of systems being targeted change over time, but the impetus that launches the wave remains the same.

The need to customize trading and portfolio management systems to address more complex hedge fund portfolios was the impetus that launched Wave 1 of recent IT investment in hedge funds. Subsequently, we have identified two additional investment waves. Our view is that the industry is currently in the latter stages of their Wave 2 investments and that industry leaders are actively engaged in their pursuit of Wave 3 capabilities. These waves and the industry's current positioning are highlighted in Chart 6.

What is also clear from Chart 6, however, is that the perceived edge or potential differentiation the hedge fund receives for creating their customized solution wanes over time. Discussions with various funds and our observations of the hedge fund technology landscape show a consistent pattern whereby commoditization pressures emerge as a wave crests.

The entire hedge fund IT investment wave cycle is illustrated in Chart 7.

IT Investments Follow a Cycle that Results in Commoditization Over Time

As discussed, the wave begins when there is divergence between the hedge fund's needs and the existing system offerings available in the market. This prompts market leaders to invest in customized IT solutions. From there, the hedge fund is able to realize unique capabilities as their differentiated platforms come on line. Because these offerings are highly specialized, there is potential over time to commercialize the IT spend invested by the hedge fund and seek alternate uses or users of their platform. It is at this point that the "differentiation" phase of the wave peaks.

The window during which a hedge fund can commercialize their IT platform is usually short. Market dynamics tend to shift over time and this works to limit interest in new platforms. There is nearly always a "first-mover advantage" in terms of which firms can successfully syndicate their capabilities or platforms. Those looking to take this track too late in the cycle find that there is only limited, if any, interest in their offerings. This was a fact that many hedge funds that sought to commercialize their trading and portfolio management platforms post-2008 came to realize.

As more and more hedge funds seek the same differentiation that earlier managers achieved through customization, new service providers emerge that are better suited from a scale and cost perspective to offer a solution. Finally, the consultants who worked on customizations within the original hedge funds either create their own offerings or go to work with the underlying vendor to enhance the standard market platforms.

In this way, core functions become commoditized, allowing newer hedge funds to easily achieve specialization that earlier hedge funds had to pay dearly to create.

"Software has come down-market in the last few years. Pre-2008, 90% of our deals were with funds managing $1 billion USD+; now, 40% of our deals are with funds managing under $1 billion USD."

– General Manager & SVP of Sales and Marketing for a leading financial software vendor

Timing of Commoditization Waves Vary

The period of time it takes for a wave to crest and recede varies based on many underlying conditions. As a general rule of thumb, commoditization will occur much more quickly when the industry is in a growth phase. Between 2000 and 2007, the size of hedge fund industry assets increased 4x. According to HFR, AUM rose from $490 billion to $1.9 trillion in this period. The number of funds increased from 3,873 to 10,096. This rapid expansion created an ideal backdrop of new buyers coming to market seeking the capabilities that earlier funds custom built. This encouraged commoditization to occur quickly, and Wave 1 to pretty much conclude by 2007.

As will soon be discussed, we are currently in Wave 2 which began back in 2004. The slowdown in industry growth has dampened hedge fund IT spend and this is allowing the cycle to draw out longer than Wave 1. Regulatory pressures are helping to drive Wave 3. Having specific dates that the industry must meet for providing certain information may cause certain capabilities created in this phase (i.e., compliance) to commoditize more quickly, whereas other facets of the current spend (i.e., research management) may remain a differentiator far longer for funds making investments at present.

It is useful to understand this overview of hedge fund IT investment evolution before delving further into the drivers, impact, commercialization and commoditization involved in each of the three waves of hedge fund technology investment we've identified.

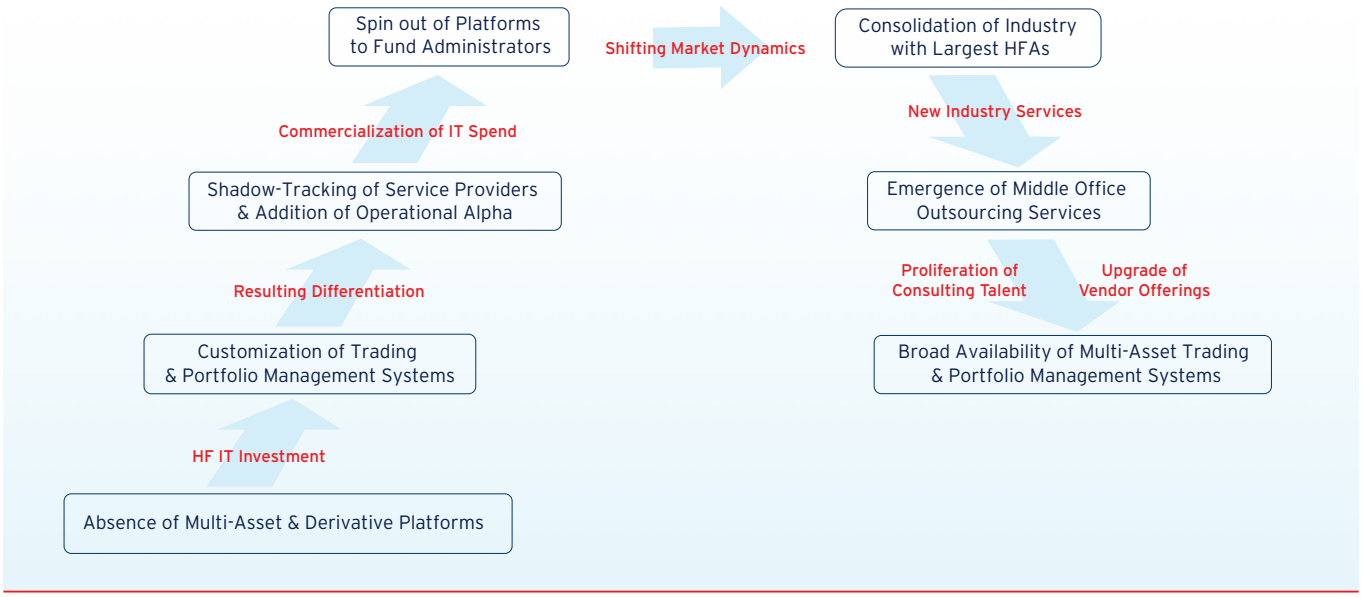
Wave 1 Customizations Drive Trading & Portfolio Management Enhancements

Wave 1 is the only full cycle the hedge fund industry has finished to date. Each of the stages of this evolution—from the differentiation early hedge funds sought to be better able to handle complex portfolios, to the resulting ability to capture operational alpha through to the emergence of broadly available middle office outsourcing services and multi-asset trading and portfolio management platforms—is highlighted in Chart 8.

To recap, the absence of multi-asset and derivative platforms was the driver that kicked off Wave 1 IT investments. Pioneering hedge funds opted to develop their own portfolio management and trading platforms as existing offerings were seen as overly geared to long-only managers. Given the lack of sophisticated vendor systems, funds that invested in these core areas at the outset of Wave 1 were able to realize a truly differentiated platform.

At a time when competitors were relying solely on service-provider reports and trading tools, those hedge funds that had created customized platforms were able to create their own view of their portfolio holdings. This allowed for several benefits. Maintaining reconciled books internally, and being able to trade both simple and complex instruments based off of up-to-the-moment positions allowed these cutting edge funds to realize efficiencies and controls beyond those found at competitors.

Chart 8: Wave 1 Hedge Fund Investment Cycle



These managers were able to "shadow-track" their prime brokers and fund administrators, determining if their portfolios were being properly handled. This included an ability to evaluate whether the hedge fund agreed with the pricing and valuation models being used by their providers. Up until that point in time, hedge fund managers had not been in a position to assess the quality of their prime broker and fund administrator reporting, especially if they worked with multiple prime brokerage firms.

Hedge funds possessing these capabilities were also able to sell their investors on the concept that their systems provided them an edge that allowed them to add "operational alpha" to their returns. The theory behind operational alpha was that by having an independent portfolio view and the best possible pricing and valuations, the manager would be better positioned to evaluate and, if necessary, challenge their service provider's view. With their prime brokerage relationships, this could result in fewer trade and position breaks, lower trade processing fees and lower margin calls, freeing up more of the fund's assets for trading purposes. With their fund administrator, this could result in more accurate attribution and performance calculations.

Some of the best internally developed platforms were commercialized and licensed to fund administrators. Long Term Capital Management was able to leverage their platform and create the core for the GlobeOp fund administration offering. Tudor Investments spun out their platform to be the foundation for Citco's Aexeo administration offering. Citadel was able to spin out its own administration business on its Omnium platform and, just this year, was able to sell that business to Northern Trust's Hedge Fund Services.

Firms that adopted this technology became some of the most successful administrators over the course of the last decade. As clients of these firms became accustomed to the newer administrator's offerings, they began to request additional middle-office support from these providers and from their traditional administrators. Middle-office outsourcing of hedge fund trade and portfolio management was a new service that emerged to help standardize the delivery of operational benefits.

With this new service, hedge funds could launch with superior capabilities, or more flexibly take on new strategies and products by leveraging the expertise of these outsourced service providers. This approach proved quicker to market, while keeping initial costs down, as the funds didn't need to hire operational experts to track the new strategies.

Another aspect of commercialization also occurred on the back of Wave 1 investments. Hedge fund technology teams or consultants who helped to realize trade and portfolio management customizations for firms that invested in Wave 1 began spinning out and launching their own software firms. Resources emerging from Perry Capital created VPM portfolio accounting software that was later purchased by Sungard. Resources from another hedge fund, Alexandria, created the core Paladyne trade and portfolio tracking offering.

Once these new offerings, capable of handling the increasing complexity of investment instruments such as credit default swaps and bank debt, were more widely available, this drove the more established software providers in the long-only asset management space to broaden their functionality and / or instrument coverage to remain competitive. Trading platforms being offered today by traditional providers such as Charles River, Eze Castle and Bloomberg's AIM are significantly more multi-asset and flexible as a result of their need to remain competitive with emerging hedge fund-focused platforms.

The resulting availability of vendor packages to service the industry meant that it was no longer a differentiator for hedge funds to develop their own portfolio management tools; this was now a commoditized function. In some cases, it still made sense for funds to internally develop trading software, especially for more technically based strategies, but by-and-large, a host of order- and execution-management solutions became available over the past decade, making that function highly commoditized as well.

When the liquidity crisis of 2008 hit, many of the largest funds, who had built extensive core infrastructures from scratch (and hadn't commercialized them) were left with a high support cost base, and much less asset-based revenue to support those costs. The lesson learned for newer funds launching was that they should take advantage of the host of commoditized vendor and/or service provider portfolio management and trading solutions, which are easier to scale up or down as assets under management change with the business cycle.

"When we are looking to address a function, our first question is, 'Can we buy this product?' If so, we prefer a perpetual license model vs. a lease model so that we don't get locked in to an annuity payment."

– CTO of a U.S.-based fund, managing between $3 billion and $5 billion USD

Wave 2 Customizations Drive Collateral Management & Financing Enhancements

The years preceding the liquidity crisis of 2008 saw a massive increase in the usage of derivatives by hedge funds of various sizes and strategies, for purposes of alternative financing, yield enhancement, risk hedging and market access. The Bank of International Settlements (BIS) shows that the total notional principal outstanding in over-the-counter (OTC) markets rose from $220 trillion in June 2004 to $684 trillion by June 2008, in part spurred by increased hedge fund interest.

As the use of derivatives soared, prime brokers began expanding their core equities-related businesses into the fixed income arena where they could better accommodate credit-related strategies and derivative trades. This occurred just as hedge funds were reaping the benefit of Wave 1 commoditization, wherein they had more broadly available multi-asset trade and portfolio management platforms and better insight into their own portfolios.

The result was a shift in the prime brokerage model. Whereas previously, hedge funds would have a single prime brokerage relationship or at most, a single prime brokerage relationship per fund, they now began to open multiple prime brokerage accounts for each fund. This allowed the hedge fund to create competition in their margin financing rates across their various primes, place trades with specific organizations to achieve position offsets and minimize risk exposures, and to access multiple derivative credit lines. As a result, the fund was no longer able to rely on their prime broker to get a holistic view on their margin requirements and collateral. Instead, they needed to aggregate this information across multiple providers.

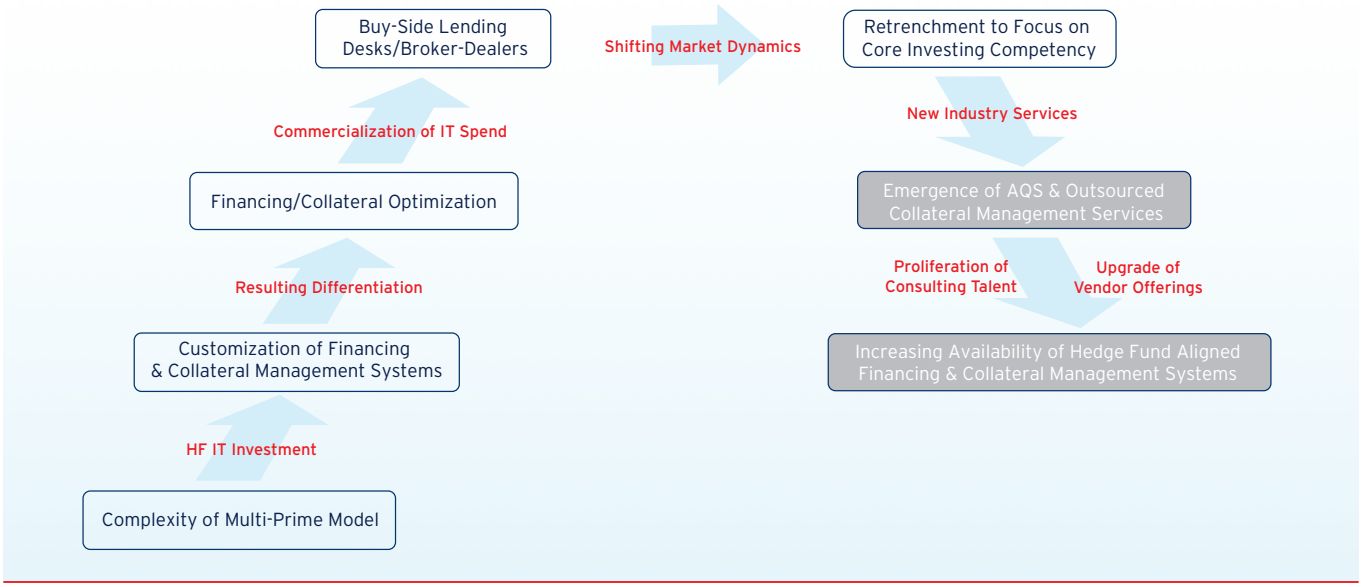
Few, if any, systems had been developed for the buy-side at this point in time to help them assess their risk and, subsequently, their margin obligations; track their collateral use; or assess their financing rates across a portfolio of prime brokers. Nearly all the systems available in the market had been created for large, sell-side firms and these platforms were primarily single asset.

Another divergence between specialized hedge fund needs and existing system offerings had emerged. This situation helped drive Wave 2 of hedge fund IT investment as illustrated in Chart 9.

By late 2004 / early 2005, several leading hedge funds in the credit space leveraging OTC derivatives had noticed an opportunity to turn their multiple prime broker relationships into a differentiated advantage. This was achieved by creating collateral management platforms able to evaluate the use of their credit lines, their overall derivatives exposures and exposure per prime broker, and to track and assess their margin calls and determine whether their financing rate would be cheaper if they offered up bonds as margin collateral as opposed to simply collecting repo financing on these instruments.

A wave of customizations took place, the result of which was that market leaders were able to "optimize" their collateral management. Firms who had customized industrial sell-side platforms to be more nimble, focused and multi-asset were able to point toward basis point savings, broader uptake of credit lines and more strategic use of their cash and collateral as real points of differentiation. This was a particularly good selling point with the rising class of institutional investors who were often unfamiliar with the more credit-related strategies and who were unsure about the operational complexities of

Chart 9: Wave 2 Hedge Fund Investment Cycle



derivative instruments. Hedge funds that had invested in these capabilities were able to present their technology platforms as offering them a competitive edge.

Other cutting-edge funds with more equities-focused strategies were able to optimize their financing across their multiple prime brokerage relationships. They sought to develop or customize trading systems to be able to determine the cheapest counter party from whom to borrow securities, looking at short locates across a fund's set of prime brokers and helping the manager identify the best borrow rate. This led to many firms building out their own internal financing desks which persist to this day.

The benefits achieved by early Wave 2 firms led some of the largest funds to identify alternate uses of their financing and collateral management-technology investments. Having built infrastructures to support their own financing and collateral optimization needs, they saw an opportunity to extend their business model to seek cheaper financing directly in the public markets rather than relying on their prime broker to supply these functions. This was a highly attractive proposition in the strong markets of the mid-2000s. To facilitate their own financing, they had to become broker-dealers that could go directly to public sources or to other funds to lend and borrow securities.

These firms would move positions from their master fund to their internal broker-dealer that would then use those assets to raise money in the public markets. To support these activities, the hedge funds would typically leverage their own platform, building additional customizations instead of using vendor solutions designed for the sell-side that were industrial strength and expensive. The hedge fund firms would connect their proprietary platforms to the same industry standard networks the sell-side used for enabling their public financing (i.e., Sungard's Loanet for securities lending and the primary dealers for repurchase agreements—Citi, JP Morgan and Bank of New York). Clearing would often be outsourced, though the largest funds would occasionally take on this burden themselves.

Signs of Wave 2 Commoditization Emerge

Commercialization of these buy-side built "broker-dealer financing platforms" may have gone even further, but the severity of the 2008 global financial crisis caused interest in such capabilities to decline dramatically.

Liquidity concerns and industry-wide de-leveraging in the wake of the 2008 crisis made it much more expensive to obtain financing via the public markets. Firms that had built extensive infrastructures to support this business found themselves trying to maintain an expensive cost base with lower management fees and fewer assets under management. Under such circumstances, it became clear for the majority of these firms that the technological, operational and regulatory overhead associated with being a broker-dealer was no longer worth the trouble once the business cycle was disrupted by the crisis of 2008.

Many of these firms then retrenched, closing down their broker-dealer operations in a move to save costs. They returned their focus to optimizing their own financing and collateral management.

Other signs of commoditization are also emerging as we enter the second half of Wave 2.

Several new services focused on financing and collateral management have launched in recent years that standardize the benefits market pioneers realized through Wave 2 custom-builds and make these advantages available more widely to the hedge fund community.

Quadriserv's AQS platform offers a central counter party-based securities lending platform that facilitates automated stock loan trading in equities, ETFs and ADR product. This electronic, direct-access platform is providing centralized price discovery and transparency in an anonymous, automated environment.

Fund administrators are extending their middle-office outsourcing capabilities to offer collateral management services for OTC derivatives. These offerings aggregate a hedge fund's view of their positions across their set of prime brokers and perform collateral tracking, processing and optimization on the hedge fund's behalf. These services are offered to hedge funds at a significantly lower cost than it would take to build out a fund's own capabilities. Moreover, these services enable hedge funds to more flexibly address a rapidly changing OTC derivatives regulatory environment without having to set aside significant investment capital.

"Consultants built our finance application. It was built for someone else, and we leveraged that intel."

– CTO of a U.S.-based Hedge Fund Managing between $3 Billion and $5 Billion USD

Finally, some established software vendors are also expanding the scope of their offerings by acquiring and adapting collateral optimization solutions that had initially been developed for the sell-side. A recent example of this is Syncova's Optima system, recently acquired by Advent Software. Syncova was initially built by the sell-side as a margin and finance system, and then the technology was commercialized by spinning out as a software company, targeting both sell- and buy-side customers.

While other systems existed for OTC collateral management, Syncova differentiated itself by also addressing prime brokerage margining structures. Its recent adoption by a few of the largest hedge funds underscores the initial commoditization of this function. The acquisition by Advent should lead to further commoditization of collateral management over time given this vendor's entrenched position in the hedge fund space. Another new vendor in this space is Hazel Tree, whose offering provides a consolidated dashboard based on margin data files from prime brokers. Their platform doesn't replicate margin structures, but rather organizes the data in such a way that funds can gain insight into their cross-broker margin picture. This approach is more straightforward—and less robust—than "shadowing" prime brokerage margin calculations, but it is potentially easier to implement for a smaller fund.

Other software packages are becoming available that will streamline collateral movements by putting automation around the wire transfer process via SWIFT protocol—recently made cheaper for the buy-side community—and other electronic methods. One such product, offered by IntegriDATA, was built by way of a consulting project for a large hedge fund. A similar product from ECS Financial was built by transaction-processing automation experts.

In the financing space, customizations designed for the hedge fund space are also becoming add-ons to existing vendor packages. A common example of this can be found in Eze Castle Software's adaptation of their order management system to accommodate short locates, which allowed funds to more easily shop for the best borrow rates across various prime brokers.

These examples of how funds can better manage the collateral and financing of their businesses were made possible because of the foundation laid by Wave 1 investments and the broad availability of multi-asset trade and portfolio management platforms. As Wave 2 continues to unfold, we expect to see continued commoditization of finance and collateral management and a reduced need for hedge funds to invest in customization of these functions.

Wave 3 Customizations Emerge to Support Insight into the Investment Process

Whereas Wave 1 and Wave 2 enhancements related to creating foundational abilities to effectively realize the manager's investment strategy, emerging Wave 3 customizations are about how to harness information and create insight. Emerging Wave 3 customizations offer managers a differentiated ability to generate and share information about their investment process to satisfy investor and regulatory demands and to support an intensified focus on alpha generation.

As outlined in our June 2010 survey, *The Liquidity Crisis and its Impact on the Hedge Fund Industry*, there were several concerns that came to light in the course of the 2008 crisis. First, it became clear that the positions held in many hedge fund managers' portfolios were far less liquid than their investors had anticipated and, in many cases, were seen as outside the manager's stated investment mandate. Second, performance in the period underscored that many managers were simply using leverage in a strategy that was highly correlated to beta rather than having a differentiated approach to produce alpha returns. Third, there had been inadequate oversight of the investment

process and too little emphasis placed on controls to protect against fraud as underscored by the Bernard Madoff scandal.

The impact of these discoveries on the hedge fund industry has been profound. Investors have subsequently demanded more transparency into a hedge fund's positions, exposures, liquidity, investment decision-making process and use of leverage. They are looking to understand the risks their stable of managers are taking and the controls each hedge fund has set up to monitor and optimize their investment process, and to ensure that there are independent checks and balances within the organization. They are looking for the manager to be able to demonstrate their success at generating alpha and to show that their performance is not overly tied to standard market performance (beta).

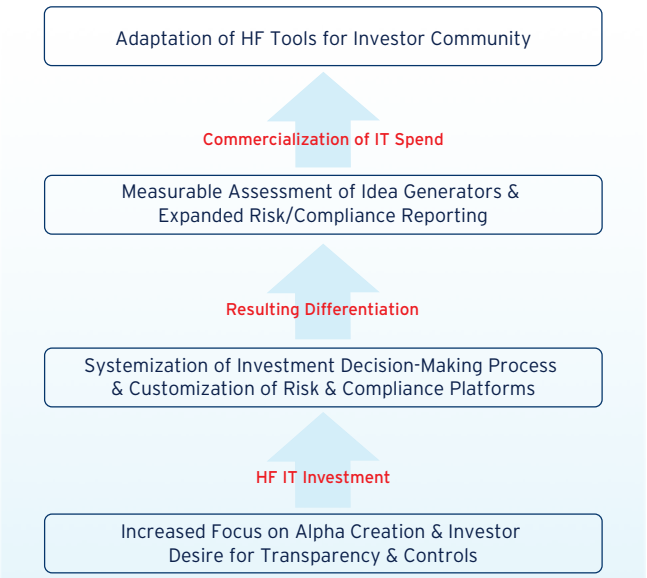
Regulators are pushing for more widespread registration of hedge funds as investment advisors. Having this designation requires that the manager have a robust compliance program which can be demonstrated in audits or spot evaluations. Moreover, rules put forth in the U.S. Dodd-Frank Act also state that each hedge fund must supply information deemed critical in helping determine the market-wide level of systemic risk. To capture such information, the CFTC and SEC are jointly proposing that hedge fund managers fill out new documents such as Form SLT and Form PF, a new filing expected by year-end that requires the hedge fund to report on up to 1,900 inputs, covering areas as diverse as investor concentrations, assets, portfolio turnover, performance, exposures, value-at-risk and potential losses in a stress period.

Meeting these investor and regulatory expectations, and having the flexibility to use their own information more effectively to improve their alpha generation, proved difficult for the majority of hedge funds post the 2008 crisis given their standard IT configuration. This divergence between emerging demands for hedge funds to produce data and reports flexibly, and the rigidity of the existing systems, set the stage for Wave 3 customizations as shown in Chart 10.

Emerging Data Management Solutions Offer Required Flexibility

Post-2008, and even today, most hedge funds rely on a few core systems, which they have only lightly integrated at key points in their workflow. Reports are generated and the underlying data populating such reports is typically housed within each individual system. Trading reports are produced and the underlying data stored in the OMS or EMS. Accounting reports are generated by, and the underlying data stored in, the portfolio management system. Risk reports come from the risk system and so on. There is no normalized "model" that ensures that similar data points are defined in similar ways across systems. There is no centralized point of capture where data is housed and reports can be built that combine information from multiple systems.

Chart 10: Wave 3 Hedge Fund Investment Cycle

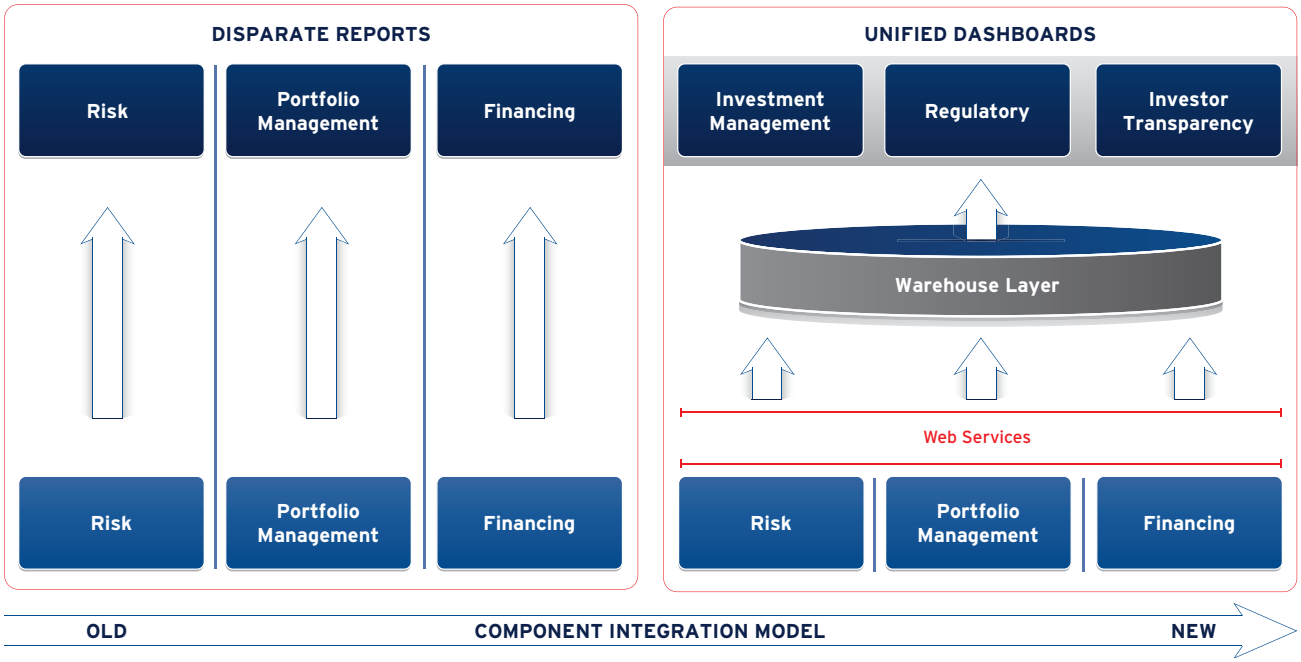


To meet this challenge, the most sophisticated funds built internal data management platforms where they took in feeds from all their various systems, normalized the incoming data and stored the information in customized data warehouses. They would then purchase separate reporting tools that allowed them to tap into their data warehouse, build custom reports and feed such information to investors or to various parts of their own organization via internal dashboards. Creating these solutions was time consuming, expensive and complicated. Sustaining the resulting infrastructure inflated the hedge fund's IT costs

Yet, the lessons learned by hedge fund pioneers in creating these infrastructure-heavy data management solutions are beginning to spawn new offerings in the market that offer the promise of lighter-weight, more nimble solutions for hedge fund managers now looking to spend money to build capabilities in this space.

As we saw with both Wave 1 and Wave 2 evolution, hedge fund technologists involved in creating initial Wave 3 data management solutions have begun to spin out and start their own consultancies and offer their own product. These teams are focused exclusively on the hedge fund space. They bring to the table unique insight into the data structures used by the foundational systems, counterparties and service providers aligned to their former hedge fund employers. Upon leaving those firms, these individuals began to develop consolidation engines geared toward the disparate sets of hedge fund specific industry data. Examples of firms that have had success in this segment include MiK Fund Services and Indus Valley Partners.

Chart 11: Advantages of Data Management Solutions



As shown, rather than a hedge fund manager having to rely on isolated reports from multiple systems, the model is evolving to provide consolidated reports from all these different underlying platforms via one data management solution.

That data management solution is built upon a custom warehouse specially tuned for the hedge fund industry to normalize reference and market data that needs to get distributed among various systems. The data management solution further provides holistic reporting tools and dashboards as an integrated part of the offering to enable powerful portfolio views, mixing position details together with performance, risk and financing information.

The added benefit of this model is that the hedge funds deploying such solutions become less beholden to any one underlying system. That is, once the data structure has been defined and integrated into the database, component systems can be substituted for newer systems, should better options become available in the market. To the extent that the components of the infrastructure are integrated via a services-oriented architecture, the task of substituting applications becomes even more streamlined.

"We report off of a customized, centralized repository, which takes feeds of clean data from multiple upstream systems."

– CTO of UK-based Hedge Fund Managing > $5 Billion USD

"Risk and portfolio management are married now, so if you don't have modeling as an extension of your platform, you're at a disadvantage."

– Business Development lead for a Portfolio Management Provider

Market Leaders Leverage Data Solutions to Create Differentiation

Having all of this data available to generate reports from a single, normalized source greatly simplifies the task of meeting the transparency and reporting demands of investors and regulators. These types of platforms also integrate easily with other tools created to satisfy these audiences.

Routine investor information can be stored within a basic vendor Client Relationship Management (CRM) system; drawing from this source, there are, additionally, a handful of vendors who have integrated funds' customer contact information with investor statements from various administrators. Between these data sources and the manager's core data repository, robust investor reports can be created and distributed.

Once these data elements have been combined, investor liquidity information can be driven off of this platform and provide the fund manager insight into upcoming subscriptions and redemptions. Some of the hedge fund-specific vendors in this space include SS&C's FundRunner, one of the earlier packages to focus on this segment; Backstop, Digiterre, Imagineer and Pertrac—which also services the fund of funds community—are additional suppliers in this category.

On the regulatory front, data can be easily extracted from emerging data management platforms and fed to specialized reporting software, such as that offered by Advise Technologies or to other compliance workflow and checklist tools that are available from compliance consultancies such as HedgeOp and My Compliance Office, whose software tracks employee trading activity.

Internally, dashboards fed from data management solutions can be leveraged as investment decision-making tools that supply the CIO, risk managers, CFOs, treasurers or other hedge fund management team members with the valuable insight they need to monitor individual traders, portfolio managers, funds or the overall portfolio.

As these tools often support the investment process, part of the expense of contracting consultants to build such systems can be allocated to the fund. This charge-back is more difficult to allocate if these custom systems are built by internal developers, as the payroll expense is harder to delineate and apportion on a project basis. This decision to charge such expense to the fund is affected by the regulatory regime under which the fund operates, the language in the fund's offering documents and the size of the fund. These factors will also influence the manner in which a fund will incur the expense, either via a direct expense allocation or by way of commission sharing arrangements (CSA).

Newer tools are also beginning to come online to create differentiation.

Research management is a growing discipline within the industry whereby funds try to assimilate their various research, analytics and models into a unified data structure. The goal of such work is to better gauge the efficacy of their internal research department and of the sell-side analysts with whom the fund interacts.

When firms are able to track the life cycle of a trade idea from inception to execution to profit and loss, they can better determine their star performers. When external research sources are included in such tracking and this information is combined with execution data, firms are more easily able to justify the commissions they pay to certain brokers via these custom "broker vote" platforms.

Assembling information is the first part of the effort. Being able to categorize and track the usage of this investment decision-related information is another matter. Some of the largest funds are spending millions to apply cutting-edge technology to the problem. Tagging their research in such a way that it is easy to recall upon demand, these firms believe that they can streamline the alpha generation process by way of a better research management regime.

Other firms are looking to leverage generic tools, such as Microsoft SharePoint, or commoditized research management applications like Code:Red and Advent's Tamale to achieve similar aims.

In all these various ways, custom data management solutions are proliferating due to the introduction of hedge fund-specific development shops. As we are still early in the differentiation phase of Wave 3, we have not yet seen many efforts to commercialize these technologies to service alternate users. However, we feel that the increased interest in direct investing from emerging pension and sovereign wealth fund investors may prove fertile ground.

These are the most rapidly growing segments of the institutional investor audience and they are increasingly becoming more sophisticated investors interested in making their own allocations as was discussed in our June 2011 Pension and Sovereign Wealth Fund Investment in Hedge Funds; The Growth & Impact of Direct Investing white paper. As such, these investors may offer an attractive audience for hedge funds looking to repurpose aspects of their more sophisticated analytic platforms.

Already, some of these pension and sovereign wealth funds are requiring that hedge fund managers in their portfolio feed position and exposure information to a third-party aggregator like RiskMetrics. This was originally a sell-side platform that got adopted by many buy-side organizations and is now finding traction with some investors. A similar pattern may unfold in the coming period as internal hedge fund tools that provide insight into the investment process may be commercialized to offer increasingly sophisticated investors expanded capabilities.

"About half our clients utilize CSA, or soft-dollars, in varying degrees. Most of these tend to be our smaller clients, who manage between $1 billion USD and $3 billion USD. These clients have a schedule that indicates how projects fall into categories, and different percentages are soft dollar-able based on category."

– COO of Data Management Outsource Consultancy

"Our historical data expense, which drives our investment models, is a heavy expense, and it stays with the manager. FSA rules are very proscriptive about what you can and can't do with CSA, and our compliance group takes a hard line."

– CTO of a U.K.-based fund managing between $3 billion USD and $5 billion USD

Section 3: Hedge Fund 3.0: Leveraging Off-Premises Cloud Technology

The approach a hedge fund manager pursues in creating their core infrastructure (hardware, networks, data) is very much tied to the prevailing technology available in the market at the time of their launch. As innovation occurs, the options available to a manager change. The costs and complexity of replacing a manager's foundational hardware is substantial. Upgrades occur, but typically only at times when a major change in capabilities is being contemplated or when a significant benefit can be realized by making such investment. As such, the type of infrastructure a hedge fund manager possesses can very much provide a clue about their vintage.

> *"You can tell when a firm started by how they do what they're doing."*
>
> *– General Manager & SVP of Sales and Marketing for a leading Financial Software Provider*

Sometimes, however, a foundational shift in technology occurs which, in turn, warrants all hedge fund managers to take a step back and reconsider their approach. The emergence of off-premises or cloud technologies appears to be moving the hedge fund industry toward such a point of reflection. Older models may persist, but the emerging model that we have dubbed "Hedge Fund 3.0" provides a radically different approach to realizing a hedge fund's core infrastructure. This new model could have significant benefit not only for new managers looking to establish their foundational platform, but for the broader universe of managers as well.

Over the past few years, in both the U.S. and the UK, a handful of infrastructure firms that focused almost exclusively on the hedge fund industry have become managed service providers. This term refers to their go-to-market model. Rather than building and supporting proprietary data centers for a hedge fund manager within their offices or maintaining that hedge fund's equipment in an external facility, these new breed of managed service providers instead provision their own rack space and basically "rent" their hardware to clients as a service. In turn, this has driven traditional IT providers to offer hosted environments as well.

The change in approach is being matched by a change in the revenue model. These new infrastructure firms have eschewed the traditional "time and materials" approach for engaging their clients, and instead are moving to a new "infrastructure as a service" model with fixed-fee contracts.

In the emerging Hedge Fund 3.0 model, these managed service providers are being contracted by hedge funds to host either their production or disaster recovery environments (or both). They are also providing a fixed-cost service wherein the hedge fund manager can opt to host their software on this rented infrastructure as well. This compares to earlier models where the hedge fund manager either had such software installed on site or where they contracted with the sponsoring vendor to host that system on their behalf.

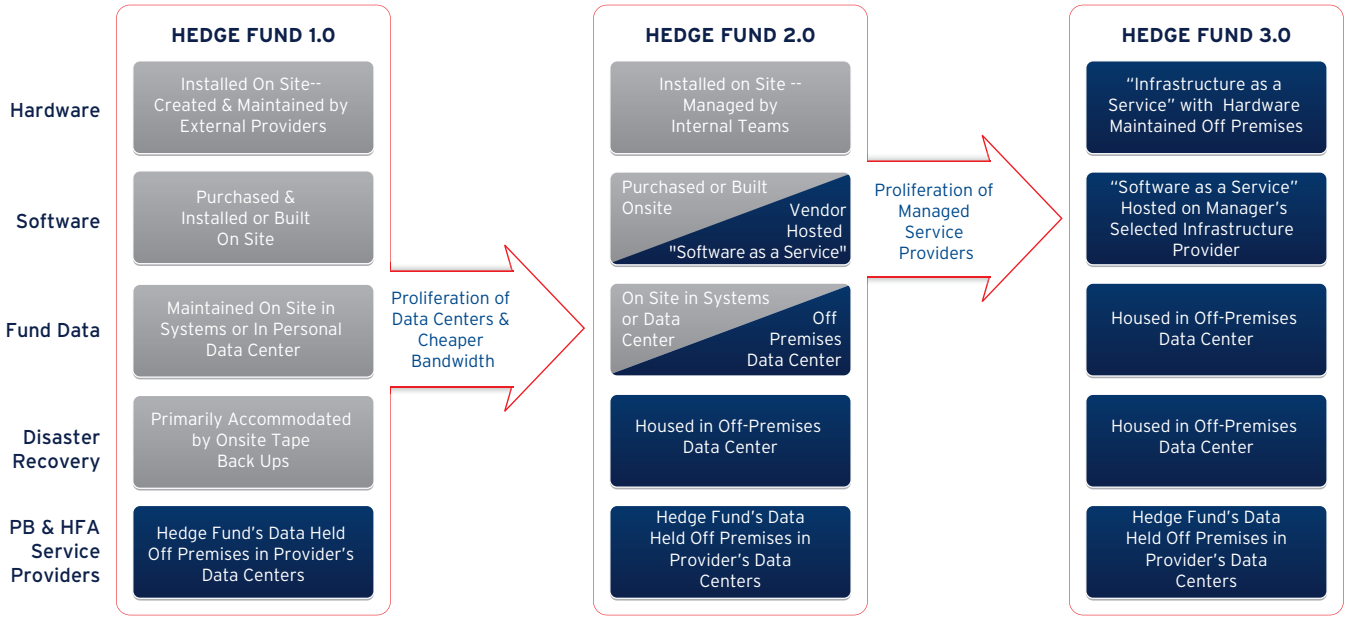
We will go into more depth about Hedge Fund 3.0 later in this section. To fully understand the benefit this new approach offers, however, we will first explore the older models that exist in the market. Remember, the majority of hedge funds in existence today continue to ascribe to one of these older models, and it is only newer-vintage funds that would be pursuing the emerging Hedge Fund 3.0 approach.

Early Vintage Funds Rely on Locally Hosted Data Centers

Chart 12 provides an overview of the three models we've identified to illustrate hedge funds' infrastructure approach. What immediately stands out is that while the "cloud" is a relatively new buzzword in the industry, the use of off-premises services has been an inherent part of the hedge fund industry since the rise of internet technologies themselves.

As shown in the first Hedge Fund 1.0 model in Chart 7, such off-premises services may have only referred to data and services being provided by the hedge fund's prime broker and fund administrator, but the concept of having key information and services used by a manager hosted elsewhere was present in all modern versions of hedge fund infrastructure.

Chart 12: Infrastructure Evolution



In creating their native capabilities, managers launching in the Hedge Fund 1.0 model built locally hosted data centers on their own premises. These data centers were often established and maintained by third-party network engineering and support firms. These firms, such as Eze Castle Integration and Richard Fleischman & Associates in the U.S., and Matsco in the U.K., would charge time and materials for the network build-out. Support would be bought in blocks, with firms pre-paying for an allotted amount of support hours. Hardware would often be provisioned through this service provider, with a cost mark-up applied, based on the wholesale price received from the manufacturer.

Earlier-vintage managers would license software from a vendor and then have that vendor work with their external network engineering and support provider to install the software on their local network. If the manager had hired external consultants or internal developers to program proprietary software, the resulting product would likewise be hosted within the manager's internal data center.

The fund's data, therefore, would be housed within these locally hosted internal systems. Disaster recovery typically entailed tape backups, occasionally taken off site—often to the home of a fund manager employee.

The creation of these locally hosted infrastructures required a fairly substantial outlay of capital. Even if the manager opted to lease rather than buy some of their equipment, they nonetheless had to provision their data center with sufficient cooling and power, build their own network connectivity and factor in the cost of support. This was a barrier to entry for many firms and helped give rise to the model whereby the majority of emerging firms in the early 2000s looked to their prime broker to provide technology to help them cover their foundational functions.

The high cost and scale of investment to build such platforms also help explain why many of the hedge fund pioneers discussed in Section 1 were found among the largest hedge funds of the time. The costs of having a locally hosted infrastructure were substantial and identifying opportunities that helped them differentiate their fund through this investment helped to justify and leverage the costs sunk into these platforms.

Proliferation of Data Centers Help Drive Hybrid 2.0 Model

The explosion of the Internet and Web technologies in the early part of the last decade helped drive changes in the options available to managers launching by the mid-2000s. As bandwidth increased and became cheaper, a new business model emerged. Third parties would build data centers where a number of tenants could place their hardware, take advantage of shared lines and reduce their costs in terms of ensuring power and back-up capabilities.

Hedge funds launching in this period could now connect to these off-premises networks in such a way that a higher level of data replication among environments was now possible. This meant that it was becoming increasingly affordable to copy critical information from a hedge fund's locally hosted data center and send a copy of that information to the off-premises data center.

> *"For our DR, we have a direct line out to our IT partner, and we continuously replicate our data via this 50 MB line. A year ago, there was a couple of days' worth of latency, and data would get backed up on a lag. Now, capacity is a bit cheaper, and our need for real-time replication has grown as we've added to our infrastructure. This coincided with AUM growth, we could support this added expense as our revenues have grown."*
>
> *– COO of US based Hedge Fund Managing between $3 Billion and $5 Billion USD*

For the most hedge funds, the emerging capabilities were seen as an opportunity to create a much more robust and secure disaster recovery environment as will be discussed in a moment. With bandwidth availability still evolving, however, managers launching in the second wave continued to rely primarily in their locally hosted on-premises data centers that continued to be built and serviced by third-party IT integration firms

Servicing of the hedge fund manager's local data centers was becoming more robust, however, due to the build out of sophisticated Network Operations Centers (NOCs). These NOCs allowed the outsource infrastructure firms to better-monitor the health of their clients' networks remotely, administering patches and performing other maintenance without having to visit their clients' physical locations. Integration firms such as Gravitas, which rose to prominence during this wave, were able to service their clients more efficiently by deploying these service models. Managers, meanwhile, who had launched in the Hedge Fund 1.0 model, were likely to bring some support staff in-house, often converting contractors into full-time employees.

Hedge funds were not the only audience able to take advantage of cheaper bandwidth and expanded availability of data centers. Software vendors launching during this period, such as Imagine and Backstop, began to leverage these data centers as well and offer a new model for their applications. Rather than pursuing the traditional approach whereby someone purchasing their system would need to locally install the software, these emerging firms would host their application in their own data center and give their users remote access using either browser-based Internet or access technologies like Citrix. This model became known as "software as a service."

Other established software providers began to follow suit as they saw this as a lightweight deployment option that reduced the need for them to directly install their product in each individual client's facility. One such example of a vendor that evolved their approach in this period is Advent with their Geneva portfolio accounting solution. Advent decided not to maintain its own data centers, but rather would recommend hosting partners. This was a welcome innovation, given the UNIX platform underlying Geneva, which many hedge funds were not equipped to support. As hedge funds began to leverage these software-as-a-service models, they in turn increased their exposure to cloud-based solutions.

The result was a mixed approach. Some of the hedge fund's software, particularly custom developed solutions, were housed in their local data centers and some of their software was being accessed remotely via software-as-a-service from the vendor's hosted data center.

One impact of this hybrid configuration was that market data required to feed systems became much more diffused. In the Hedge Fund 1.0 approach, investment firms would license their data from providers such as Bloomberg or Thomson Reuters and pipe that data directly in to locally hosted software applications. In Hedge Fund 2.0 models, where some of a fund's software was hosted locally within their offices and some was being ºhosted in remote data centers, market data would need to be licensed twice in some cases. Furthermore, execution management systems, licensed by hedge funds but funded by their broker-dealer counter parties in return for trade flow, would also be receiving market data feeds directly from the exchanges. The consequence of this was that funds would often get charged for receiving multiple instances of the same data from different sources in different physical locations.

This shift in the dynamic of physical infrastructure and its impact on market data charges heightened the need for funds to focus on their data costs. Specialty firms, such as Done Plus (formerly Market Data Insights) were formed to provide business process outsourcing to address these effects. Through careful analysis and allocation of market data expense at the user level, a third-party firm can identify and file for rebates with the exchanges, so that any one user is only charged for using a given set of market data once. These so-called MISU (Multiple Installation Single User) credits have yielded significant savings for some of the largest funds, whose extensive use of data makes it one of their greatest expenditures.

> *"As you grow, you have multiple providers, and it becomes hard to keep on top of data costs."*
>
> *– CTO of US-based Hedge Fund Managing between $3 billion and $5 billion*

"The IT department needs to provide the CFO with insight into their costs and how those costs are benefitting the organization. Since IT has a full-time job managing the infrastructure, technology expense management is ripe for business-process outsourcing, which can result in driving costs down through exchange rebates and vendor contract management."

– CEO of Expense Management Business Process Outsourcing Firm

As mentioned earlier, funds of this vintage also took advantage of the increased capacity and bandwidth to augment their disaster recovery / continuity of business environments. Data could now be replicated in shorter and shorter intervals from production environments, and fail-over to these environments became much more seamless, leading to minimal loss of data and less downtime. Some of the earlier off-premises data centers of this vintage were maintained by the funds themselves; having rented rack space directly from existing data centers, the internal IT staff at the fund would travel to the remote location to maintain all the hardware, from the operating systems on up through the business applications.

Despite this overhead, managers were willing to undergo this effort to mitigate the business risk of losing data and having their networks – and therefore their trading operations – be down for extended periods of time. Such controls began to assuage investor concerns, as questions on disaster recovery increasingly appeared within due diligence questionnaires.

Hedge Fund 3.0 Allows Managers to Move Their Entire Infrastructure Off-Premises

Given the interest in adopting off-premises solutions by hedge funds up to this point—by way of service providers such as prime brokers and administrators, vendor-hosted software and disaster recovery environments—it didn't take long for infrastructure firms to focus almost exclusively on the hedge fund space to adopt the "managed service provider" model. As noted earlier, in this model, IT infrastructure firms would rent cages within established data centers and, in turn, these firms would lease server capacity to hedge fund clients.

It is worth noting that these cloud environments are typically hosted on discreet sets of servers—a "virtual private cloud." This approach differs from the generic cloud-based hosting services model offered by firms such as Amazon and Google. In the generic cloud-based model, data and services are distributed across multiple, anonymous servers and CPUs, but in the Hedge Fund 3.0 model, the managed service providers are typically allocating specific servers for each client.

Early pioneers of this model include Options IT in the UK and InfoHedge in the U.S. More recently, other IT infrastructure firms, including Abacus and Auxia, have launched similar platforms, while the traditional providers from the first and second iterations of hedge fund infrastructure development have adjusted their business models to reflect this new reality, offering traditional on-premises network build-outs and support, as well as hosted solutions.

How Hedge Fund 3.0 firms deploy their software also evolves. With the hosted infrastructure model, hedge funds now have a new option on how to access software. They can opt to have their vendor install their application within the hedge fund's own virtual private cloud at their managed service provider's data center. For some firms, this may be seen as offering more security than choosing to access software-as-a-service directly from the vendor's own hosted platform.

In the vendor-hosted software-as-a-service model, applications may be "multi-tenant," with a fund's data segregated by permissioning within the application, not by way of segregated servers. Delving into this point with various providers will be necessary for those funds that take the most-conservative approach toward data security although most software providers who manage their own hosted environments are often able to present strong enough security credentials to get many funds comfortable.

"There are three ways to handle infrastructure: 1) hire your own team and buy your own gear; 2) buy the gear and rent the labor by outsourcing it to an integrator; or 3) outsource the hardware and the labor by leveraging a managed service provider."

– CEO of a Managed Service Provider in the Alternative Asset Space

In recognition of the changing landscape, market data providers have begun to adjust their price models based on the fact that the applications being used by their clients may now be dispersed across multiple off-premises centers as well as potentially on-premises. Many have developed pricing that now treats the hedge fund like a singular entity and just tracks their overall usage regardless of where that data is consumed. This is preferable to needing multiple data licenses based on the physical location of applications.

There are additional benefits to be gained for firms utilizing the Hedge Fund 3.0 model in terms of how they ensure their disaster recovery and business-continuity planning. One of the major benefits of leveraging a data center maintained by a managed service provider is that these firms also have cages in other data centers and they ensure full data replication among each location. Provisioning a fully replicated infrastructure across multiple data centers becomes a matter of simply paying the managed service provider for the additional capacity, and maintaining enough bandwidth between the fund's offices and the data centers to replicate any data that might be locally hosted.

This is a particularly good arrangement given the increased focus in recent years on process controls and compliance. For Hedge Fund 3.0 firms, documenting their disaster recovery / continuity of business plan begins with them collating documents from all of the fund's off-premises hosting partners: managed service providers, vendors of hosted software and service providers such as prime brokers and administrators.

Given the variety of benefits discussed in this section, it is fair to say that "infrastructure as a service" and the emerging Hedge Fund 3.0 model have become the de facto standard for funds launching within the last two years. Better stated, new fund launches will lean toward the managed service provider infrastructure model first, and then ask themselves what, if any, applications should reside locally within their offices. Not only does this approach result in a quicker time to market for the fund launch, but it also minimizes capital expenditure by substituting a hefty initial cash outlay for a much smaller, recurring operating expense.

Opportunities also exist for older vintage funds to leverage this model to upgrade or augment their Hedge Fund 1.0 or 2.0 infrastructures. This will be explored as part of the coming section that focuses on how to apply the hardware and software lessons discussed thus far in this report.

"The market is familiar with the concept of software as a service; now we have infrastructure as a service. You can eliminate the capital expenditure while lowering the operating expense by leveraging a managed services provider for infrastructure."

– President of a Managed Service Provider in the Alternative Asset Space

Section 4: Making the Best IT Choices in 2011-2012

Knowing how peer organizations plan to spend their IT dollars in 2011 and having insight into how the IT environment for hedge funds has evolved in recent years is helpful, but applying that knowledge to allow a hedge fund to make meaningful decisions on how to best deploy their IT dollars going forward requires that a manager understand that there may be differences between the "optimal" and the most realistic approach they should pursue.

Much of what has been discussed in this paper thus far has focused on what a hedge fund would do if they were free to pursue their "optimal" solution. Most hedge funds are not in such a position however.

While there may be tremendous appeal in the emerging Hedge Fund 3.0 technologies, older vintage funds with sunk investment costs may have little flexibility to pursue these options. It may be primarily the smaller and newer funds that can take advantage of these innovations.

Conversely, the opportunity to achieve differentiation through deploying customized data management and investment decision-making tools may only be available to larger hedge funds with mature infrastructures. As will be discussed, there is a sequence to which hedge funds should look to create capabilities, and pursing differentiation is only relevant when foundational elements are in place.

To determine the best path forward, we recommend that you think about the following three questions in relation to your own individual organization: Is there a "trigger event" coming up that would offer me an opportunity to leverage off-premises or cloud technologies? Based on my existing platform, what capabilities should I be looking to create next? For new functionality, would the best approach be for me to buy / outsource such capabilities or should I invest in building a custom solution?

Trigger Events & Leveraging Off-Premises Cloud Technologies

As noted previously, start-up funds coming to market in these post-crisis years are likely to embrace off-premises cloud technologies as their de facto go-to-market model. This reflects their ability to think about their infrastructure options with a "clean slate" and design an optimal offering. For hedge funds that launched in earlier Hedge Fund 1.0 or 2.0 models, however, that ability to shift their infrastructure approach is far more limited.

Data obtained in the benchmark survey underscores this sentiment. Small hedge funds were by far the "youngest" in terms of having the highest percentage of respondents having been in business for less than 5 years (39%). These participants sourced 49% of their infrastructure from either third-party managed service providers or from software vendors that hosted their own data centers. Only 39% of these small hedge funds hosted their own infrastructure.

By comparison, franchise firms were at the opposite end of the spectrum. All of the franchise-sized firms had been in existence longer than 5 years. They only sourced 24% of their infrastructure from these managed service providers or hosted software vendors typical of the Hedge Fund 3.0 model. By contrast, 66% of franchise firms indicated that they hosted their own infrastructure.

> *"In the old days, you bought your own cage, but it doesn't make sense now. The right model is to outsource your network management unless you're a very large firm."*
>
> *– COO of a U.S.-based hedge fund managing between $3 billion and $5 billion USD*

For organizations that remain primarily rooted in the earlier models, it is likely that they will need to identify a "trigger event" that gives them an opportunity to rethink aspects of their infrastructure to make any significant strides toward Hedge Fund 3.0 sourcing. In such instances, they may be able to realize superior efficiencies or identify relevant cost-savings in discrete areas.

We have identified 3 common trigger events that offer natural segues for older hedge funds that may want to rethink their infrastructure approach.

Inadequate Space to Expand Server Capacity: Funds that currently have locally hosted data centers on-premises may find that they do not have ample server rooms within their existing office space as they look to add or upgrade their capabilities. If the "comms" room within a small office lacks enough cooling capacity, it becomes much more efficient to host new applications remotely than to engage in a lengthy renovation or office move.

Equipment Nearing End of Life: Even if a hedge fund has sufficient space in their locally hosted data center, they may still look to migrate some of their infrastructure off-premises as their current hardware whose expense has been amortized down to zero over three or four years, reaches the end of its useful life. In such instances, the costs of replacing the equipment either directly or via their integration firm may be weighed against the substitution of a fixed-fee contract with a managed service provider.

More Synchronous Data Replication is Required: With the emerging emphasis on data management and investment decision-making tools, more hedge funds are building custom applications that draw together large quantities of data from upstream systems. These tools may offer up critical insight into the effectiveness or exposures of the investment portfolio. Ensuring that this information is readily available may prompt a hedge fund to reassess their disaster recovery plan. It is typical for many organizations to run asynchronous disaster recovery where information is exchanged between the production and recovery environment at intervals. For these new analytic tools, the hedge fund may rather desire a "live-live" connection between their environments. This capability might be most effectively and efficiently realized by creating a new disaster recovery relationship with a managed service provider.

Each of these trigger events may offer a hedge fund manager an opportunity to evaluate their infrastructure and make a change However, the benefit to be gained by this move has to be weighed against the amount of disruption the change may create.

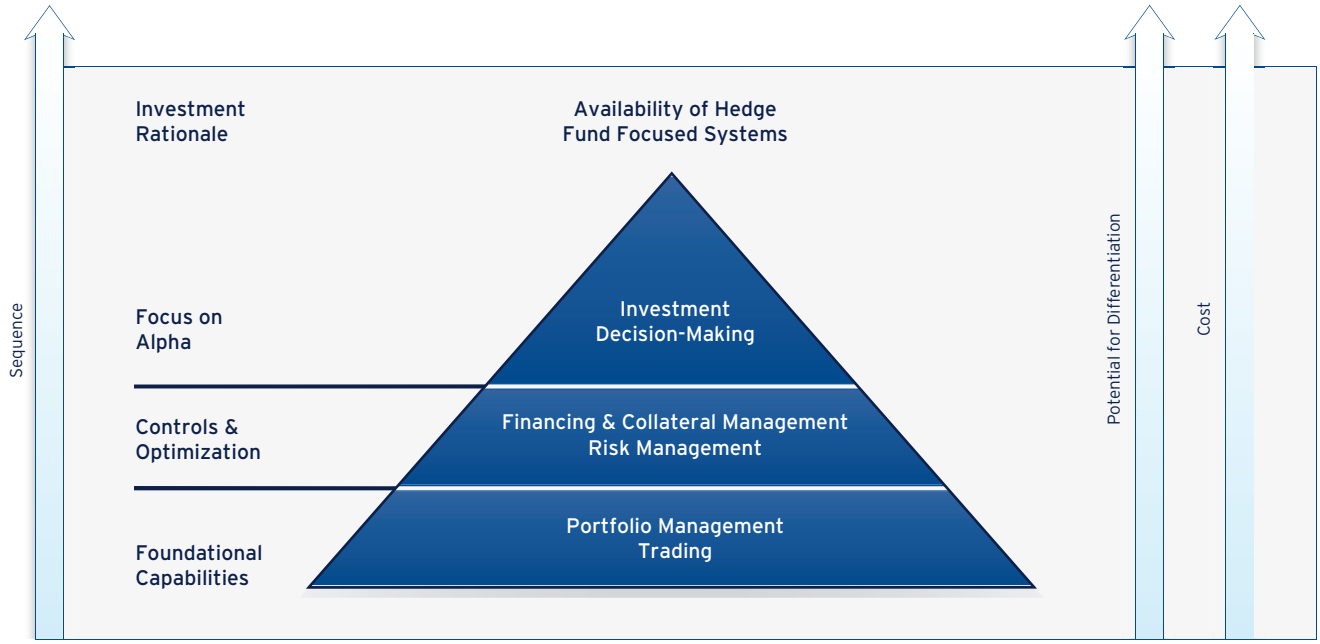
Older and larger hedge funds with entrenched, self-hosted infrastructures are less likely to be interested in emerging cloud technologies. The majority of these participants have custom built the majority of their software and, as noted earlier, they host that software locally within data centers they maintain themselves, both on- and off-premises.

Any cost savings these franchise firms may achieve by moving to a managed service or hosted software model would be outweighed by the opportunity cost they would lose in terms of other projects that would need to get de-emphasized, and the burden of managing such a massive undertaking.

"Most of our infrastructure is on-premises, as the basement data center is part of our lease. But that decision to host ourselves is a bias based on fund vintage and size; we might do it differently if we started again. But there is an opportunity cost to migrating your infrastructure off-premises, and it's just not worth it to us at this point."

– CTO of a UK-based Managing> $ 5 Billion USD Hedge Fund

Chart 13: Evaluating Hedge Fund Software Options



Software Sequencing Places Core Capabilities Before Insight

As IT planning turns from infrastructure to software, a hedge fund manager needs to assess the state of their existing platform and determine, from a sequencing perspective, which capabilities make the most sense to introduce next. A desire to immediately seek differentiation with targeted investment decision-making tools needs to be balanced against focusing on core systems that ensure basic capabilities.

Chart 13 highlights some critical points to consider in planning how to deploy software dollars. Foremost is the fact that there is typically a sequence by which hedge fund managers' look to add new functionality. This sequence reflects a progression whereby the manager first builds out foundational trading and portfolio management capabilities, then focuses on risk, financing and collateral management systems that offer them opportunities to better control and optimize their investments and, only when they have these core capabilities in place, begin to spend on customized tools that allow them to focus more effectively on understanding their alpha creation.

Benchmark data provided by survey respondents underscores the validity of this sequencing. Both small and medium-sized hedge funds spent the majority of their IT software budget on foundational trading and portfolio management systems. This outlay accounted for 39% of small manager's software budget and 32% of medium-sized managers' spend. Large hedge funds by contrast only allocate 29% of their IT software budget to these platforms as other priorities began to draw the majority of their available dollars.

Not only are trading and portfolio management seen as the foundational systems, thanks to the commoditization that occurred in the industry during the tail end of Wave 1, they are also the most broadly available and thus the most competitively priced. One reason that these systems lie at the base of the triangle shown in Chart 13 is that there is a significant number of vendors available to hedge funds to pick from in selecting a platform to meet their individual needs.

The impact of this trend can be seen in the benchmark data. In evaluating the vintage of survey respondents, we see that only 29% of large hedge funds are more than 5 years old, whereas 100% of franchise hedge funds fall into that category. The majority of large hedge funds thus launched in a period when commoditization of trading and portfolio management platforms was already underway.

> *" Our business needs to expand as we get into trickier instruments. Once that is stable, we can focus on customizing the outputs."*
>
> *– CFO of a U.S.-based hedge fund managing less than $500 million USD*

> *" We've always invested more in technology than people. We have tiny finance and operations teams, as we've automated everything. We have six people in operations, and we process 10,000 complex trades every day."*
>
> *– CTO of a Managing between $3 billion and $5 billion USD, UK-based hedge fund*

These firms were able to take advantage of standardized, competitively priced platforms whereas the older vintage franchise firms had to build customized platforms to achieve their desired functionality. Indeed, these franchise firms represent the hedge fund pioneers discussed in Section 2 and they have typically maintained their customized platforms through to the present day. As a result, they still spend 39% of their software budget on these platforms versus the 29% large funds spend, as noted earlier.

Realizing adequate risk controls over the investment process and finding opportunities to optimize the firm's financing and collateral management are typically the drivers that emerge to justify the next set of hedge fund investments. These enhancements directly impact the manager's perceived "institutional" quality, a critical consideration given shifting investor dynamics. Much has been written about how large a hedge fund manager must be to attract institutional dollars. One reason that larger funds are seen as more attractive targets is that they have typically devoted more of their IT spend to ensuring these core control and optimization systems.

This assertion is supported by the data emerging from survey respondents. Benchmark data shows that as AUM grows, the proportionate share of the hedge fund manager's budget devoted to these capabilities also increases. Small and medium-sized hedge funds cite risk, financing and collateral management software as accounting for 15% of their total IT spend. This jumps to 19% for large hedge funds and 24% for franchise firms.

Because we are not yet through with Wave 2 and are only beginning to see the full impact of its commoditization influence, there are fewer commercially available systems focused on the hedge fund space available in the risk, financing and collateral management functions as compared to trading and portfolio management. As will be discussed in a moment, this affects the approach a manager would use to achieve capabilities in this space.

From a sequencing perspective, it is typically after these core investments have been made that a manager then begins to focus on building customized data management and investment decision-making tools to enhance their focus on alpha creation.

Benchmark data shows that in 2011, large hedge fund managers will focus the majority of their IT software budget (36%) on realizing the differentiation inherent in these tools. On average, dollars spent on these capabilities more than quadruple as a hedge fund manager moves from the small and medium to the large AUM category. Franchise firms spend even more—again doubling the size of their investment to realize the differentiation available with these advanced functions.

Tracking Movement in the Buy versus Build Threshold

Once a manager understands which software capabilities they should be focusing upon, the final decision they must make to optimize that investment is whether they should look to "buy" or "build" that functionality. To be clear, in this context buying such functionality can relate to either licensing a vendor application or paying to have an outsourced service provider manage this function on their behalf. Build refers to having in-house developers or external IT developers who have been hired on a consulting basis create proprietary applications.

Chart 14 lays out the major categories of software hedge fund managers consider in creating their core platform. Each type of software is positioned by the relative complexity of its functions and by the hedge fund's relative need to customize such solutions to obtain differentiation. A third dimension of time is also applied to the chart. This is represented by movement of the "buy versus build threshold."

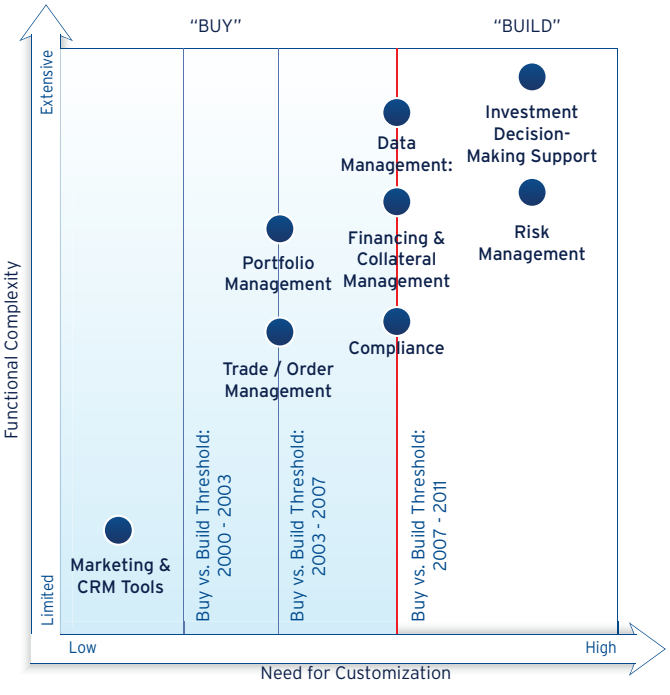
Back in 2000-2003, only the most rudimentary and simplistic CRM platforms existed behind the buy- versus-build threshold. All other functionality a hedge fund would have considered core to their investment approach were to the right of this line, indicating that building custom solutions was the most viable path to obtain those capabilities.

In these years, hedge funds relied almost universally on technology provided to them by their prime brokers for trading and for understanding their portfolio holdings. These were the years that Wave 1 pioneers had opted to "build" their own platforms in the trading and portfolio management to achieve differentiation. As their efforts peaked and the commoditization of such capabilities began to occur, the buy versus build threshold shifted to the right.

Between 2003 and 2007, new entrants coming to market were starting to have options that called into question their need to build trading or portfolio management solutions. By 2008, there were enough offerings available to emerging funds—either from new entrants or from traditional providers having upgraded their offerings—that for the majority of hedge funds, there was no longer a need to consider custom building these functions. Indeed, the emergence of middle-office outsourcing providers offered hedge funds emerging post-2007 a route to market that did not even require them to invest in portfolio management software at all, and yet still enjoy advanced capabilities.

Benchmark data underscores this dramatic change in approach. Small, medium and large hedge funds showed a significant preference for buying their trading and portfolio management platforms, while the majority of franchise firms continued to build these capabilities. At one end of the spectrum were small hedge funds that preferred to buy rather than build a trading solution, 64% to 36%, and a portfolio management solution, 79% to 21%. At the other end of the spectrum were franchise firms whose buy-versus-build ratios were 41% to 59% for trading applications and 48% to 52% for portfolio management platforms.

Chart 14: Determining Buy vs. Build Approach



Wave 2 innovations are beginning to have a similar impact. Between 2003 and 2007, hedge funds looking to obtain advanced capabilities in financing or collateral management were forced to invest their own money as these systems lay beyond the buy-versus-build threshold. Advances achieved in recent years have started to change that situation. Since 2008, enough commoditization has occurred so that, by today, only hedge funds with highly complex requirements would consider building their own solution as opposed to buying an existing platform.

Small hedge funds that would most typically be served with standard functionality in these areas are fairly evenly split on their preference to buy rather than build financing and collateral management solutions, by 52% to 48%, in contrast to a clear build preference for both large funds (29% to 71%) and franchise firms (37% to 63%).

A similar dynamic exists for compliance software and data management solutions, both areas where new vendor offerings are emerging quickly to address shifting investor demands and increased regulatory hurdles. Small hedge funds are fairly evenly split in their approach for compliance solutions (45% buy to 55% build), whereas franchise firms at the other end of the spectrum continue to favor build options (29% to 71%). Data management solution approaches show an almost identical profile. Small funds (55% to 45%) and medium-sized funds (62% to 38%) prefer to buy solutions whereas large hedge funds favor building solutions (38% versus 62%), as do franchise firms (32% to 68%).

Risk management and the creation of investment decision-making tools are the only areas where the majority of hedge funds of all sizes continue to build rather than buy solutions. In the pursuit of risk management capabilities, small hedge funds showed a 40% to 60% bias toward build, medium funds a 36% to 64% preference, large funds a 39% to 61% split and franchise firms a 21% to 79% ratio. Investment decision-making tool preferences were as follows: small and medium funds at 33% buy to 67% build, large funds at 41% buy to 59% build and franchise firms at 21% buy to 79% build.

As the industry continues to evolve, we would expect these functions to become increasingly standardized as well and allow for another shift in the buy-versus-build threshold. In the foreseeable 2011-2012 period, however, it is most likely that hedge funds seeking capabilities in these areas will be looking to either hire in-house expertise or contract with industry expert consultants to address their need for customization in these applications.

Using these Data Points as Establishing Benchmarks

As we near the end of this inaugural IT Trends and Benchmarking survey, we have been able to both lay out the story of the hedge fund industry's recent evolution and show through our 2011 survey responses the most realistic approaches hedge funds of various size and vintage are taking today to build out their infrastructure and capabilities.

This year's report can be viewed as establishing a set of benchmarks. Much of what will make the IT Trends and Benchmarking survey interesting in coming years will be the year-over-year changes we see in a respondent's profile and in their investment path.

Our goal is to publish this paper each fall as hedge funds begin to formulate their budgets and priorities for the coming calendar year. This timing should provide our clients and prospects an independent view against which to assess their own metrics. As an incentive to those managers that participate in our survey, we will additionally provide individualized scorecards and analysis of their responses relative to their peer universe.

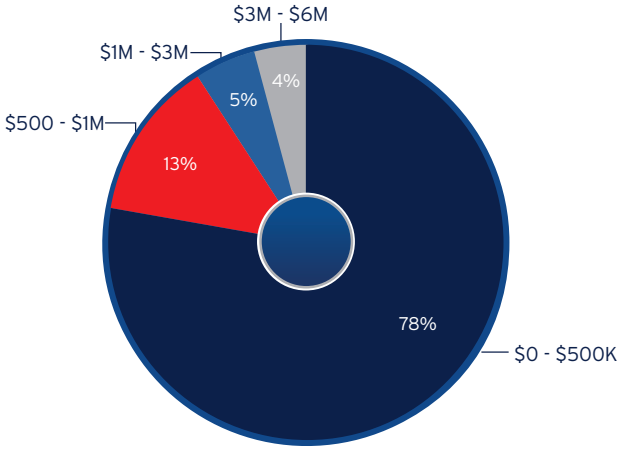
For the broader set of readers, we will now present the 2011 baseline data for each sized set of hedge fund respondents.

Small Hedge Fund Benchmarks [Manager's with AUM < $500 millions USD]

Total IT Spend

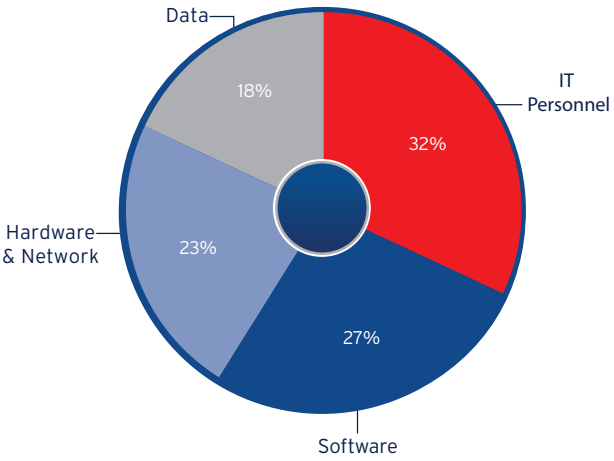
Small Funds: Total IT Spend

- While over three-quarters of small funds spend less than $500,000 USD on their annual IT budget, 9% spent more than $1 million USD
- Total IT spending for small funds averages $598,000 USD per year
- As a percentage of AUM, small funds spend 12 basis points on technology
  - 4 bps – personnel
  - 3 bps – hardware & networks
  - 3 bps – software
  - 2 bps – data



Source: Citi Prime Finance

Small Funds: IT Spend by Catagory

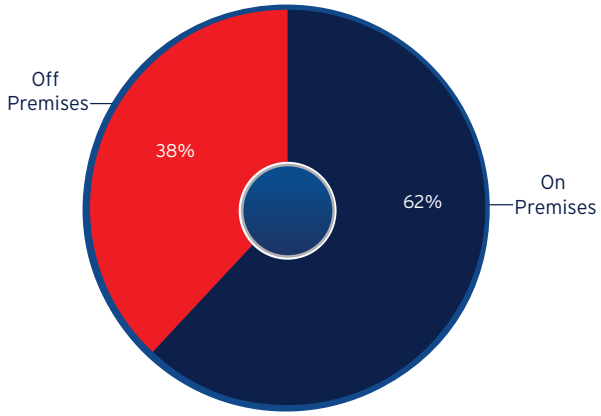


Source: Citi Prime Finance

- Small funds spend the most proportionately on software but the least on data, relative to larger funds
- Almost a third of their budgets were allocated to personnel—both internal and outsourced. This is in line with the averages across all fund sizes

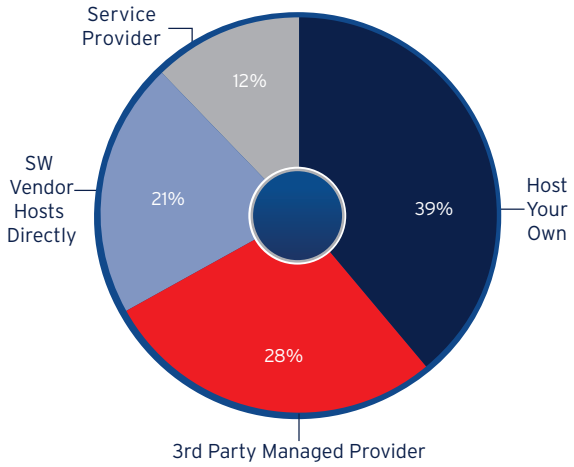
Small Funds: Infrastructure Approach

- 38% of the infrastructure of small funds is hosted off-premises, the highest percentage of all responding segments



Source: Citi Prime Finance

Small Funds: Infrastructure Sourcing

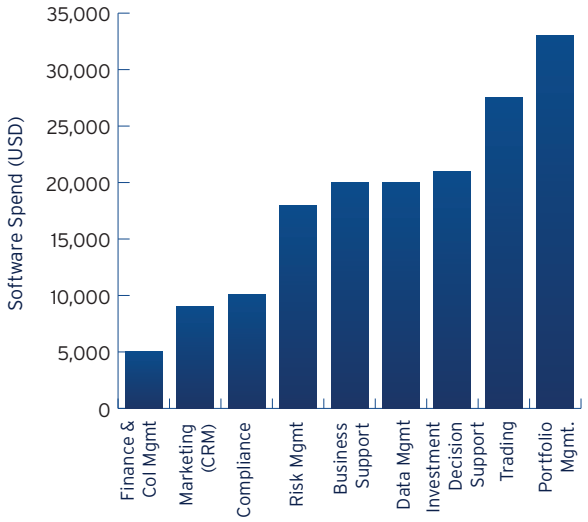


Source: Citi Prime Finance

- Consistent with all fund segments, about two-thirds of hardware / network budget is allocated to the production environment, and the remainder toward the disaster recovery / continuity of business environment
- More than a quarter of small funds leverage a managed service provider to host their infrastructure

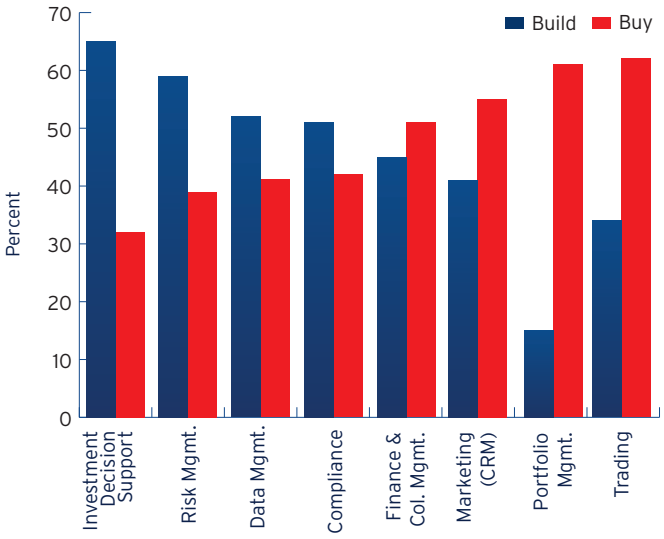
Small Funds: Software Spend by Category

- Small funds spend the least on marketing- and finance-related applications
- Funds in this segment allocate the most budget towards portfolio management and trading software
- Total software spending for small funds is $161,000, on average



Source: Citi Prime Finance

Small Funds: Software Approach by Category

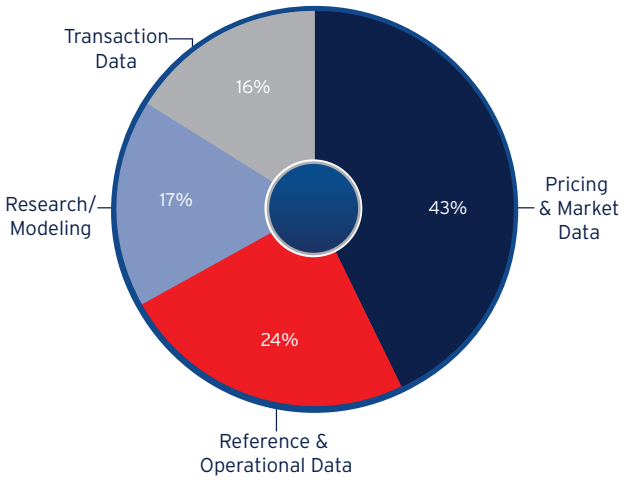


Source: Citi Prime Finance

- Small funds acquire applications from a variety of sources: software vendors, service providers, in-house and outsourced developers
- Small funds were 5 times more likely to source portfolio accounting applications from a vendor or service provider than build it

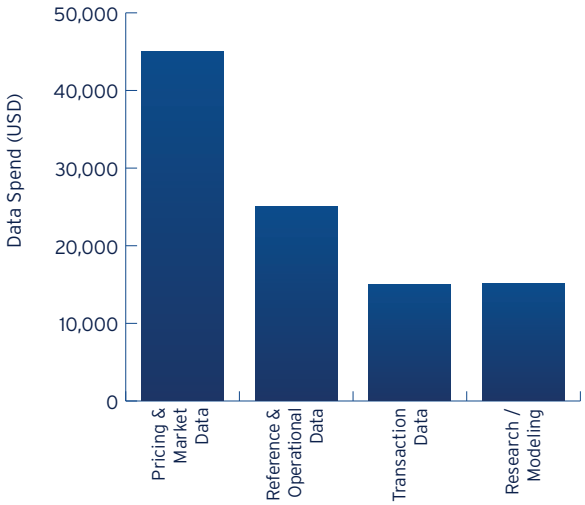
Small Funds: Breakdown of Data Spend

- 43% of the data budget of small funds is spent on pricing & market data—the highest proportion of all fund segments surveyed
- 17% of the data budget of small funds is allocated toward research / modeling data—the lowest proportion of all fund segments surveyed



Source: Citi Prime Finance

Small Funds: Data Spend by Category



Source: Citi Prime Finance

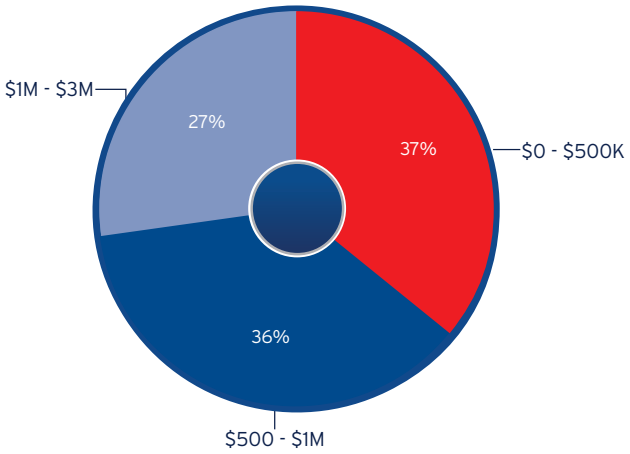
- Total data spending by small funds is, on average, $107,000 USD annually

Medium Sized Hedge Fund Benchmarks [Manager's with AUM between $500 million and $3 billion USD]

Total IT Spend

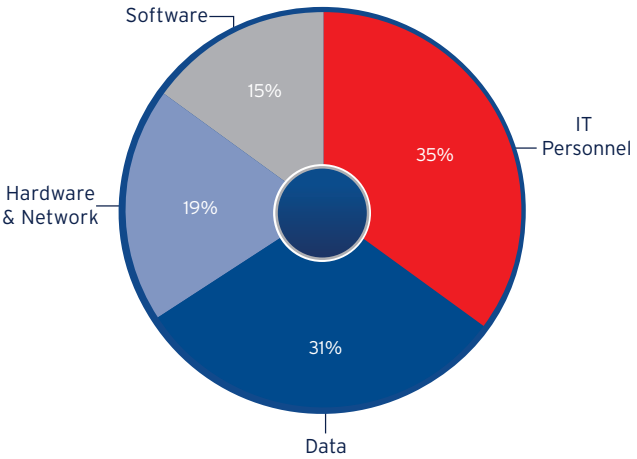
Medium Funds: Total IT Spend

- More than one-third of medium funds spent between $500,000 USD and $1 million USD on their IT budgets, but an equal percentage spent less than this amount
- Average total IT spend is $909,000 USD for medium-sized survey respondents
- Total IT spending is 6 basis points of AUM
  - 2 bps – personnel
  - 1 bps – hardware & networks
  - 1 bps – software
  - 2 bps – data



Source: Citi Prime Finance

Medium Funds: IT Spend by Catagory

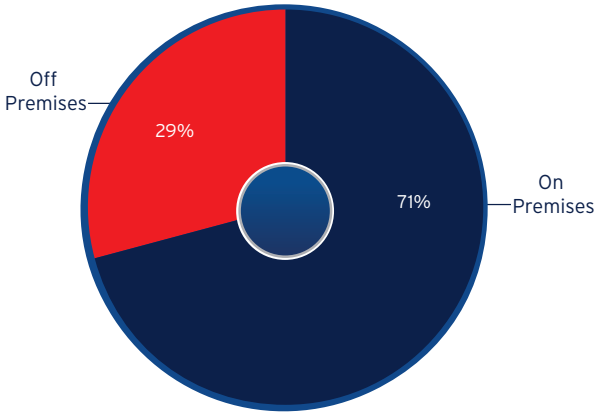


Source: Citi Prime Finance

- The allocation toward data expenses almost doubles as funds grow beyond the $500,000 USD AUM threshold, accounting for 31% of the total IT budget
- Medium funds begin to spend less proportionally on software, as the initial software employed by the fund continues to be leveraged as the fund (and the budget) grows

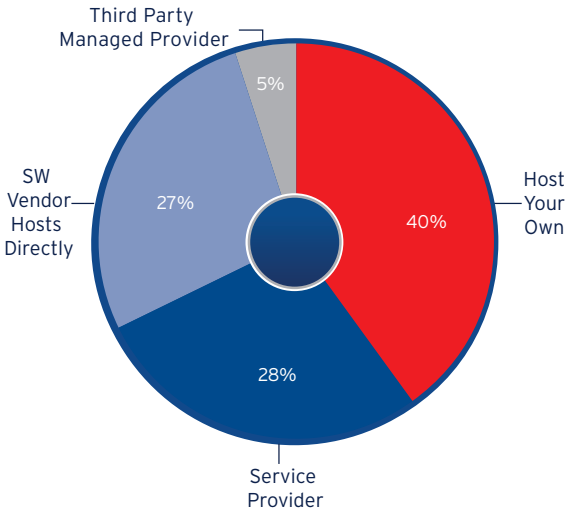
Medium Funds: Infrastructure Approach

- Medium funds begin to take more infrastructure in-house, bringing the percentage of on-premises infrastructure to 71%



Source: Citi Prime Finance

Medium Funds: Infrastructure Sourcing

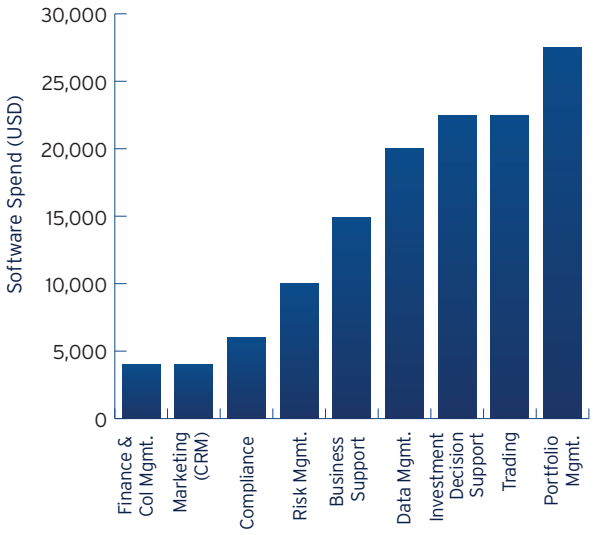


Source: Citi Prime Finance

- Consistent with all fund segments, about two-thirds of hardware / network budget is allocated to the production environment, and the remainder toward the disaster recovery / continuity of business environment
- Medium funds turn away from leveraging a managed service provider to host their off-premises infrastructure

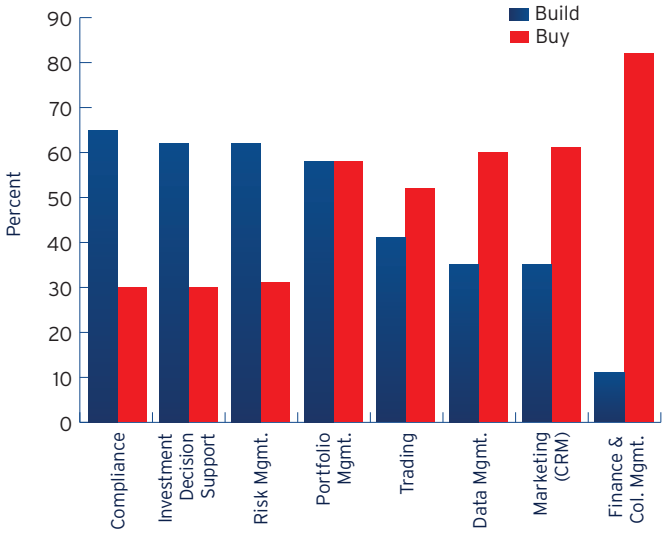
Medium Funds: Software Spend by Category

- Interestingly, medium funds allocate their software budget based on the same order of importance as their smaller peers, spending the least on finance and compliance, and the most on trading and portfolio management
- Total software spending for medium funds is $136,000 USD, on average
- The following chart demonstrates how much money medium funds are allocating toward various software functions



Source: Citi Prime Finance

Medium Funds: Software Approach by Category

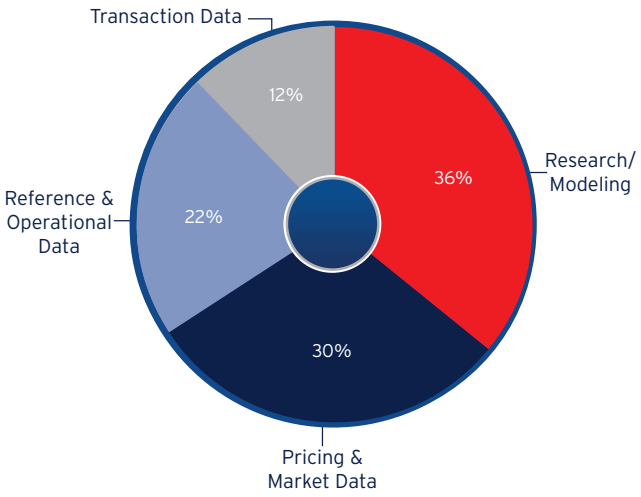


Source: Citi Prime Finance

- Medium funds acquire applications from a variety of sources: software vendors, service providers, in-house and outsourced developers
- Funds in this segment become more likely than their smaller peers to build foundational capabilities such as portfolio management and trading

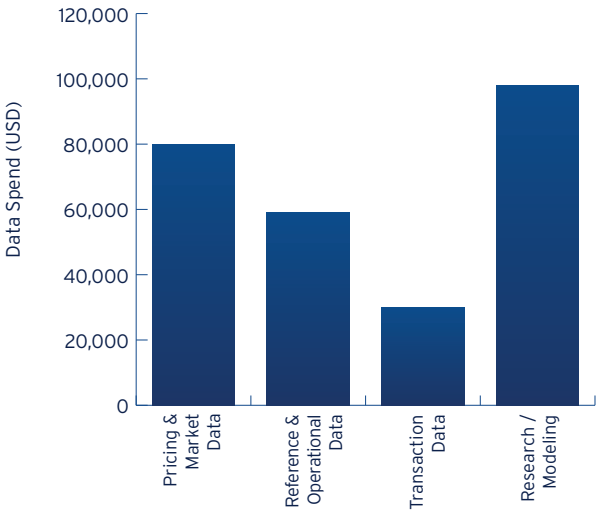
Medium Funds: Breakdown of Data Spend

- Medium funds double the percentage of their Research / Modeling data budget allocation relative to smaller funds, as they begin to refine their investment decision-making process



Source: Citi Prime Finance

Medium Funds: Data Spend by Category



Source: Citi Prime Finance

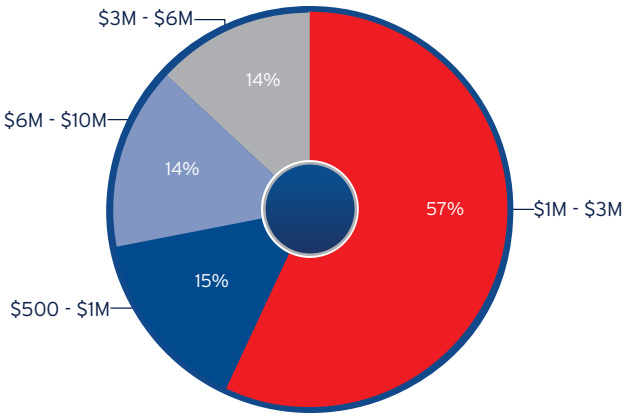
- Funds in this segment have an average annual data expense of $282,000 USD

Large Hedge Fund Benchmarks [Manager's with AUM between $3 billion and $5 billion USD]

Total IT Spend

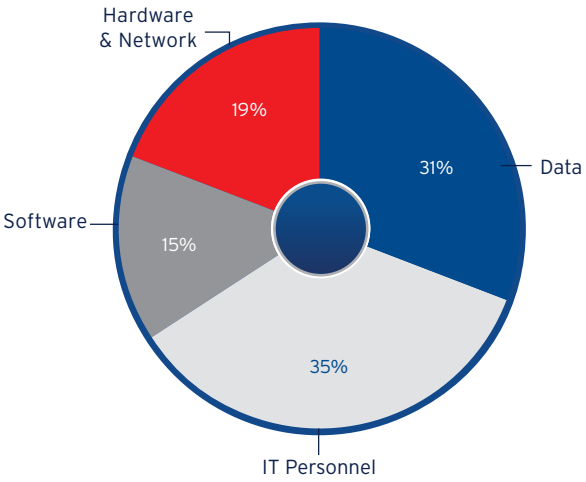
Large Funds: Total IT Spend

- More than half of large funds spend between $1 million USD and $3 million USD on their IT budget in 2011. More than a quarter spent more than that amount
- Total annual IT spending for large funds averages $3.1 million USD
- On a percentage basis, total IT spending is 8 basis points of AUM
  - 2.5 bps – personnel
  - 1.5 bps – hardware & networks
  - 1.5 bps – software
  - 2.5 bps – data



Source: Citi Prime Finance

Large Funds: IT Spend by Catagory

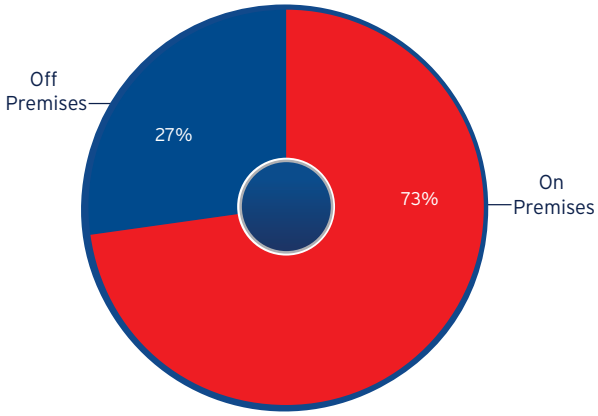


Source: Citi Prime Finance

- Data reaches its highest proportionate percentage of IT budget in the large-fund segment

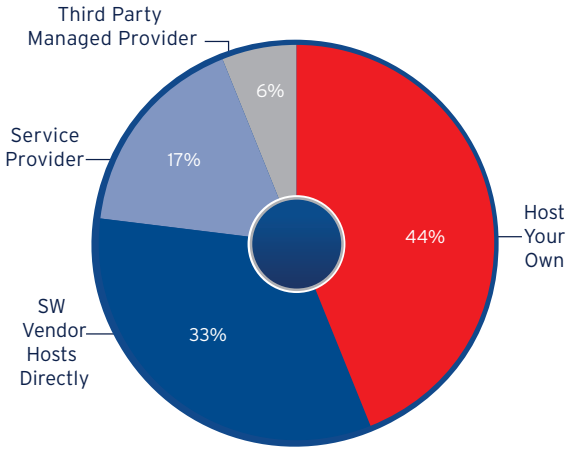
Large Funds: Infrastructure Approach

- Large funds grow their in-house infrastructure relative to the medium fund segment, bringing the percentage of on-premises infrastructure to 73%—the largest proportion of any segment



Source: Citi Prime Finance

Large Funds: Infrastructure Sourcing

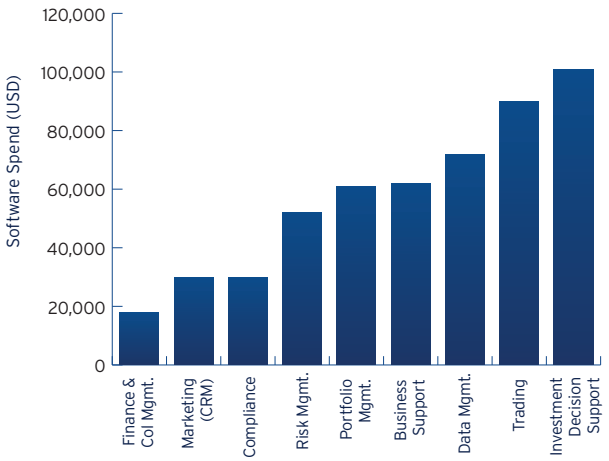


Source: Citi Prime Finance

- Consistent with all fund segments, about two-thirds of hardware / network budget is allocated to the production environment, and the remainder toward the disaster recovery / continuity of business environment
- Large funds leverage software hosted directly by the software provider more than any other fund segment, even though they begin to increase self-hosting off-premises data centers

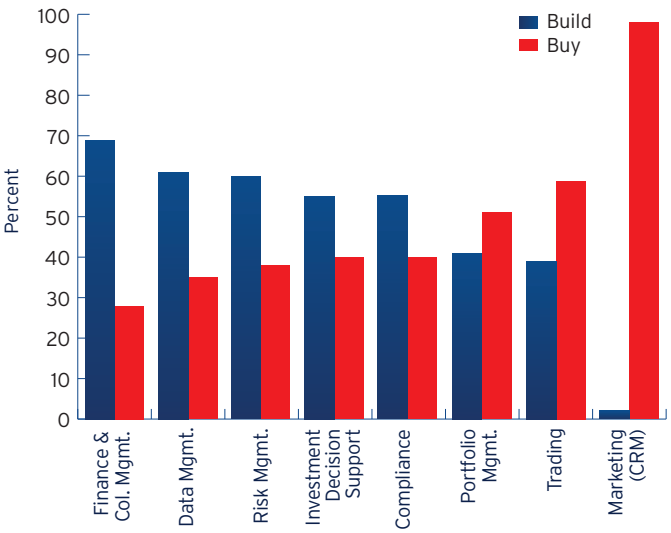
Large Funds: Software Spend by Category

- Large funds begin to allocate a higher percentage of their IT budget dollars toward the marketing function, reflecting the need to cater to their institutional investor asset base
- Investment decision support becomes the function that receives the most software budget dollars, relative to other functions, reflecting the effort by large funds to institutionalize their investment process
- Total software spending for large funds is $559,000 annually, on average
- The following chart demonstrates how much money large funds are allocating toward various software functions



Source: Citi Prime Finance

Large Funds: Software Approach by Category

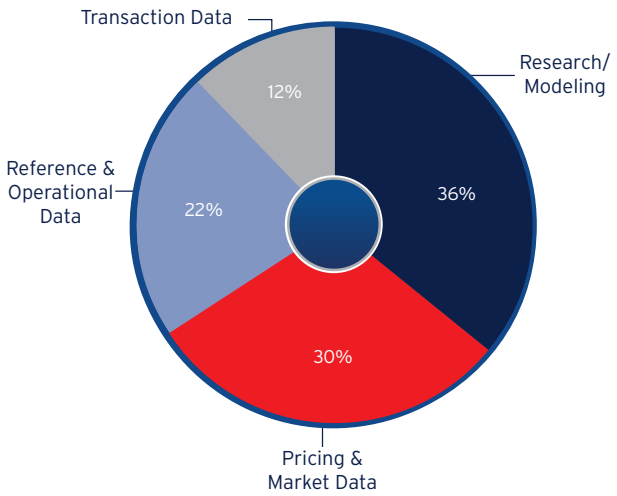


Source: Citi Prime Finance

- Large funds acquire applications from a variety of sources;: software vendors, service providers, in-house and outsourced developers
- Large funds almost exclusively source their marketing applications from vendors, indicating both their need to augment their investor servicing as well as the high availability of off-the-shelf solutions in the market

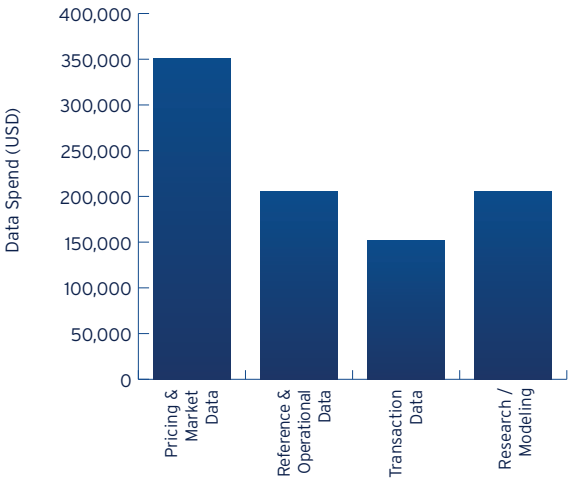
Large Funds: Breakdown of Data Spend

- Large funds allocate less of their IT budget toward research / modeling than their medium-size peers, reflecting the notion that their investment approach has now been well developed



Source: Citi Prime Finance

Large Funds: Data Spend by Category



Source: Citi Prime Finance

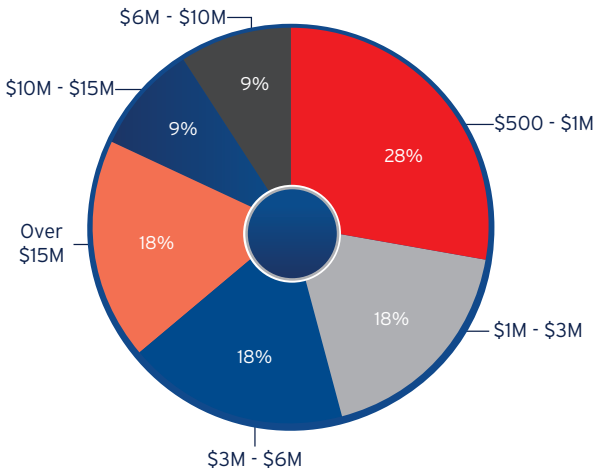
- Average annual data spend for large funds is $1.025 million USD

Franchise Hedge Fund Benchmarks [Manager's with AUM > $5 billion USD]

Total IT Spend

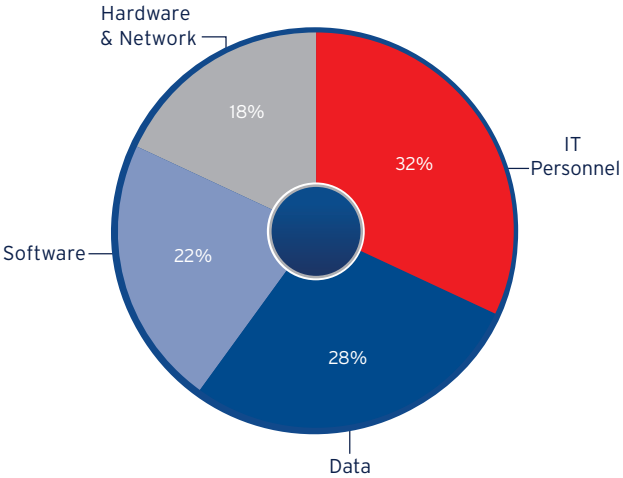
Franchise Funds: Total IT Spend

- While some of the largest funds spend under $1 million USD on technology, some spend more than $15 million USD annually
- Average annual IT spend for franchise funds is $7.9 million USD
- As a percentage of AUM, IT spend for funds in this segment runs 10 bps
  - 3 bps – personnel
  - 2 bps – hardware & networks
  - 2 bps – software
  - 3 bps – data



Source: Citi Prime Finance

Franchise Funds: IT Spend by Catagory

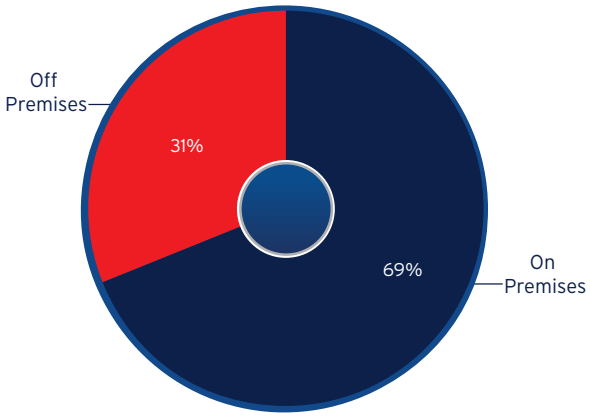


Source: Citi Prime Finance

- Software allocation of IT budgets remains in line with large and medium funds, indicating that applications costs scale in proportion as their budgets grow over time

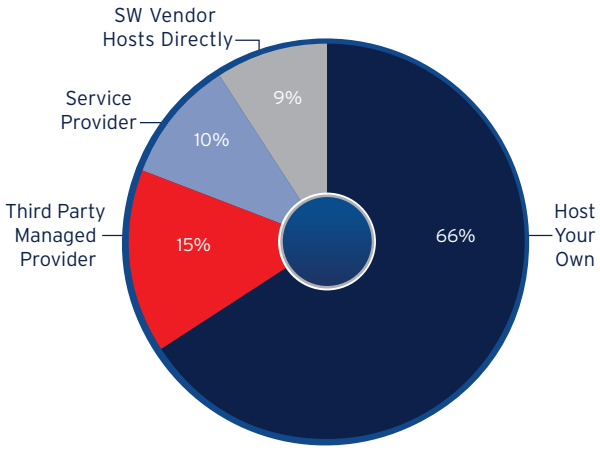
Franchise Funds: Infrastructure Approach

- As funds reach the franchise threshold, they begin to rationalize their on-premises infrastructure and move some of it off-premises



Source: Citi Prime Finance.

Franchise Funds: Infrastructure Sourcing

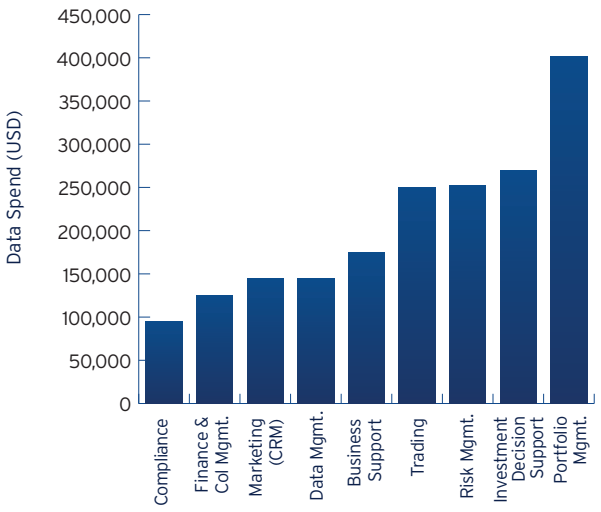


Source: Citi Prime Finance

- Consistent with all fund segments, about two-thirds of hardware / network budget is allocated to the production environment, and the remainder toward the disaster recovery / continuity of business environment
- Some of the reduction of on-site data centers for franchise funds is accounted for in their increased use of self-hosted off site data centers. Franchise funds represent the segment most likely to host their own off-premises data centers, as they are 18% more likely to do so, relative to the average fund

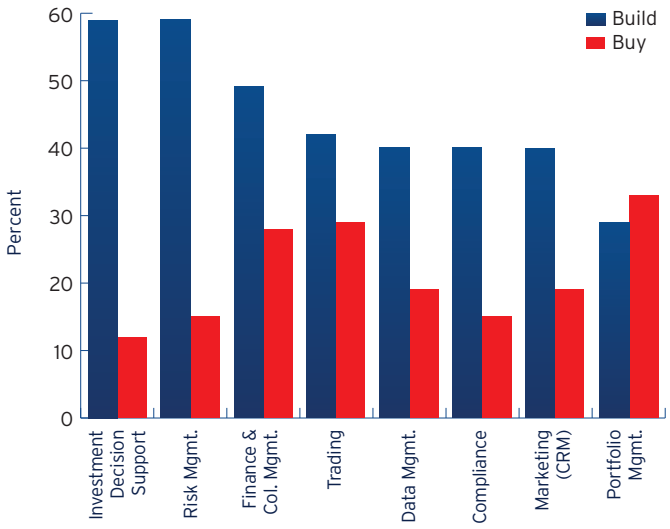
Franchise Funds: Software Spend by Category

- Franchise funds continue to allocate a higher percentage of their IT budget dollars toward the marketing function, reflecting the continued need to cater to their institutional investor asset base
- Franchise funds triple their software budget allocation in the finance & collateral management category, relative to their large-fund peers
- Risk management receives more budget dollars than trading applications
- Total annual software spending for franchise funds is $1.78 million USD, on average



Source: Citi Prime Finance

Franchise Funds: Software Approach by Category

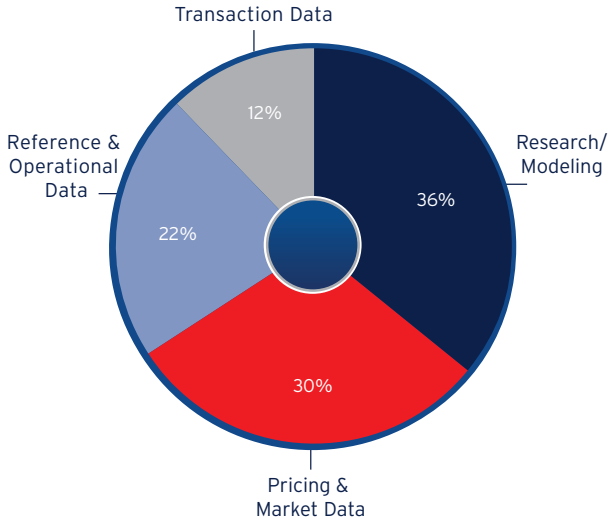


Source: Citi Prime Finance

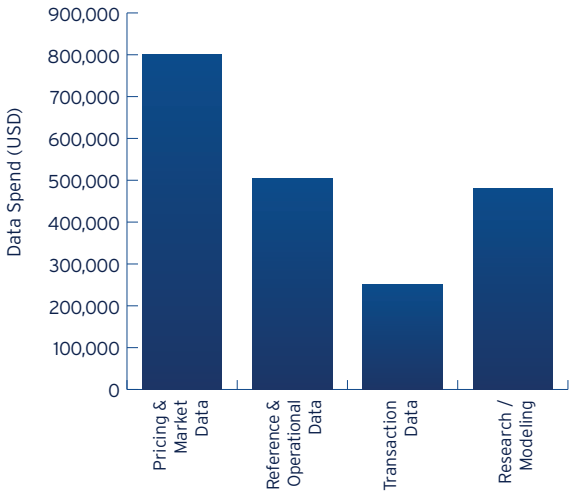
- Franchise funds acquire applications from a variety of sources: software vendors, service providers, in-house and outsourced developers
- Funds at this stage have a greater tendency to build investment decision support, risk, data management and compliance solutions

Franchise Funds: Breakdown of Data Spend

- Interestingly, the data budget allocation of franchise funds most-closely represents the data budget allocation of the average fund across all segments



Franchise Funds: Data Spend by Category



- Average annual data spending by franchise funds is $2.2 million USD

Source: Citi Prime Finance

Citi Prime Finance

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