

# The Management of Hedge Funds’ Operational Risks

Jean-René Giraud<sup>1</sup>

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<sup>1</sup> Jean-René Giraud is C.E.O. of Edhec-Risk Advisory, the consultancy arm of the Edhec Risk and Asset Management Research Centre and research associate, focusing on extreme risks.

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# 1 The importance of managing FoHF<sup>2</sup> operational risks

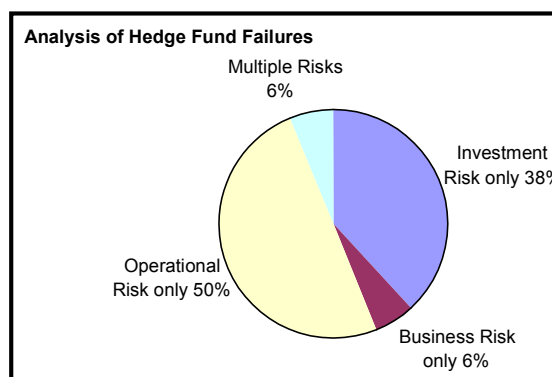
By their very nature, hedge funds allow the investor to be exposed to different risk factors such as volatility, counterparty, or liquidity risk, since this exposure is considered to be a source of superior returns for invested funds. As an example, it is well understood and widely accepted that market makers receive a premium (the spread) when acting as liquidity providers in a market. When hedge funds implement trading strategies that provide liquidity to a specific market (such as fixed income arbitrage, distressed securities or securities involved in an M&A process), part of the return that can be expected is a premium for the liquidity risk they carry when holding illiquid instruments that are potentially subject to large price swings.

Exposure to these risk factors is not only a source of superior return but also the very essence of hedge funds' extensive diversification possibilities compared with traditional investments<sup>3</sup>. More importantly, it is interesting to note that the exposure to these risk factors is also a diversifiable risk as it has been demonstrated that hedge funds exhibit low correlations amongst themselves<sup>4</sup>.

These advantages do not come without a downside. Gaining exposure to alternative risk factors usually requires trading activities that can be considered less conventional than in the long only universe. These include investments in illiquid instruments, extremely high portfolio turnovers and non-vanilla OTC contracts. While these technicalities do not themselves represent an issue (the trading techniques of hedge funds usually originate at the desks of proprietary trading dealing rooms), they do however carry a level of operational risk for which the investor receives no premium.

It is interesting to note that hedge reporting on hedge fund risk exposure focuses on financial risks only, when it is not limited to market risk only. Recent studies such as the one conducted by Capco in 2003<sup>5</sup> show interesting results on the importance of non-financial risks within hedge funds. A key finding of the study is that operational risk greatly exceeds the risk related to the investment strategy, with at least 56% of the hedge fund collapses (i.e. funds that have ceased operations with or without returning the capital to their shareholders) directly related to a failure of one or several operational processes.

Graph 1: Analysis of Hedge Fund Failures



Capco Research and Working Paper, "Understanding and Mitigating Operational Risk in Hedge Fund Investments", 2002

With an average of only 15 fund collapses per year<sup>6</sup> out of a universe of a few thousand funds open to investment, it becomes clear that the risks related to the operational weaknesses of hedge funds significantly outweigh the levels of financial risk, which are usually the focus of the managers' attention and investors' concerns. If we assume that the universe of investable funds is 2,500, the failure rate can be estimated at 0.6%, which represents a very high probability of default in the context of funds of hedge funds that invest in 10 to 25 vehicles.

<sup>2</sup> FoHF: Fund of Hedge Funds

<sup>3</sup> See Agarwal and Naik (2000) or Schneeweis and Spurgin (2000).

<sup>4</sup> See M.W. Peskin, M.S. Urias, S.I. Anjilvel, B.E. Boudreau, "Why Hedge Funds Make Sense" (Morgan Stanley Dean Witter, November 2000).

<sup>5</sup> Capco Research and Working Paper, "Understanding and Mitigating Operational Risk in Hedge Fund Investments", 2002

<sup>6</sup> Source: Edhec Risk and Asset Management Research Centre, based on publicly available information only

It is important to note that the analysis of historical data on hedge fund failures is rendered extremely difficult by the lack of transparency on the chain of events that leads to bankruptcy or closure. Not only is information not always publicly available as investors may choose private settlement to exit a difficult situation with a fund manager, when information is available, it is usually in the form of very controversial and even passionate debate.

As an example, we can analyse the root causes of the ten most widely publicised failures of hedge funds. The following table shows these cases with very high level interpretation of what might have caused the failure. Information in this table is based exclusively on publicly disclosed information.

Table 1: Details of the ten most publicised hedge fund failures

Name	Year	Loss (estimates)	Overview
Long Term Capital Management (LTCM)	1998	\$4,000mn	Strategy failed to absorb post Russian debt default shock. Uncontrolled leverage, absence of transparency to prime brokers, conflicts of interest, model bias in the risk management process.
Tiger Management	2000	\$2,000mn	10% loss on a single day on trading activity, followed by a 23% loss in the value of the fund resulted in large redemptions bringing the total size of the fund from \$20,000mn down to \$8,000mn.
Everest	1998	\$1,300mn	Unfavourable market conditions and post Russian debt default shock.
Fenchurch Capital Management	1995	\$1,264mn	Change in investment strategy, absence of adequate risk management system for the new strategies.
Princeton	1999	\$1,000mn	Ponzi scheme, conflicts of interest and collusion with Prime Broker.
Beacon Hill	2002	\$1,000mn	Losses on directional bets, Mortgage Backed Securities pricing issues and lack of liquidity resulting in the need to stop redemptions and liquidate the fund.
Vairocana	1994	\$700mn	Directional bets instead of market neutral strategies, highly complex portfolios leading to difficulties in calculating the NAV.
Morgan Grenfell	1997	\$600mn	Unauthorised holdings of unlisted securities and pricing irregularities.
Manhattan Investments	1999	\$500mn	Trading losses and misrepresentation of fund performance.
Askin Capital Management	1994	\$420mn	Crash in the CMO market and weaknesses in the risk management system, very high leverage.

Source: Edhec Risk and Asset Management Research Centre, 2003; based exclusively on publicly available information.

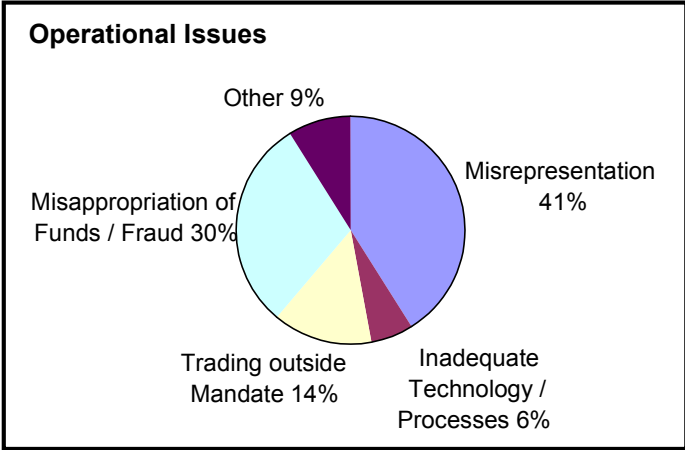
A key point is that in eight out of ten cases (the exceptions being Tiger Management and Everest), operational weaknesses are the root cause of the failure or have prevented a fund from managing a crisis situation appropriately in an unexpected financial context.

While few funds fail purely because of an operational problem (such as a terrorist attack, a system breakdown or the loss of a key member of staff), it is easily understood that a weak operational environment will increase the impact of an external event such as tough trading conditions or brutal changes in financing conditions.

As an example, while fraud is rarely the initial intention of a hedge fund manager, the complexity of the support infrastructure inherent in the trading activity, as well as the lack of maturity of the industry, provide many opportunities for operational risks that can only be mitigated by an appropriate and professional due diligence process on the investment pools.

Capco’s study on hedge fund failures provides more insight into the underlying causes of hedge fund failures.

Graph 2: Details on Operational Failures



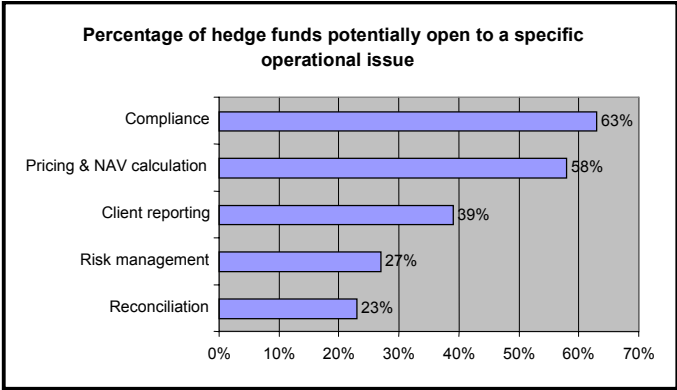
Source: Capco Research and Working Paper, “Understanding and Mitigating Operational Risk in Hedge Fund Investments”, 2002

While misappropriation, misrepresentation and deliberate fraud constitute the main sources of operational issues that can explain hedge fund failures<sup>7</sup>, these issues are only made possible by the limited regulatory constraints hedge funds face and the lack of maturity of the industry with regard to operational practices, especially in relation to:

- Position pricing & NAV calculation procedures
- Client reporting procedures
- Reconciliation capabilities
- Compliance controls
- Risk management infrastructure

The relative operational weaknesses of hedge funds have been analysed and show the importance of compliance controls; pricing and Net Asset Valuation; and client reporting, as the three main sources of operational failures.

Graph 3: Percentage of hedge funds potentially open to specific operational issues



(2) Source: Edhec Risk and Asset Management Research Centre, 2003

This analysis confirms the importance of adequate operational due diligence prior to investing in a hedge fund and the need for formal procedures and methods in order to ascertain the level of operational risk, so as to allow for the construction of an optimal hedge fund portfolio.

<sup>7</sup> Capco Research and Working Paper, “Understanding and Mitigating Operational Risk in Hedge Fund Investments”, 2002

## 2 The recurring question of transparency

Full transparency and managed accounts are very often cited as a key element in providing higher levels of security with hedge fund investments. This idea does not seem to correspond to the reality of FoHFs, as 79% of the funds that responded to the Edhec European Alternative Multimangement Survey survey do not require their target hedge funds to segregate assets in a managed account<sup>8</sup>.

At first glance, managed accounts might be seen as extremely secure as they seem to solve a series of important issues raised by investors:

- Segregation of assets. With a managed account structure, assets are effectively physically separated from the management company, which only receives a mandate to trade on behalf of the account owner. This mechanism effectively reduces the level of risks related to misappropriation of funds.
- Transparent reporting. As the managed account comprises all assets allocated to the fund manager, reporting on the actual valuation of these assets cannot be biased through the manager providing false reports on the value of a fund. Strictly speaking, the administrator is in a position to value the funds independently without any possible interference by the manager.
- Transparency on the strategy and resulting P&L. With a daily snapshot of open positions, the Fund of Hedge Funds is effectively in a position to monitor the implementation of the fund strategy and its direct results, offering the possibility of early redemptions when the investor is not keen to follow that investment strategy in certain market circumstances.

However, one should not overestimate these benefits. Not only does the cost of monitoring a series of managed accounts represent an extremely high cost and hence is only available for large FoHFs, recent cases have also proven that these benefits cannot always be fully realised:

- Structured derivatives and other complex financial instrument can allow the manager to divert capital from the fund to offshore accounts without being seen as anything other than investing in a losing strategy;
- Transparent daily reporting is nice in theory but reaches its limitations when the staff in charge of monitoring the hedge funds have to validate hundreds, sometimes thousands, of open positions, very often in totally illiquid instruments where valuation may even come down to the responsibility of the manager as the independent administrator might be caught in a situation where the only available source for price is the front office. The question of building permanent teams that have the required skill set and experience to understand the trades implied by a specific investment strategy on top of the control of the daily valuations of the fund might prove impossible to solve. Hiring experts in sophisticated and highly technical disciplines in order to provide a clerical and monitoring service might prove challenging over time.
- Interfering with the day-to-day management of the assets might prove dangerous and not in line with the expectations of the final investors. Is a FoHF manager hired to select the best performing funds and allocate capital in line with the risk profile of the investor or is he hired to perform the job of the underlying hedge fund managers? Understanding the complex trading strategies implemented by 20 or 30 underlying funds might prove such a difficult task that the FoHF may take redemption decisions that are not consistent with its initial allocation strategy and result in overall underperformance.

If ensuring that appropriate controls are in place in order to make certain that the hedge fund manager will only operate in the best interest of his client is a required step, full daily transparency on positions will not provide the level of guarantee required to justify the infrastructure, team and costs implied.

As a concluding thought on the question of managed accounts, one could compare FoHF to traditional mutual funds where, to our knowledge, the best level of transparency a manager can expect from the companies in which he invests is quarterly reporting.

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<sup>8</sup> Edhec European Alternative Multimangement Survey, 2003

### 3 Liquidity risk – a key source of operational risk

Liquidity risk is very often cited as a main source of concern by alternative product investors, but this reality encompasses three different issues for alternative managers. While the issues arising from the lack of liquidity in instruments traded by hedge funds in order to generate returns are the most widely discussed, the importance of financing liquidity and the asset-liability mismatch should be considered even more important for Fund of Hedge Fund managers.

In order to achieve returns that are uncorrelated with traditional markets, hedge fund managers very often access less efficient markets that exhibit low levels of liquidity. The range of products that might cause liquidity concerns goes from emerging markets and Over the Counter (OTC) contracts to distressed securities. Timing is essential in these markets as the low level, or absence, of liquidity can result in extremely violent price shifts at the time the manager is trying to liquidate a position. However, liquidity issues also arise for the largest funds, since they may constitute massive positions over time that can represent up to 20% or 30% of a market. This liquidity risk has two major consequences for the investor:

- Potential extreme price shift, hence losses for the portfolio in the case of the manager being required to disinvest rapidly;
- Potential asset-liability gap whereby the impact on the market would be so important (certain market circumstances result in a flight to quality where the impact on an illiquid market is amplified) that disinvestment can not be considered an option at a moment in time, preventing investors redeeming as contractually agreed.

Less publicised is the issue of financing liquidity. Hedge funds rely on prime brokers and banks to obtain financing for leverage or bridging cash positions. These lines of credit are highly dependent upon market conditions and contractual agreements are usually such that the prime broker or the bank is in a position to substantially increase the haircut (i.e. the cost of financing) or the amount available, potentially resulting in situations where the manager is forced to liquidate positions at a loss, before maturity or in unfavourable market conditions. It is therefore highly recommended that individual managers and FoHF managers using external financing monitor the sensitivity to haircut changes by their provider.

This problem does not disappear with Fund of Hedge Fund structures. While the theoretical level of liquidity of the underlying investments is known in advance (redemption periods are part of the offering memorandum), the Fund of Hedge Fund manager has to resolve an equation that involves several variables. In order to successfully manage the liquidity of his vehicle, the manager will take into consideration:

- the redemption periods and payment conditions for each underlying fund, taking into consideration the potential default situation that one of the underlying might exhibit at a given stage;
- the subscription/redemption periods applicable to his own fund as well as its cash position;
- the implications of any redemption on the allocation to the various funds (for example if an investor decides to redeem the equivalent of 10% of the FoHF's capital, how will this decrease impact each investment in the underlying funds, which might not allow redemption at that precise moment, potentially resulting in variation from the initial allocation).

Funds of Funds have two major solutions available in order to manage such situations. The first solution is to maintain a buffer of available capital that will not be invested in locked funds but will allow the transition period required to divest properly to be managed. While this strategy is affordable, it nevertheless results in a lower exposure to the hedge funds and thus might reduce the returns of the FoHF. A second solution is the use of bridging loans agreed with a bank or a prime broker in order to cope with the transition period. While these loans usually come at a high cost, they do give sufficient flexibility, provided they are negotiated in relatively firm terms before any liquidity event occurs.

# 4 Facts and figures

In light of the numerous quantitative issues related to the analysis of historical fund performance and proper isolation of the alpha from the premiums related to residual risk factors, one might question the real value-added of Funds of Hedge Funds within the fund selection process.

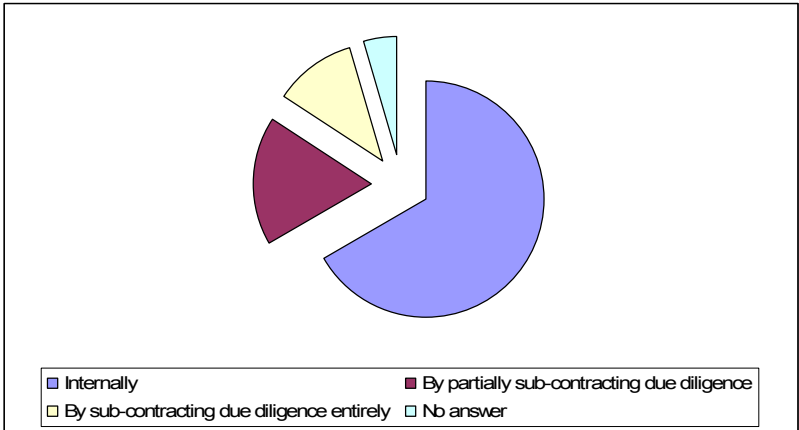
Investors usually turn to Funds of Hedge Funds in order to benefit from one of the following three advantages:

- Access to investment capacity: Funds of Hedge Funds, especially the ones that have been operating for a long period, might allow the investor to benefit from an agreed access to investment capacity with funds that are no longer open to new investors. With such agreements, existing clients might increase their assets allocated to a manager as part as a capital raising round only open to existing investors;
- Better fund selection: Investors such as HNWI or institutional investors might not have the capability or the desire to perform the appropriate manager selection, through lack of interest or because the amounts involved do not justify internalising the process. Funds of Hedge Funds usually market themselves as fund pickers capable of selecting the winning hedge fund manager through a set of analytical techniques or through a better network and access to historically high performing managers;
- Better risk management capability: We have seen that hedge funds are exposed to a series of risk factors that are not comparable with the ones that can be seen in the long only universe. Measuring and managing the exposure to these risk factors can be considered a difficult task requiring substantial investment in people and systems, building the case for mutualisation through Funds of Hedge Funds.

While access to investment capacity and fund selection are usually the selling points for Funds of Hedge Funds, the complexity of managing risk may remain an issue for small to medium-sized Funds of Hedge Funds. The risk management function encompasses a series of responsibilities prior to and after the investment decision. These cover the whole spectrum of risks, from the financial risks associated with the various investment strategies to the no less important operational risk factors resulting from the highly complex nature of hedge fund trading activity.

It is therefore not surprising to see that 33% of Fund of Hedge Fund managers have decided to partially or entirely sub-contract the due diligence process, which represents the most challenging task for risk managers (see Graph 4).

Graph 4: How do you select managers?



If selecting the funds that will perform best is a difficult goal, avoiding allocating assets to future losers cannot be considered a ‘no-brainer’. For some Funds of Hedge Funds, performing due diligence on a hedge fund is sometimes still synonymous with performing a background check on the manager and the company and then spending a few hours discussing the investment strategy and the supporting infrastructure with a representative of the fund.

We have seen that this approach will not provide any sense of the reality of the investment’s extreme risks, as the due diligence takes place in the middle of a sales relationship where the hedge fund is selling its capacity rather than openly discussing strengths and weaknesses. Instead, we will see that a structured process needs to be implemented that assesses a series of risk indicators, if possible in a systematic, repeatable and numerical approach in order to allow for the inclusion of the results within an allocation model.

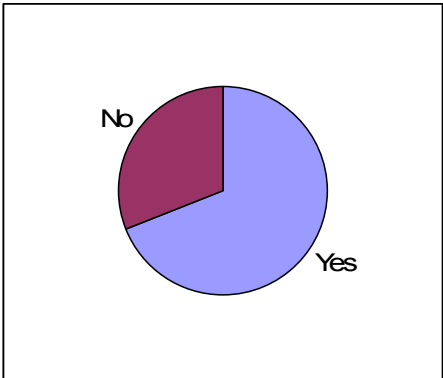
It is interesting to note that while most Fund of Hedge Fund respondents cite the quality of risk monitoring and reporting, verification of historical fund performance and the reliability of the position evaluation process, the reputation of the key service provider is still considered an important factor. With regard to risk management functions, FoHF attach very high importance to the capacity of the underlying funds to implement risk controls (quality of risk monitoring and reporting, organisation and reliability of the position evaluation process) as they are not themselves in control of these processes (see Table 2)<sup>9</sup>.

Table 2: Which qualitative criteria do you apply to due diligence on managers?

Europe	Very Important	Not very Important	Not considered
Coherence and quality of explanations regarding the investment strategy	96%	0%	0%
Quality of risk monitoring and reporting	95%	2%	0%
Verification of fund performance	91%	4%	0%
Legal soundness of the fund and the proposed contracts	87%	7%	2%
Competence and credibility of key service providers (prime brokers, custodians, auditors)	85%	13%	2%
Analysis of the quality and liquidity of the instruments used by the fund	84%	9%	4%
Organisation and reliability of the position evaluation process	84%	11%	2%
Quality of technical infrastructure	84%	11%	2%
Financial soundness of the manager	82%	11%	4%
Quality of the decision support model or models	80%	13%	2%
Managers' financial investment in the fund	71%	9%	9%
Analysis of off-balance sheet operations	60%	18%	9%
"Market place" opinion on the fund	47%	29%	20%
Quality of other subscribers	42%	35%	18%
Transparency of the manager	4%	0%	0%
Size	4%	0%	0%
Reputation check	4%	0%	0%
Consistency of investment process	4%	0%	0%

This finding may be explained by the fact that only two Funds of Hedge Funds out of three have a specific department in charge of risk management (with an average of 3.7 staff members involved), leaving one third of the funds without any control on the levels of risks the investor is exposed to (see Graph 5)<sup>10</sup>. As a result, small to medium-sized funds that have not developed a sufficient internal risk capability will have to rely on a less formal assessment of risk exposure.

Graph 5: Do you have a specialised risk analysis department?



<sup>9</sup> Edhec European Alternative Multimangement Survey, 2003

<sup>10</sup> Edhec European Alternative Multimangement Survey, 2003

## 5 Industrialising the operational due diligence

### 5.1 Objectives and limitations

We have just seen that by their very nature hedge funds are vehicles that remain open to sources of operational risks. Full transparency and tighter regulatory control do not resolve these issues. In order to continue providing exposure to new risk factors, hedge funds remain exposed to illiquid securities, highly complex financial instruments and very often remain rather small operating structures.

Seeking an absolute level of confidence within such an organisation will prove not only to be utopian but would also be extremely costly in terms of procedures and controls. The objective of operational due diligence is to provide a transparent picture of the infrastructure supporting the trading strategy in terms of

- People & Organisation
- Processes & Systems
- Third Party Involvement

Identifying the potential weaknesses of every vehicle the investor is considering as a potential investment will allow for the implementation of a well-informed allocation process that takes into consideration not only the financial characteristics of the fund (historical returns, risk factors, volatility), but also the operational risk profile of the fund. It complements the usual background checks and financial due diligence that are already included in industry practices.

Adequate operational due diligence will provide:

- a transparent view of the strengths and weaknesses of the fund's operations. This will support a permanent dialogue between the investor and the funds' management with regard to the improvement of the operational infrastructure;
- a means of taking operational risk profiles into consideration, to allow the investor to take well-informed decisions, and potentially to take arbitrage decisions where similar funds provide different risk profiles;
- a measure of the appropriate risk premium that should be expected to justify the investor accepting a higher level of operational risk;

But the investor should note that whatever the extent and the quality of a due diligence process, it nonetheless does not predict which funds are about to fail and does not replace:

- an assessment of the quality and success likelihood of the investment strategy, even if the operational due diligence process is highly specialised in line with the investment style (as different investment strategies result in different operational requirements);
- a review of the fund's books and records. Operational due diligence does not overlap with the responsibility of the auditors, even if it does provide an insight into the strengths and weaknesses of the administration of the fund;

Additionally, the operational due diligence process will not replace the traditional background checks on the companies and individuals involved in the hedge fund activity.

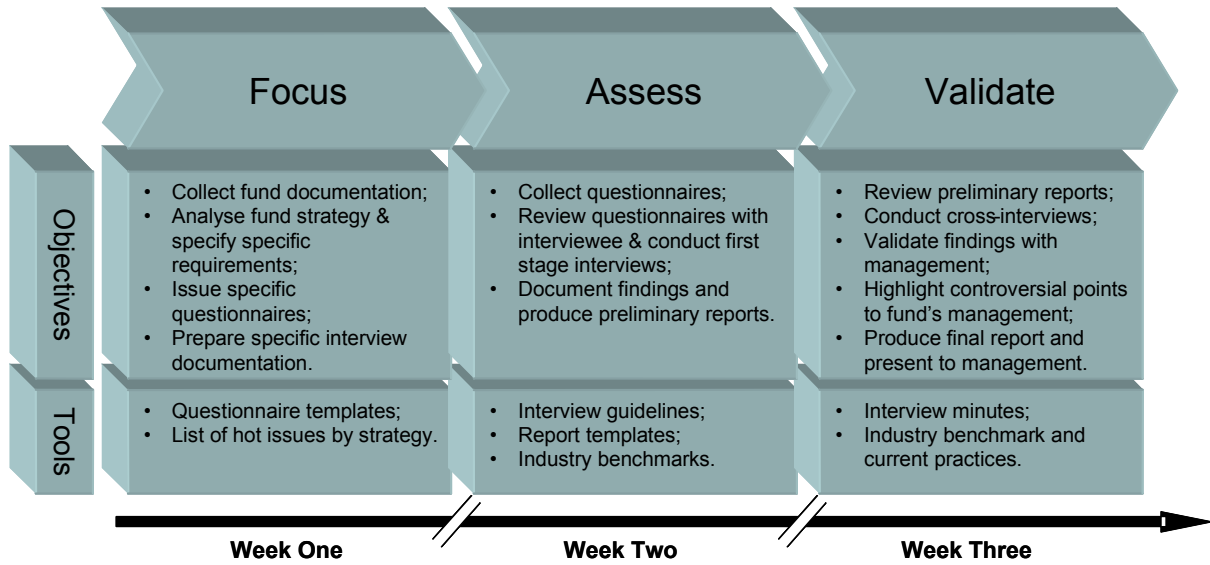
### 5.2 Operational due-diligence framework

Conducting operational due diligence is a challenging task as it involves investigating a team and a firm based on a partial view of the situation, in a very limited period of time. Operational due diligence is also made difficult by the extent of disciplines it has to cover, from risk management to financing, clearing and settlement, with a wide range of different angles, from technology to organisation and processes.

The approach for conducting the due diligence process therefore requires a strong methodological framework supported by templates and directive instructions summarising experience and research into the fields of operational risks and controls.

The following approach is comprehensive and can be considered a baseline for industrialising the operational due diligence.

Illustration 1: Baseline for industrialising operational due-diligence

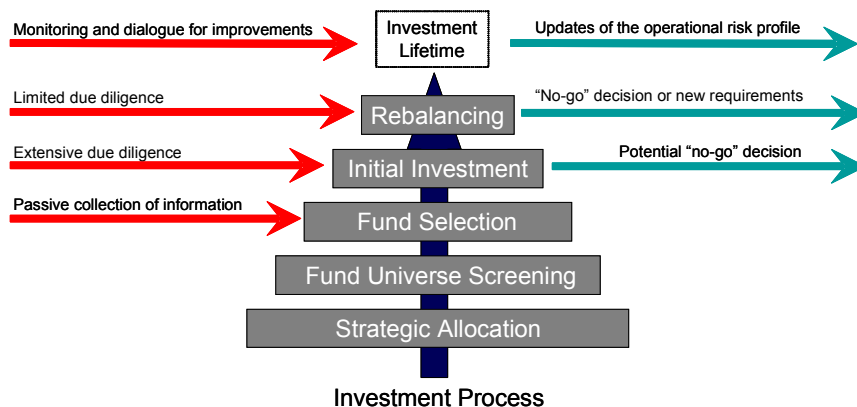


Source: Edhec-Risk Advisory, 2003

This standard approach is based on three principal phases. The objective of the first phase is to ensure sufficient preparation of the diligence process itself. Specifically, a preliminary analysis of the fund's strategy and specific characteristics will allow for a targeted approach to questioning the fund representatives. The assessment phase will result from the combination of interviews and questionnaires, where the key to success will lie in cross-controls and soft questions. (One should not expect to identify key issues from answers that are usually prepared and polished to convince the investor that the fund is worth investing in and that the reliability and operational control are optimal.) Finally, a validation phase will allow for feedback of the main findings to the fund representatives and development of the potential issues that could prevent the investor from entering into an agreement with the fund management company.

Due diligence is of course a permanent effort that starts with the evaluation of the fund as a potential investment and continues with the follow-up of the vehicle as funds have been allocated to that firm. While the most labour-intensive part of the due diligence process is at the beginning of the relationship, when funds are about to be invested in the vehicle, one should not underestimate the monitoring effort that is required to remain updated on how the firm is supporting the investment process over time.

Illustration 2: The investment process



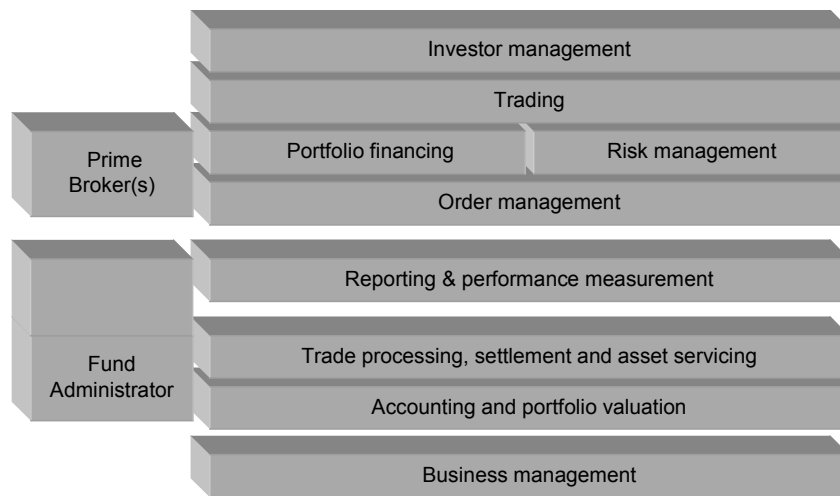
Source: Edhec-Risk Advisory, 2003

### 5.3 A systematic and repeatable process

Hedge fund trading, organisation and activities vary considerably across the various investment strategies, making the task of executing consistent operational due diligence more difficult. It is however possible and necessary to formalise upfront the various responsibilities and activities required in order to adequately support a fund strategy.

The following self-explanatory chart describes the nine main areas of responsibility that require investigation during the operational due diligence process. It is important to note that this map represents all of the activities, from the management of the investment strategy through the usual support functions down to the management of the fund as a business entity.

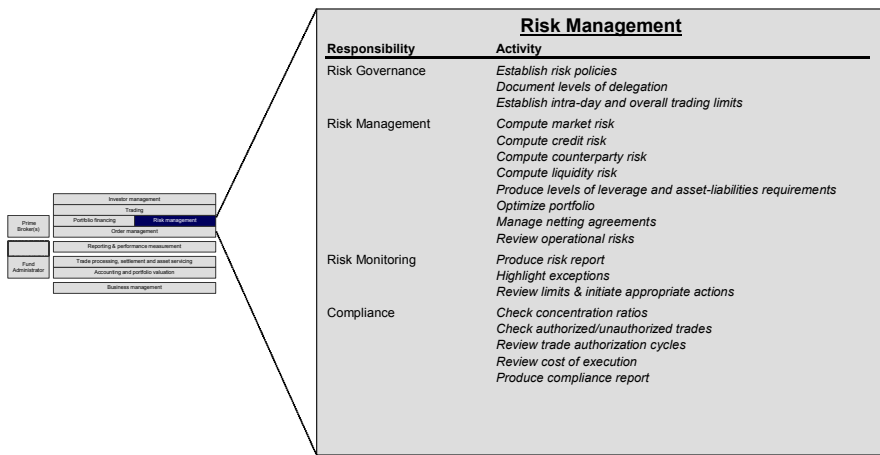
**Illustration 3: Hedge fund operating model**



Source: Edhec-Risk Advisory, 2003

Each area of responsibility is then further broken down into responsibilities and detailed activities that can be described by a series of process flows and interactions.

**Illustration 4: Breakdown of detailed activities (illustrative)**



Source: Edhec-Risk Advisory, 2003

The benefits of supporting the investigation process through a normalised operating framework are multiple:

- Systematisation of the process in a consistent procedure rather than informal discussions;
- Ease of tailoring questionnaires and interview documents to the fund's specific activities;
- Possibility of implementing objective metrics (from the measurement of time and effort required to prepare the due diligence to the possibility of scoring individual areas of operations and consolidating the information at a global level);
- Possibility of constituting a knowledge repository that not only categorises questions and answers obtained from the manager but also supports a systematic analysis of the information collected during the due diligence and from external data sources.

#### **5.4 About the difficulty of handling questionnaires and interviews**

Due diligence processes are usually managed through questionnaires and interviews. Both approaches have pros and cons. While questionnaires allow for detailed and systematic questioning, they suffer from the fact that the respondent can think through the questions and establish the answers that will most likely satisfy the investor. On the other hand, interviews allow for direct contact and hence for building a sense of how the fund's operations are managed. The downside is that they very often suffer from a lack of structure and the lack of experience of the interviewer may result in sterile findings.

The operational due diligence framework takes these issues into account and provides the auditor with the tools required to get straight to the point. Detailed questions relating to each activity within the various responsibilities will allow:

- for a focus on hot spots only and a reduction in the time wasted on information that is not relevant to the level of operational risk;
- for the elaboration of cross-checks;
- for the interviewer to stick to structured questioning when the interviewee attempts to divert;

Within large organisations, it can prove useful to organise debriefing sessions in groups comprising representatives from different departments, as such sessions can provide regular opportunities to learn from others and to confront various opinions or statements. While group sessions may suffer from a 'political syndrome' whereby not all information is disclosed, it nevertheless usually results in better forward-looking analysis and better estimates of extreme risks.

Finally, benchmarking the information received during the due diligence with external information will undoubtedly allow for early identification of signs indicating potential operational issues (for example, number of staff required to manage the back office/number of OTC trades, STP rates, number of fails or penalties paid per quarter).

Finally, the most difficult task will be to score the responses on an absolute basis as well as in light of industry best practices and importance relative to the investment style. Facts collected through the questionnaires and the interviews need to be attached to the scores to justify the decisions. The focus is necessarily extreme scores, i.e. scores reflecting either problematic issues identified or extremely positive points. For each of these, the investigation has to go through a second phase in order to confirm initial estimates.

Scores will be established according to a set of criteria that covers the multiple dimensions of operational risks:

As an example, the investigation dimensions can be:

- People & Organisation
- Processes & Systems
- Third Parties

The following criteria allow for a comprehensive analysis of the early signals of most risk factors:

- Control
- Transparency
- Capacity

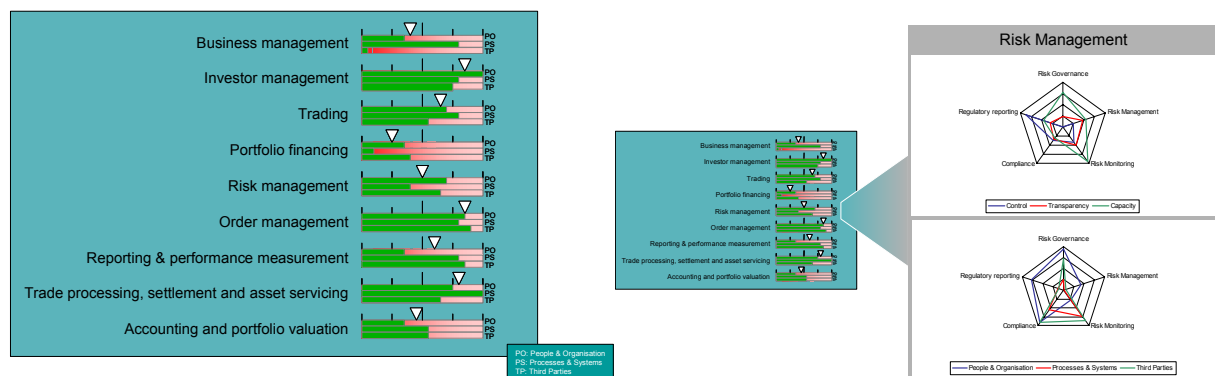
Consolidation of the scores based on the activity matrix will provide an unquestionable high level view that reflects the important areas of risk and allows for drilling-down and establishing a dialogue with the fund representatives in order to prevent potential future issues.

## 5.5 Straightforward reporting

The due diligence often results in the production of a report that consolidates the unstructured information collected (process diagrams, IT infrastructure flow charts, organisation charts) with the very structured assessment of the organisation presented in a top-down frame:

High level indicators inform the management of key areas of concern, with a clear view of which dimensions of the study are affected for each criterion:

**Illustration 5&6: Operational Due Diligence reporting (illustrative)**



Source: Edhec-Risk Advisory, 2003

Finally, detailed information would be presented, with all the necessary justifications, to allow the fund's principals to be confronted with indisputable information:

**Illustration 7: Sample reporting**

	People & Organisation			Processes & Systems			Third Parties		
	Control	Transparency	Capacity	Control	Transparency	Capacity	Control	Transparency	Capacity
<b>Risk Monitoring</b>									
Produce risk report	-1	2	-2	-2	1	-2	0	1	0
Highlight exceptions	0	1	-2	0	1	-2	0	1	0
Review limits & initiate appropriate actions	1	2	-2	1	1	-2	0	1	0
<b>Compliance</b>									
Check concentration ratios	2	2	-2	1	1	-2	0	0	0
Check authorized/unauthorized trades	0	2	-2	1	1	-2	0	0	0
Review trade authorization cycles	1	2	-2	2	1	-2	0	0	0
Review cost of execution	-2	-2	-2	-2	-2	-2	-2	-2	-2
Produce compliance report	1	1	-2	1	1	-2	0	0	0

2 Best of breed  
1 Very satisfactory  
0 No issue found  
-1 Minor issues required to be fixed  
-2 Substantial improvements required

This organisation scores very low with regards to capacity in the area of risk monitoring and compliance. These responsibilities are correctly addressed with one independent risk manager supported by a series of Excel spreadsheets, perfectly fulfilling the requirements of the fund. However, this does not leave any room for an increase in the number of trades or funds under management. Capacity is therefore limited by the number of staff required to run and maintain the spreadsheets. The interview has also highlighted a series of issues related to the maintenance of the spreadsheets (hence an average score on control) as well as a very high and permanent workload.

This organisation scores very low with regards to all aspects of controlling best execution and trade costs. This fund is an equity market neutral systematic trading fund, with very high portfolio turnovers due to very frequent rebalancing. The cost of trades might represent a risk to be taken into consideration as the P&L on individual trades remains very low compared to the nominal amount engaged in the trading. As a consequence of the high importance of this risk factor in the risk profile of the fund, this potentially minor issue has been raised to maximum importance.

## 6 Quantifying operational risk

Describing the full set of quantitative tools available for modelling operational risk is beyond the scope of this paper. In this section, we aim to provide an overview of some techniques available and discuss their benefits and limitations<sup>11</sup>.

Before attempting to provide any quantitative figure as a measure of risk, it is important to agree on a definition of risk. Several definitions exist that could be applicable to operational risk:

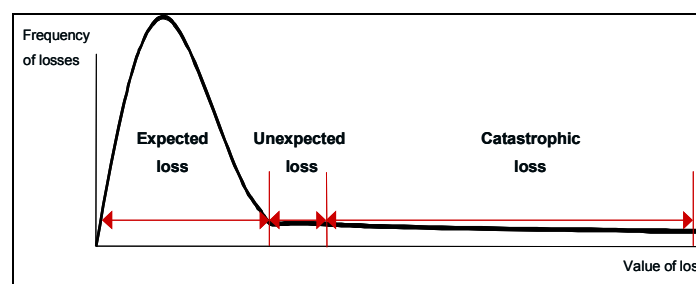
- Risk as a mean outcome: actuarial view of event risk as the expected outcome, with regard to operations, this translates into operational losses. This view does not provide information on the range of outcomes and eludes extreme risks;
- Risk as variance in outcome: statistical variance (or standard deviation) of outcomes (P&L or losses);
- Risk as catastrophic downside: focus on worst case scenario that might result in the activity being ceased. For financial institutions, this typically relates to the concern of the regulator to avoid systemic risk (focus on the extreme percentile of the losses) and is the basis for VaR and Extreme Value Theory;
- Risk as an upside opportunity: focus on upside risk, or risk as source of opportunity (very true in HF world with futures & options, merger arbitrage, etc.).

Losses lie at the source of risk. Loss events can be described and categorised by their size (i.e. the effective loss) and their frequency. This constitutes a distribution of losses, which is the foundation of any risk analysis. Three categories of losses are unanimously used:

- Expected risk: related to losses affecting the day-to-day operations of the firm. Usually the focus of management due to its impact on P&L (close to efficiency);
- Unexpected risk: losses with lower frequency of occurrence and higher size, but still in the domain of control of the firm;
- Catastrophic: extreme risks threatening the activity of the firm, usually related to external factors not controlled by the firm or deliberate actions in the case of fraud

These loss categories can be represented schematically on a loss distribution graph:

Illustration 8: Loss distribution graph



But the measure of loss distribution faces a series of complex challenges related to the extreme nature of the events:

- Absence of historical observations to model the extreme tail of the loss distribution;
- Difficulty identifying quantifiable risk factors;
- Non-applicability of mean-variance models to extreme risks (interest in the highest percentile only).

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<sup>11</sup> The reader might refer to existing publications on operational risk such as “Measuring and Managing Operational Risks in Financial Institutions” by Christopher Marshall (Wiley Finance).

In order to evaluate the distribution of operational losses, it is necessary to collect two series of data:

- Expected event occurrences
- Expected event sizes

Event occurrences can be described through stochastic counting models that provide the distribution of the cumulative number of events ( $N$ ) occurring in a period ( $t$ ). The most common distributions are:

- Homogeneous Poisson Process (HPP): the times between two occurrences are independent and exponentially distributed with a constant failure rate  $\lambda$ . In this case, the number of events occurring within any time interval is Poisson distributed with mean  $\lambda$  times the length of the interval.
- Non-Homogeneous Poisson Process: NHPP distribution is applicable when the failure rate varies over time.

These distributions are based on the assumption that no major structural change occurs that would alter the likelihood of events or their impact. This assumption is extremely strong and needs to be carefully considered when attempting to quantify operational risk exposure.

Rather than model the distribution of losses, EVT (Extreme Value Theory) provides the maximum losses in a given time period. It is therefore more appropriate for catastrophic, high impact, low frequency events as it focuses on the tail of the distribution. EVT states that the distribution of extreme values  $x$  converges asymptotically independently of the underlying distribution to a value dependent on the mean and standard deviation of the distribution, but also  $\xi$ , the tail index (measure of the heaviness of the tail).

It is based on a combination of three commonly used distributions:

- Frechet if  $\xi > 0$
- Gumbel if  $\xi < 0$
- Weibull if  $\xi$  tends to zero

#### Estimating loss event size and frequencies

The task of estimating loss sizes and frequencies, especially with a focus on low-frequency, high-size events (a detailed analysis of the underlying causes of operational failures proves consistent with the Pareto law as 80% of the failures can be linked to the largest 20% of loss events) has proven to be extremely challenging in the context of the operational risk of hedge funds for multiple reasons:

- The sensitivity of accepting the reality of potential losses is extremely high for clear political and commercial/marketing issues. If a firm is open to disclosing information on the quality of their supporting infrastructure, it is understandable that neither the firm nor any manager within the firm will be ready to openly assess the probability of unexpected events occurring.
- The traditional absence of transparency when events occur (fund collapses, fraud), added to the very low frequency of these events, results in a lack of reliable internal and external quantitative information;
- Human failures in the assessment process are common and human behaviour is reflexive, leading to time-varying risks (a hedge fund will for example reinforce controls after being advised that due diligence has highlighted potential weaknesses).

Three approaches are nevertheless available to assist in the evaluation of the probability of operational risk events occurring. These approaches are historical analysis, subjective risk assessment and an implied approach from a causal or statistical model.

### **6.1 Historical analysis approach**

The Historical Analysis approach is based on the assumption that the causal structure driving the loss events does not change over time. As a consequence, this approach should be used with care for growing or changing funds. The measurement is based on internal or external reports of incidents, capturing the loss category, size, date and source, and adjustment to reflect major structural changes is possible when the change is related to scope (e.g. geographic, investment strategy) or scale (size). External data can be used for reconciliation and/or adjustment purposes, or to support the assessment process.

Table 3: Historical Analysis Approach<sup>12</sup>

Approach	Sources of information
<ul style="list-style-type: none"> <li>- Construct distributions based on historical loss database (external or internal), or event reports;</li> <li>- Include forward-looking data (changes planned);</li> <li>- Reconcile with ledger / P&amp;L</li> </ul>	<ul style="list-style-type: none"> <li>- Internal loss collection databases, ledger systems</li> <li>- External research services (Lexis/Nexus, EDGAR reg. filings, press, Internet, etc.)</li> </ul>
Applicability to Hedge Funds (Possible mitigations)	
<ul style="list-style-type: none"> <li>- Low applicability as the approach focuses on expected losses (internal data) or does not take into consideration idiosyncratic risks (external data);</li> <li>- No internal structure within hedge funds to monitor operational risks;</li> <li>- Difficulties in evaluating impact of the liquidity risk of non-financial events, reputation effect on subscriptions/redemptions, etc.</li> <li>- Low quality of external data due to sensitivity, limited public information on causes and impacts.</li> </ul>	

## 6.2 Subjective risk assessment approach

The Subjective Risk Assessment approach is a combination of interviews, scorecards & self-assessments, cross-department workshops and expert input. Crosschecks can be carried out internally (cross departments, paired interviews, etc.) or with external data (overall universe or similar competitor). Group estimates can be assessed (variance analysis) and self-corrected with specific methods such as Delphi (distribution of all estimates to all experts for assessment).

The basic assumption is that the management is best placed to highlight (directly or indirectly) the idiosyncratic risks of the organisation. In order to minimise the effort, one can focus on extreme events that explain 80% of the losses. Interviews can follow the nominal group method (allow for limited discussion between experts to clarify issues) or consensus method (workshops).

Table 4: Subjective Risk Assessment Approach<sup>13</sup>

Approach	Known biases on information collected - possible mitigation
<ul style="list-style-type: none"> <li>- Based on external expertise, mostly quantitative approach (ranking, likelihood buckets, etc.)</li> <li>- Based on interviews + workshops (staff, management, third parties, clients, etc.)</li> <li>- Requires a feel for “soft questions”, should be based on an established methodology (e.g. questionnaires by strategy, business area)</li> <li>- Should not only consist of closed-ended questions, requires cross-checking of information at boundaries of responsibilities</li> </ul>	<ul style="list-style-type: none"> <li>- Threshold heuristic (out of radar screen of manager when too low) – match with external data</li> <li>- Availability bias (attention focused on most recent activity) – match with internal data</li> <li>- Anchoring (future judgements based on past judgements) – ask for extremes to obtain the mean</li> <li>- Framing bias (based on group context) – Interfunctional groups</li> <li>- Subjective frequency bias (low frequency overestimated) – calibration</li> <li>- Confirmation bias (gathering of more information supporting the initial judgement) – match with other opinions</li> <li>- Ego, loss averse but not risk averse (long bets), representativeness bias, illusion of control, etc.</li> </ul>
Applicability to Hedge Funds	
Very good but requires strong methodology and external expertise, feel for “soft” questions	

<sup>12</sup> Source: “Measuring and Managing Operational Risks in Financial Institutions” by Christopher Marshall (Wiley Finance), & Edhec Risk and Asset Management Research Centre

<sup>13</sup> Source: “Measuring and Managing Operational Risks in Financial Institutions” by Christopher Marshall (Wiley Finance), & Edhec Risk and Asset Management Research Centre

### 6.3 Causal or statistical approach

The last approach is based on causal or statistical models of the fund’s organisation. As it requires a detailed causal model of the organisation, this approach is only suggested when due diligence is required on a very high number of funds as it provides a very systematic approach to measuring operational risks.

Table 5: Causal Model approach<sup>14</sup>

Approach	Available causal modelling techniques
<ul style="list-style-type: none"> <li>- Identify the high-risk events that need to be explained;</li> <li>- Identify the events and factors that affect the high-risk event;</li> <li>- Quantify the relationship between the independent factors and dependent events;</li> </ul>	<ul style="list-style-type: none"> <li>- Fishbone analysis – event hierarchy</li> <li>- Fault tree analysis – event hierarchy with AND/OR connectors, provide information on possible combination of events, allow for identification of minimal cut and path sets (can not be reduced) then allow for assignation of probabilities (OR is additive, AND is multiplicative) – absence of time conditions</li> <li>- Bayesian Belief Networks – nodes representing events linked by probabilities conditional to the occurrence of a second event, can be run top-down or bottom-up (network)</li> </ul>
Applicability to Hedge Funds	
Very good as a framework to support a subjective risk assessment analysis	
Risk factors can be limited to 6-10 per loss event type, with a good level of repeatability	

### 6.4 Recommended approach

The following table summarises the advantages and disadvantages of the three approaches:

Table 6: Summary of advantages and disadvantages of the various models<sup>15</sup>

Approach	Strengths	Limitations
Based on internal loss data	<ul style="list-style-type: none"> <li>- Captures idiosyncratic features of firm’s own controllable risks;</li> <li>- Appropriate for mature processes that are unique to the firm;</li> <li>- Potentially more accurate.</li> </ul>	<ul style="list-style-type: none"> <li>- Backward looking;</li> <li>- Limited tail risks. Availability of data;</li> <li>- Data-gathering is time consuming;</li> <li>- Requires internal data management and analytical expertise.</li> </ul>
Based on external loss data	<ul style="list-style-type: none"> <li>- Biased toward major uncontrollable or influenceable losses;</li> <li>- Provides a larger sample to capture catastrophic risk (tail risk);</li> <li>- Inexpensive;</li> <li>- Appropriate for mature processes that are generic.</li> </ul>	<ul style="list-style-type: none"> <li>- Backward looking;</li> <li>- May not be a representative sample (different context);</li> <li>- Data-gathering is more expensive;</li> <li>- Availability of data.</li> </ul>
Subjective risk assessment	<ul style="list-style-type: none"> <li>- Gets business managers involved; leverages a broad range of expertise and experience;</li> <li>- May be useful for estimating tail risk; may be forward looking;</li> <li>- Good at focusing on the interfaces between processes where many losses</li> </ul>	<ul style="list-style-type: none"> <li>- Subject to individual and group cognitive biases, group-think;</li> <li>- Difficulties in selecting appropriate individuals/groups;</li> <li>- Estimates may be inconsistent.</li> </ul>

<sup>14</sup> Source: “Measuring and Managing Operational Risks in Financial Institutions” by Christopher Marshall (Wiley Finance), & Edhec Risk and Asset Management Research Centre

<sup>15</sup> Source: “Measuring and Managing Operational Risks in Financial Institutions” by Christopher Marshall (Wiley Finance), & Edhec Risk and Asset Management Research Centre

	originate; - Identifies risk factors or loss events controlled or realised within the respondent's area	
Implied from causal or statistical models	- Appropriate for frequencies of statistically or causally dependent but relatively rare events for which other approaches are inappropriate.	- Only as good as the model developed; - Needs statistical or causal structure of implied event; used for frequencies rather than impact estimation;

Source: Measuring and Managing Operational Risk, Chris Marshall, Wiley Finance

We recommend the use of a combination of these approaches to conduct an in-depth analysis of the loss impact and frequencies for a given hedge fund using the following steps:

1. Construction of generic causal models by strategy
2. Identification of key risk factors
3. An initial subjective assessment with hedge fund management and staff + appropriate subject matter experts
4. Gap analysis with the generic causal model and review of the subjective assessment with hedge fund management and staff
5. Calibration of the data with external loss data

# 7 The real cost of a due-diligence process

The cost implied by a professional and repeatable due diligence process is not easy to analyse. Based on a series of assumptions, we can however provide an idea of the economic problem relating to the due diligence process.

If we assume a Fund of Hedge Funds that monitors a universe of 100 target funds on a permanent basis and invests in 25 of them. This situation will usually result in a minimum of 40 hedge funds to be processed in a thorough due diligence process.

The second assumption is that 15 man-days are required on average to perform a thorough due diligence process prior to allocating capital (2 man-days for technology, 2 man-days for the front-office, 2 man-days for the risk management processes, 2 man-days for operations and 3 man-days for third party suppliers, 2 man-days for legal issues, 2 man-days for documentation and validation). This assumption takes into consideration the initial investigation, documentation of the findings, discussion and validation with the fund representatives and final documentation of a full due diligence report as well as travel time, usually fairly high as the management companies are spread widely around the globe.

The first issue that will have to be solved is the problem of the skill set. We have seen that conducting due diligence on topics related to front-office, risk management and operations or technology will require separate profiles. Moreover, the sophistication of trading techniques and infrastructures required to support a hedge fund will require sourcing these professionals from industries such as Investment Banking. These resources come at a cost. As an appropriate due diligence process will require senior and experienced people, we can estimate the average cost per year of such profiles at approximately \$200,000 fully charged (this cost includes premises, travel and any other cost related to this employee’s activity).

The maths is straightforward and results in a figure that might surprise more than one investor: conducting 40 due diligences in a year would cost 600 man-days, resulting in 3 full-time equivalents at a total cost of \$600,000.

One can argue that the 40 investigations will not take place in one year. This might be true but our calculations do not include the cost of the continuous due diligence required after the investment is made, costs of external background checks, specific investigations required on sensitive topics as well as the cost of performing a first level of due diligence on the 60 funds that are situated in the investable universe.

When restated for assets under management (cf. Table 7), the cost expressed in basis points highlights a critical economic issue for small and medium-sized Funds of Hedge Funds.

Table 7: Cost of operational due diligence expressed in basis points of assets under management

Fund Size	Cost of due diligence in bpts
\$50mn	120 bpts
\$100mn	60bps
\$250mn	24 bpts
\$600mn	10 bpts
\$1bn	6 bpts

While these figures may look surprising at first glance, they will be realistic when one looks at the size of teams employed by the largest FoHFs, where it is not uncommon to see teams of 6-8 people involved in the due diligence process when assets under management are greater than \$2bn.

But the picture is even more worrying in the broader context of the overall FoHF universe. In its Q1 2003 Asset Management Focus, Freeman & Co. highlighted the fact that only the 50 largest FoHFs globally had assets under management above a billion, leaving all the other funds with an average of \$200mn under management. If one adds the costs of non-operational due diligence (manager checks, legal audit) to these costs, it becomes clear that the economics of ensuring an appropriate level of due diligence can be considered an economic issue for funds under \$200-\$300mn, favouring large institutions that have the capacity to set up and maintain strong risk management departments.

## 8 Conclusion

The assessment and management of hedge funds' operational risks represent the most important technical challenge for the alternative investments industry. Far from being a secondary topic, we have seen that operational risks can dramatically impact the performance of funds of hedge funds.

Because operational risk management covers a wide range of expertise and is embedded in the complex operational framework hedge funds are developing, building appropriate teams of experts that can conduct operational due diligence in a thorough yet pragmatic and efficient way is the most important challenge for the industry.

Funds of Hedge Funds represent the most promising vehicle for delivering the benefits of alternative asset classes to institutional investors, but they will only succeed in attracting sophisticated investors if they demonstrate clear added value to justify the levels of fees.

It is now clearly understood that fund selection, far from being a task that can be handled by an analyst on the sole basis of an historical performance database, is an art that requires extremely high levels of expertise and experience. Attempts to quantify the due diligence process are promising but will have to be measured against the expected benefits that one can expect from the exercise.

The main benefit of these efforts is a better understanding of the various risk factors investors are exposed to when allocating capital to hedge funds, and what premiums can, or should, be expected for this exposure.