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Strategic commodity and cash-flow-at-risk modeling for corporates

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Strategic commodity and cash-flow-at-risk modeling for corporates

“While our expected performance continues to be positive, increased commodity volatility implies we are now 30 percent likely to not be able to afford our planned growth plan while maintaining financial ratios at acceptable levels. We can lower this likelihood to 10 percent by increasing our longer-term fixed-price sales volume.”

That’s the type of insight corporates with strategic cash-flow-at-risk (CFAR) models are able to obtain. What does it take to get there?

Indeed, for some time now, commodity-intensive companies, especially those that trade significantly on the physical or financial commodity markets, have borrowed and adapted techniques from financial institutions to assess and manage their aggregate financial-risk exposures. As a result, these companies often have quite sophisticated and mature value-at-risk (VAR) models for the portfolio of commodity positions of the company. These models let them not only manage their exposures but also profit from them by taking measured amounts of risk.

For approximately the past decade, the use of such models has been expanding in two ways. First, in those same companies, models have been moving from the machine room to the boardroom: instead of just aggregating and reporting momentary risk exposures, the models increasingly inform a range of important corporate-level decisions that radically change the risk profile. These include overall contracting strategy in both purchasing and sales, hedging, strategic portfolio choices, asset optimization, investment decisions, and overall financial structure and cash management—crossing organizational boundaries by clarifying the trade-offs or “equivalences” between very different ways to husband the company’s risk capital.

Second, models of this type are increasingly being used by a new class of companies: those who view their commodity-risk exposures as a curse rather than an opportunity—accepting them as a necessary part of their business model, but without any aspirations to trade for profit. The goal is to make thoughtful commodity or currency-risk trade-offs in the course of doing business—much like the quote at the beginning of this paper. The models used by this type of company focus not on VAR but on cash flow or profit or earnings at risk—variables pertaining to navigating the business “ship” overall, rather than one-off “damage” before positions can be unwound. While the relevant models owe a debt to their energy-trading and financial-institution heritage, they look and feel quite different.

Starting point: Commodity value-at-risk models for trading

VAR models for risk taking in the financial markets by financial institutions were popularized in the 1990s. The goal was to attempt to make sense of the question, “How much value might we lose unexpectedly on our positions (in a reasonable, quantified way) given expected relationships between risks and between assets?” It did not take long for the same methodology to be applied to commodity positions (especially energy), first to purely financial positions, and then also to physical ones (storage/inventory, contracts, and other physical commitments), which expose the company to rights and obligations in which value depends on the evolution of commodity prices.¹

Since then, this type of commodity VAR model has undergone important developments:

- Vastly improved **tools and platforms (IT systems)** to accurately and quickly aggregate the portfolio’s physical and financial exposures. The central concept is one of a “book of record” or “netted risk book” of all positions and their offsets, including exposures at future points in time (for example, a commitment to purchase a certain volume of energy in the future, at either a price specified now or at the market price at that point in time).
- Enhanced **methodologies to model the variation of commodity prices** over time. This includes mean reversion combined with volatility, spot versus forward price movements, generalized forms of correlation

¹ Claude Généraux, Eric Lamarre, and Thomas-Olivier Leautier, “The special challenge of measuring industrial company risk,” *McKinsey on Finance*, January 2003.

reflecting relationships between commodities, and so on. Such methodologies are particularly important for reflecting positions that span several related commodities or include complex future commitments.

- A change in focus from simply reporting an aggregate VAR to using **integrated-management dashboards and decision support** providing guidance on hedging and trading for specific business units within the company. In many cases, the solutions developed not only report but also actually optimize physical and financial positions to maximize value creation within risk bounds.

As a result of these improvements, there has been a significant increase in internal company spending on developing these capabilities, coupled with growth in specialized third-party software platforms in this area.

Adjusting the paradigm to inform strategic decisions by corporates

The VAR models described above are heavily grounded in a trading mind-set: how much could we lose given what we are doing with our commodity positions, and how can we either reduce our risk or create more value with the same amount of risk thus measured? Even this approach involves the commitment of significant resources. But companies should not stop there. To reap maximum benefit, they can adopt a more strategic mind-set, adjusting their use of the modeling paradigm to focus more on the core questions CEOs, CFOs, CROs, and boards are asking regarding the effect of volatility on their business.

1. How much of our performance is at risk through the impact of volatility?

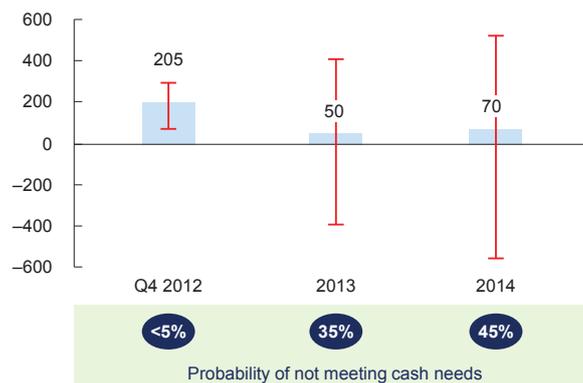
The first key question is “What do we mean by performance?” or, put another way, “What are the metrics that matter?” Rather than how much money could be lost in a short period of time (VAR), the focus becomes how profitability (for example, EBITDA, or earnings before interest, taxes, depreciation, and amortization), cash flow, and earnings will evolve, since that is most relevant to a company’s operations and its shareholders. Often, the primary metric is operating cash flow—hence the generic name, “cash flow at risk,” for this type of model.

Supplementary metrics may include other financial and strategic variables—how bad could our interest coverage ratio get (and could our credit rating be at risk)? Will we meet our growth targets? Market-share targets? The time scale is typically medium-term performance measured over a few months to several years out—the time needed to decide on and implement fundamental changes to running the business, not the time to unwind specific financial positions in the markets.

Exhibit 1 How much is our performance at risk?

EXAMPLE

Cash from operations (plus retained cash) vs. cash needs
\$ million (5% and 95% error bars)



Reading Exhibit 1: In 2013, the expected consolidated cash end of year is \$50 million. There is only a 5 percent chance that it will be above \$400 million, but there is a 95 percent level of confidence that it will not be worse than -\$400 million. There is a 35 percent chance it will be less than zero.

2. How do individual risks aggregate, including across the portfolio?

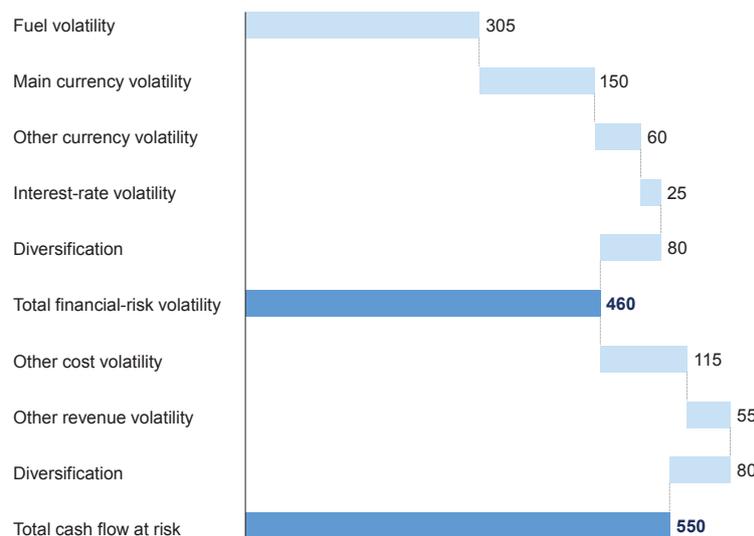
C-suite-level interest focuses as much on the “why?” as the “what?” Why are our risk levels what they are? What is the relative importance of risks that contribute to the overall impact? What is the relative contribution to total portfolio risk of different business units or assets? What are the natural offsets between different assets in the portfolio (one may be long and another short a given currency, for instance)? What is the level of interdependency and diversification between different commodity exposures and how much benefit does that entail? How will these risks be amplified or dampened with future planned asset/project or business mixes?

In addition, while strategic CFAR models are typically built by companies for whom commodity and currency risks are particularly large, these are far from the only risks that matter. Strategic CFAR models usually include some kinds of operational and supply-chain risks, such as variation in production levels, operational uncertainties and uncertainties in capital-expenditure spending, regulatory changes, default of major suppliers, etc.

Exhibit 2 How risks aggregate.

AIRLINE EXAMPLE

Cash flow at risk 95th percentile decomposition
\$ million



Reading Exhibit 2: There is 95 percent confidence that fuel volatility will not itself cause a gap to the plan of cash flow of more than \$305 million. There is 95 percent confidence that volatility in the main foreign currency in use in this company will not itself cause a gap of more than \$150 million. Taking all risks together, there is 95 percent confidence any gap will not be worse than \$550 million. The negative “diversification” bars arise from the fact that only in some cases will fuel and forex be “bad” at the same time (that is, the correlation is less than 1).

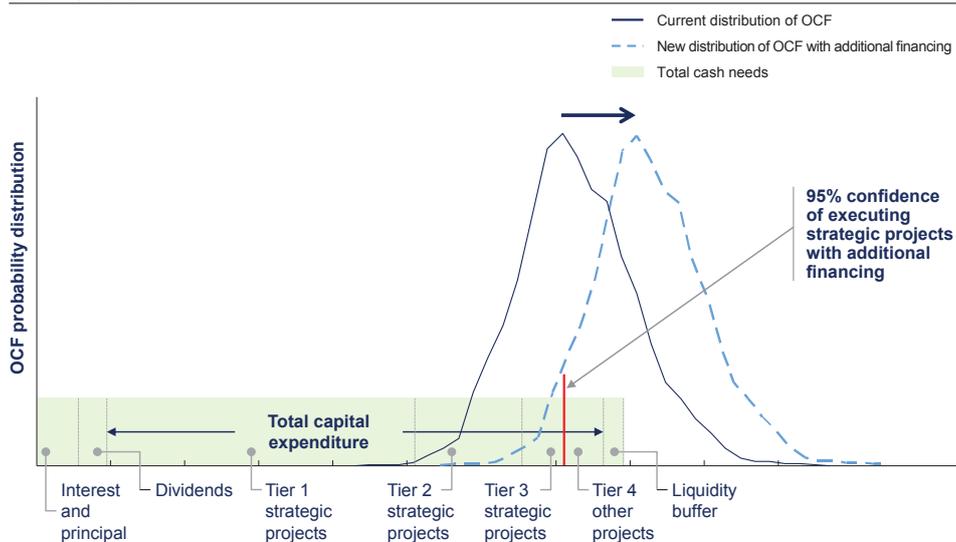
3. How does the level of risk depend on and affect financial and strategic choices?

Strategic CFAR models act as decision-support tools, so the key framing is typically “How does the risk to my expected performance change as a consequence of choices I can make?” The CFAR model is a lot more focused on “what ifs” and alternatives rather than on pure aggregation and monitoring. How much does the CFAR change if an investment is made versus delayed? If the hedging or contracting strategy is changed? If fundamental macro conditions deteriorate? If the structure of the balance sheet is changed? What would be the consequences of our operational transformation program failing to reach its targets? The answers often involve bespoke approaches recognizing the specific decisions or levers of flexibility that are available.

Exhibit 3 Impact of a strategic decision on cash flow at risk.

OIL AND GAS EXAMPLE

Cumulative operating cash flow (OCF)
2010–14, \$ billion



Reading Exhibit 3: The solid curve is the probability distribution of operating cash flow under current conditions. The boxes on the bottom are anticipated cash needs, arrayed in order of priority. While the company is essentially guaranteed to be able to pay interest, principal, and dividends, there is a significant chance it will not be able to afford tier-two, three, and four projects—a large part of the solid curve is above these blocks. Raising enough financing to move the curve to the right (to the dotted curve) means the chance of being able to afford up to tier three is reduced to only 5 percent.

Some examples of strategic CFAR models

Many of the differentiating features of these new types of strategic-risk models are best illustrated by examples. Not surprisingly, adopters include energy companies (at the portfolio/strategic level, going well beyond their trading activity), but they are emerging in other sectors. As can be expected, the much higher volatility of commodity markets in recent years, buffeted by the sometimes contradictory winds of the developed world's economic missteps and extraordinary commodity-intensive growth of the developing market, has been a powerful impetus to adoption and innovation. In some cases, ambitious growth plans making significantly higher demands on future cash flows have increased the urgency.

1. A North American independent oil and gas company was struggling with how to navigate the cash needs of an ambitious growth program in a highly volatile price environment. By building a strategic CFAR model, it determined the optimal amount of hedging and capital raising needed to cover its developmental cash flow at a desired level of confidence (95 percent).²
2. Before the 2008 crisis, a Middle East national oil and gas company sought to optimize its portfolio-growth mix between upstream and less attractive but also less risky (and diversified) downstream projects so as to maintain a target risk profile and credit rating. A CFAR model provided the quantitative framework for the optimization, tested under different assumptions for forward-looking correlations between crude and gas and various refined products.
3. A deregulated energy utility pursuing an ambitious new build strategy with structured financing built an ad hoc CFAR model for new assets to pinpoint a commodity-hedging strategy just right for keeping risk at a comfortable level for all stakeholders.
4. Several global basic-materials companies have built financial risk dashboards as part of their risk-management and business-planning processes. They involve CFAR models for the whole portfolio, as well as specific new assets, to navigate growth and market volatility within a target financial-risk appetite. Apart from strategic portfolio steering, in several cases, these companies have saved money by stopping hedging of minor currency or metals/energy exposures after their calculations showed these hedges had minimal net impact on overall risk levels after portfolio diversification across risk factors was taken into account.
5. Several airlines have built CFAR models reflecting fuel costs, demand, and—in some cases—currency, to measure not only the effectiveness of their hedging positions (a straightforward application of the book-of-record type of model described earlier), but also to trade off the financial impact of changes to fuel hedging strategy, adjusting fuel-price pass-through in pricing, and right-sizing the amount of extra cash to keep on hand, all to optimize an overall financial-risk-management strategy. In an environment frequently suffering from overcapacity, a more nimble approach to navigating volatility is important for competitive positioning in key markets.
6. An industrial manufacturer with a fundamental currency mismatch (revenues largely in dollars but most of its costs in euros) built a strategic CFAR model to consider the costs and benefits of longer-term currency offset strategies versus its current portfolio of short-term currency hedging.

² Bryan Fisher and Ankush Kumar, "The right way to hedge," mckinsey.com, July 2010.

Metrics: VAR, CFAR, and stress testing

VAR and CFAR both answer the question of how much companies could deviate from their expected performance (on the downside) with a given level of confidence. For instance, a financial institution or a trading desk that says its portfolio five-day VAR is \$200 million at a 99 percent confidence level is asserting that in only 1 percent of possible future worlds would portfolio losses (versus expected valuations) exceed \$200 million over a five-day period. A mining company saying its 95 percent CFAR (or earnings at risk) over the next year is \$300 million is asserting there is only a 5 percent chance that its cash flow or earnings over the next year will be over \$300 million less than in its plan.

There are a few key differences. VAR is a single number, reflecting how much portfolio value could be impaired until the owner can take corrective action, such as liquidating the no longer favorable positions. CFAR is a risk measure over a time horizon—how much is at risk over the next month, quarter, year, and successive years. This reflects the fact that many nonfinancial exposures are integral components of the company's business and cannot be “unwound” in short order to shake off an undesirable market shock with a one-time loss. VAR typically is evaluated over short time horizons of a few days, while CFAR typically looks at medium- to long-term corporate planning horizons ranging from a few months to several years.

Second, the confidence levels vary. Prior to the financial crisis, many banks would claim to calculate VARs at a 99.9 percent or even 99.97 percent confidence level. Events showed that tails were woefully underestimated. In contrast, most nonfinancial companies calculate strategic CFAR at no more than a 95 percent level, recognizing that the longer time frames involved make unquantifiable tails almost a certainty.

Because of this tail issue, stress testing is absolutely crucial as a complement to probabilistic CFARs.

While stress testing in financial institutions is usually a formalized exercise to test the portfolio under specific stress assumptions prescribed by a regulator or other outside party, the analog for strategic CFAR tends to be well-defined alternative scenario assumptions including macro, regulatory, and even operational effects defined in a plausible and consistent way. It supports a story stated as “our 95 percent CFAR is \$300 million, assuming normal volatility in a world roughly as expected. However, we could lose three times as much in the case of a sustained Chinese economic downturn or war in the Persian Gulf.” This is much more subjective use of probabilities since these shocks are posited as less than 5 percent likely. The role of such stress testing is to enable management to evaluate possible mitigation measures early on and put them in place in case they are deemed suitable. Stress tests typically also foster discussions about individual risk drivers and their consequences, thus in effect exposing for debate possible risks and uncertainties in the business-planning process.¹

There are also important practical differences. While practices vary, many institutions calculate their short-term VARs by bootstrapping the range of volatility in similar historical periods, or by parametrizing assumed probability distributions of financial-asset prices. In contrast, while many models for commodity prices have been developed, they are less amenable to such purely parametrized treatment, and companies find that the best strategic CFAR models carefully model tactical response to certain risk events in a way that makes Monte Carlo simulation the only possible methodology.

Finally, as mentioned in the main text, the cash-flow-at-risk approach is often used for other business-performance metrics, such as EBITDA at risk, earnings at risk, and derived measures such as financial ratios and their implication on credit ratings.

¹ Natalie Davis, Stephan Görner, and Ezra Greenberg, “Shaping strategy in a highly uncertain macroeconomic environment,” *McKinsey Working Papers on Risk*, December 2008 (mckinsey.com).

Key enablers of effective strategic CFAR models

What has enabled companies like these to deploy these models strategically and often quite quickly? While naturally some of the underlying methodologies are shared with the trading VAR models described previously, there are key differences in scope as well as in how the models are constructed.

Theme A: Top-down focus aligned with business strategy

1. Strategic CFAR models are tailored to **focus on specific metrics that are strategically meaningful to the company** in question. For instance, while upstream-commodity producers may focus on their free cash flow available for growth capital expenditure (allowing them to manage the cycle), companies that are more cash- and profit-tight may focus instead on key financial ratios considered by rating agencies, for instance, interest-coverage ratio. One state-owned oil company focuses not on annual cash flow but instead on its multiyear contribution to the government's budget. This involves much more than simply quantifying risk levels via a VAR or simple CFAR number and matching it to a board-approved risk appetite. Strategic CFAR models need to be fundamentally forward looking, exploring the financial impact of different future commodity-pricing regimes and using a longer time horizon for analysis, typically one to five years, rather than "potential losses until we would take remedial action" in a trading-risk model. This also implies a different philosophy of measuring exposures: while a typical trading-risk VAR model needs to stay safe and make clear and ungameable calibration assumptions, a typical strategic CFAR model is an exploratory decision-support tool, where everyone understands assumptions may be wrong but agrees on the need to put a stake in the ground and then test the impact of moving that stake around.
2. Some strategic CFAR models are increasingly trying **to include other risks beyond commodity and currency-price volatility, namely strategic and operational risks.** In addition, varying macro-cycle scenarios may be run. These additional risks may be quantified via probabilistic assumptions or as scenarios or sensitivities layered on top of a probabilistic model of more data-rich, easily quantified, risks. It is the exploratory decision-support-tool philosophy taken one step further, reflecting a greater breadth of the risks that matter, even though the grounding in "fact" of the assumptions becomes increasingly murky. In the words of one CFO, "we may not know a [heck] of a lot, but we'd be dumb not to put the best our people might know to the best possible use."
3. Regardless of the breadth of the scope of risks being covered, there is increasing focus on **top-down understanding of natural risk offsets and "true economic exposure."** This includes making estimates on market, customer, and competitive reactions to external shocks. While in a trading-risk model, the "trading book of record" construct of the sum total of financial and physical positions works well, as models turn more strategic, the most important offsets reflect what is written into supply-side and demand-side contracts, and what might happen even outside of contracts (for example, suppliers who would have to pass through their cost increases regardless of contracts they previously signed). This therefore forms the bulk of the nitty-gritty analysis, as opposed to bottom-up aggregation of physical and financial-risk positions in the typical commodity VAR model. In the words of one risk manager, "[these models] have made us spend more time looking at what we've signed than what we own."

Theme B: Broad ownership and transparent implementation

4. As a consequence of the above, the mind-set of these **strategic CFAR models is much more "riskifying the business plan"** instead of "quantifying the risk in the book of record/risk book." Therefore, the process typically requires ownership (or at least co-ownership) by the finance and strategic-planning functions (and includes broad CXO and business-unit engagement overall), rather than sole ownership by treasury or risk management or purchasing.

5. While commodity-risk models are increasingly being built using third-party specialized platforms (so-called energy-trading-and-risk-management or commodity-trading-and-risk-management software, known as ETRM and CTRM respectively), the platform of choice for many strategic **CFAR models is Excel, enriched with Monte Carlo and commodity-modeling techniques**. This feels like a retrograde step, or a sign of immaturity, but is actually a reflection of the different focus of these models. While linkage to corporate data is important, the natural ecosystem is the strategic plan, augmented by assumptions and analysis of the value chain and market. The outputs are strongly customized and are subject to “what if” analysis.
6. Finally, successful deployment of these models involves a good dose of humility and a mind-set shift among users. The typical commodity value-at-risk model for trading strives to be “right” (or at least unbiased), so that traders with incentives to take on risk do not game it in order to take more risk than is optimal for the company. **The strategic CFAR business-plan-at-risk model recognizes that many of the assumptions are quite dubious, but nevertheless reflect the best intelligence available.** The mind-set shift is that the focus is on senior-management dialogue on the right way to navigate uncertainty, rather than on policing whether the sum total of risk taking is within decided limits.

Why bother? How strategic CFAR models deliver value

In our experience, the value of strategic CFAR models for commodity-intensive companies comes both from better managing the risk downside of their activities and enabling the upside.

- **Enabling companies to determine a comprehensive risk appetite and allowing for a more “informed steering” of the business.** A consistent aggregated top-level view of all the key risks allows corporates to size, compare, and prioritize major risks on one side and also actively shape their risk profile in the desired direction on the other side. Where commodity/currency risks are key and the exposures involve time differences and offsetting positions, a CFAR model is the best approach to collect all this information and translate it into C-suite (and board-level) metrics. The best metrics are anchored in the variables or hurdles that could cause step changes in the business, for example, a credit downgrade or the need to delay capital expenditure.
- **Enabling comparability of risks across the entire corporate portfolio/activities.** Traditionally financial-market activities, operational risks, and—to a limited extent—credit/counterparty risks were subject to strict but quite often siloed risk-management procedures. This “control what’s measurable” approach often results in some large risks not being included in the risk-management process and therefore remaining, in effect, uncontrolled. When setting up a CFAR model on the corporate cash flow one has the chance to evaluate systematically the relevance of possible risks across the entire business portfolio. Furthermore, once included in the model, the different risks become comparable. Many companies find some of their choices involve trade-offs between these risks—do we control market risk in our operations and purchasing strategy, or do we control it with financial levers? Should we obtain more favorable preferred treatment from a handful of suppliers or opportunistically play the market and lower concentration risks? All of these are trade-offs across risk types that are elucidated by the CFAR formulation.
- **Fostering a dialogue on uncertainties and the trade-offs in managing them.** A consistent view on the uncertainties in a corporate portfolio and the comparison of their outcomes under different market, economic, and operational scenarios allows model users to compare different options and appropriately account for their pros and cons prior to taking decisions. In particular, there is an important equivalence principle operating through most businesses, where, for example, pricing-strategy decisions (such as cost pass-through to customers) affect optimal capital structure and commodity hedging and contracting affects available growth capital.

- **Removing biases from the strategic-planning process** by enriching planning data with risk information. In most corporates, strategic planning mainly relies on a single base market and operational scenario or on a small set of deterministic scenarios. The risk view provides better information on the possible realizations of the strategic plans and also removes the human bias against the occurrence of adverse market and operational conditions.
- Finally, **creating value through “safe” optimizing of risk taking**. Model users can utilize options and flexibilities available in project development, assets, and production processes to increase the portfolio return without taking on large undue risks. Optionality can easily change the net present value of a decision by 50 percent. More than just getting the number “right,” managers care about understanding—quantitatively—what are the drivers of risk and the opportunities through flexibility, and therefore what is the value at stake in what circumstance and how to respond. CFAR models elucidate this.

Building a CFAR model

Companies building an industrial-strength trading VAR model often find it a multiyear undertaking, due largely to the deep interfaces needed with ERP software and all portions of the company where positions are taken on a day-to-day basis. In contrast, first-generation, top-down initial strategic CFAR models can often be implemented quite quickly. Companies typically see the first meaningful results in a couple of months and sometimes (especially if the scope can be meaningfully limited to just part of the portfolio) in a couple of weeks. This comes from mercilessly prioritizing and making top-down initial estimates on aggregate exposures. The work does not stop there, of course. A strategic CFAR exercise tends to remain a work in progress, continually pushing and pulling with financial-reporting changes, strategic-planning variations, and adapting to support specific changes.

In a nutshell, the building blocks of a CFAR model are the following:

- **Creation of a driver-based financial model.** This may be the profit and loss or cash-flow statement for individual business units or assets or a full-fledged valuation model for the business—depending on the metrics to be “at risk.” The key element is that it is a driver-based model, where changes in key drivers propagate appropriately to all the bottom lines.
- **Identification, prioritization, and exposure modeling of the relevant risk factors.** While the model drivers will a priori depend on a huge number of uncertainties, in practice typically three to five, or maximally ten, factors explain most of the volatility. The focus is then an accurate representation of the exposure to these priority risk factors into the model drivers.
- **Commodity-model calibration and debate around key assumptions.** Standardized methodologies exist to combine historical commodity time-series behavior and forward-looking market data. However, it is crucial for management to debate what large-scale assumptions they choose to believe (for example, the market forward curve versus a proprietary one? Use volatility to take into account the possibility of a major macro shift or assume the forward curve is “right”? What assumptions should be made on correlations?). In addition, players must decide how to treat operational, strategic, and other risk factors.
- **Incorporation of business responses and flexibility.** Brute-force application of a black-box model often involves uneconomic or irrational business assumptions. A mine would probably not cheerfully continue to operate at full volume below its variable costs. On the other hand, an oil project might well increase production if oil prices remain high. Thoughtful incorporation of this type of optionality—not via magic formulas, but as reasonable management decisions under certain conditions—is important to ensure the output of the model is realistic.

- **Development of the relevant reports and application to strategic decisions.** The goal is management-friendly decision information. Typically, this is an iterative process in which first insights beget interest and further questions, which in turn drive priorities for future development.

Finally, it is worth noting that, given the nature of CFAR models, building such models, operating and maintaining them, interpreting the results, and deriving conclusions requires cross-functional teams from finance, strategic planning, and risk management, and often operating units themselves. Depending on the requirement at hand, these teams need to be enriched with experts from the different business lines as well as given strong IT support because of the breadth of data required.



For companies exposed to a complex interplay of risks, strategic CFAR models provide an interesting new analytical tool for supporting management decisions. The methodology is based in techniques developed for financial and commodity-trading risk management, but companies whose investment in risk analysis stops there may be missing the highest-value opportunity: better strategic portfolio decisions, operations-footprint decisions, capital-investment decisions, and even pricing and product-development decisions.

In making the jump, strategic CFAR adopters will recognize what they've always known intuitively but can now see analytically—that all of these decisions are linked and affect one another, and that there is a deep “equivalence” principle operating in their business.

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