

Getting Real

WANT TO TAKE MORE UNCERTAINTY OUT OF CAPITAL INVESTMENT DECISIONS? TRY REAL OPTIONS.

BY S.L. MINTZ

"THE EDSEL IS HERE TO STAY." That's what Ford Motor Co. chairman Henry Ford II told Ford dealers in 1957. "There is no reason why anyone would want a computer in their home." Thus intoned Digital Equipment Corp. founder Kenneth Olsen in 1977. Even for business leaders with vision, the future is difficult to predict. So where does that leave less-than-legendary executives come budget-planning season? Stuck, largely, with the same venerable tools that guided their predecessors and *their* predecessors: net present value and gut instinct. Short of denigrating tools that account for many great successes (along with memorable flubs), many executives are wondering if that's all there is.

"There is definitely room for improvement," concedes Rens Buchwaldt, CFO of Bell & Howell Publishing Services, in Cleveland. Large capital-investment decisions—whether it's launching a new automobile, or building a chip-fabrication plant, or installing an ERP system, or making any number of other very pricey investments—hurl companies toward uncertain outcomes. Huge sums are at risk, in a competitive climate that demands ever-faster decisions. Is there a better way to evaluate capital investments? A growing and vocal cadre of academics, consultants, and CFOs say there is one: real options.

Fans insist that real options analysis extends quantitative rigor beyond discount rates and expected cash flows. "Everybody knew there was some kind of embedded value" in strategic options, says an oil industry finance executive. Real options analysis, he says, brings that embedded value to light.

Real options is "a way to be a little more precise about intuitive feelings," declares Tom Unterman, CFO of newspaper company Times Mirror Co.

By quantifying the fuzzy realm of strategic judgment, where leaps of faith govern decisions, real options analysis fosters the union of finance and strategy. "It's a way to be a little more precise about intuitive feelings," says Tom Unterman, CFO of \$3 billion Times Mirror Co., the Los Angeles-based news and information company. A real options analysis recently bolstered the company's decision to back away from an acquisition, says Unterman, and wider use of the approach is foreseeable. "We are quite actively looking for ways to apply it," he says.

Casting investment opportunities as real options increased both the top and bottom lines at Cadence Design Systems Inc., a San Jose, California-based provider of electronic design products and services. "We have closed a number of transactions that we would not have closed before," CEO Ray Bingham declares.

Most software licenses, for example, require a royalty payment on sales back to the vendor. In a recent transaction, Cadence was asked to pay a royalty plus a floor, a minimum payment in the case

that sales were low. A real options analysis enabled Cadence to measure the effect of the floor on the value of the design project—in effect capitalizing the wide range of possible sales-volume and unit-price outcomes. The results showed that negotiating a release from the floor at unit prices just below \$16, in exchange for a larger royalty payment at high unit prices, would add more than 25 percent to the value of the design project. The real options analysis also showed that under certain outcomes, the project would be cash "needy"—information the negotiating team could use to smooth cash needs with other modifications to the payment structure.

Besides using real options behind the scenes to support negotiations, Cadence has also shared methodologies and results with counterparties, says Bingham. The reason: negotiations go faster when both sides have the same framework.

THE VALUE OF FLEXIBILITY

Unlike net present value measurements, real options analysis recognizes the

flexibility inherent in most capital projects—and the value of that flexibility.

To executives familiar with stock options, real options should look familiar. A stock option captures the value of an investor's opportunity to purchase stock at a later date at a set price. Similarly, a real option captures the value of a company's opportunity to start, expand, constrain, defer, or scrap a capital investment, depending on the investment's prospects. (For a demonstration of how real options analysis can be applied to a start-up company, see box, "In Practice.")

When the outcome of an investment is least certain, real options analysis has the highest value. As time goes by and prospects for an underlying investment become clearer, the value of an option adjusts.

Sweep away the rocket science, and real options analysis presents a more realistic view of an uncertain world beset by constant shifts in prices, interest rates, consumer tastes, and technology. To focus strictly on numerical value misses the depth and complexity of real options discipline, observes Nalin Kulatilaka, a professor of finance at Boston University School of Management. Kulatilaka is an evangelist for a methodology that obliges managers to weigh equally all imaginable alternatives, good and bad.

Real options analysis liberates managers from notions of accountability that mete out blame when plans don't go as expected. That's not a healthy environment for workers or companies that need to be nimble all the time, if not right all the time.

"The best decision may lead to a bad outcome," says Soussan Faiz, manager of global valuation services at oil giant Texaco Inc. "If you are judged on a bad outcome, guess what? People will say, 'Why go through that?'" To succeed today, companies must create new options. But unless managers are rewarded for creating them, Faiz warns, "it ain't gonna happen."

CERTAINTY IS A NARROW PATH

By taking uncertainty into account, real options analysis fosters a more dynamic view of the world than net present value does.

Net present value ultimately boils down to one of two decisions: go or no-go. When the net present value of expected cash flows is positive, companies usually proceed. As a practical consequence, managers concentrate on prospects for favorable outcomes. Prospects for unfavorable outcomes get short shrift. In this analysis, certainty enjoys a premium—and that's a narrow path. Even

The real options approach is more than dense mathematics, says Boston University finance professor Nalin Kulatilaka. Its a way of thinking.

without gaming the numbers to justify projects, this upside bias invites unpleasant surprises.

"Unfortunately, discounted cash flow collapses to a single path," says Texaco's Faiz. Management and measurement are intertwined, she explains, yet companies manage with an eye to options, but measure performance as if options don't exist. In the oil business, oil prices don't remain low for the life of a project; they bounce back. "The likelihood of prices being low for the rest of the project are zero or nearly zero," says Faiz. But even if prices do remain stagnant, defying the odds, managers don't snooze the whole time. They wake up and react. Net present value, however, treats investments as if outcomes are cast in stone. This, needless to say, is not realistic.

"Net present value makes a lot of heroic assumptions," warns Tom Copeland, chief corporate finance officer of Monitor, a strategy consultancy in Cambridge, Massachusetts. Typically, a multiyear project is plotted along a single trajectory worth pursuing only if the net present value exceeds zero or some hurdle rate. This type of reasoning may satisfy requirements for a midterm exam, says Copeland, but situations in the real world change constantly as new information surfaces. Most managers realize that flexibility ought to be included in valuations, Copeland says. "The bridge they have to cross is understanding the methodology to capture the value" of flexibility.

With Phil Keenan, a consultant at McKinsey & Co. in Cleveland, Copeland has developed ways to bridge this gap. "Anytime you can determine net present value," Copeland says, "if you also focus on uncertainty, you can figure out the real options value. The additional input

is modeling the uncertainty." Modeling uncertainty relies on identifying the risk factors in a company, its products, and its markets, a fairly familiar exercise.

OUT OF THE IVORY TOWER

Experts have touted the merits of real options for at least a decade, but the sophisticated mathematics required to explain them has penned up those merits in ivory towers. That's changing, as proponents tout the virtues of real options as a mind-set for decision making.

"The big news," says Vinay Kapoor, a senior manager at Ernst & Young LLP in Washington, D.C., "is thinking about [real options] as a process and implementing the thinking, not the model." Similarly, in his 1999 book, *Real Options* (written with consultant Martha Amram), finance professor Kulatilaka underscores the value of the approach as a way of thinking.

Meanwhile, capital markets are also chasing real options from the ivory towers. "The Internet has posed the value question so crisply that it has risen to prominence," says Amram. Internet companies that lose money but attract more market capital than larger, profitable rivals expose the irrelevance of discounted cash flow. Viewed as options on a future that has not yet revealed itself, sky-high price/earnings ratios seem a little more palatable, if not more rational.

"The kinds of businesses companies go into today are difficult to go into with NPV," says John Vaughan, vice president for business development at M/A-COM, the Lowell, Massachusetts-based wireless products group of AMP Inc.

Vaughan speaks from experience. Three years ago, managers at M/A-COM were mulling ways to expand a business with two discrete parts, communications-

"You kind of think of yourself as a venture capitalist," says M/A-COM's Vaughan. "First, you place small bets."

In Practice

Valuing a new venture with real options analysis * By Nalin Kulatilaka

Table 1. Discounted cash-flow valuation of Portlandia Ale (\$ millions)

| | Today | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|-------|-----|-----|-----|-----|-----|-----|-----|-------|
| Investment | .50 | .50 | .50 | .50 | .50 | .50 | .50 | .50 | 12.00 |
| Terminal value | | | | | | | | | 22.00 |
| PV of investment | .50 | .49 | .49 | .48 | .48 | .47 | .46 | .46 | 10.86 |
| PV of terminal value | | | | | | | | | 14.46 |
| Net present value at 21% discount rate = \$0.23 | | | | | | | | | |

Portlandia Ale, a hypothetical start-up microbrewery, needs \$4 million to begin product development and manufacturing and another \$12 million in two years for its market launch. The entrepreneurs are optimistic, despite considerable uncertainty about the value of the market opportunity.

Portlandia shows potential investors a traditional business plan. Each quarter

made only if business conditions are strong enough to make the launch profitable. By investing in the early-stage development, Portlandia is in effect purchasing an option to launch the product. However, the costly launch will be done only if market conditions in two years' time make it sufficiently attractive.

The launching option held by Portlandia is analogous to a call option on a

stock. Hence, we can use the well-known Black-Scholes formula to value Portlandia's launch option. The formula requires only five inputs to produce a single output, the current value of the option. Table 2 draws the parallel between the inputs needed in valuing a call option on a stock and the launch option. (A note

of caution: not all real options can be valued so easily. Many corporate options are more complex and require tailored mathematical formulas.)

The current value of Portlandia's option to launch is \$4.96 million. Its value comes from the upside potential. If two years from now business conditions are terrific, then there will be a very high payoff to the \$12 million launch cost. If business conditions are poor, the product will not be launched and the \$12 million won't be needed.

Portlandia now has a *contingent strategy*, one that depends on business conditions. Before the launch-decision date, Portlandia's total product-development cost will be \$3.83 million in present value terms. The value of Portlandia with the launch option is \$1.13 million (\$4.96 million-\$3.83 million).

Next, let's more realistically characterize

Portlandia's strategy by adding a set of additional options: the options to abandon the business at the end of each quarter. Suppose that at any time during the first two years, Portlandia could cease operations if business conditions soured to a level that the microbrewery could not see making the launch. The calculations at this point become a bit more complex, requiring specialized mathematical tools. The option to launch and the options to abandon are valued in an integrated manner, resulting in a \$1.74 million valuation for Portlandia (see Table 3).

Where did the additional value come from? By assuming that Portlandia commits to completing the development process and going ahead with the launch, the DCF valuation ignored an important flexibility that the firm really had. In fact, a more realistic depiction of the investment process is one in which management will reassess business conditions at various intervals and make subsequent investments contingent on those reassessments. The real options analysis recognizes that these contingent decisions would in fact reduce the risk exposure of Portlandia Ale while retaining all the upside benefits.

Could we have used a decision tree analysis (DTA) to reach these conclusions? It appears at first glance that the real options method is very similar to DTA, which models possible future business outcomes and the reactions to those outcomes in a decision tree. However, the way in which future outcomes and their associated probabilities are modeled in DTA can be quite arbitrary and colored by analysts' opinions.

The subtle yet important difference in real options analysis is the market discipline it imposes. The analysis obtained its measure of the business risk from the prices of traded microbrewery stocks. The ability to replicate Portlandia's business risk with existing securities allowed us to value the business plan using real options.

*Nalin Kulatilaka is a professor of finance at Boston University School of Management. This article is based on Chapter 10 of Real Options: Managing Strategic Investment in an Uncertain World, by Martha Amram and Nalin Kulatilaka (Harvard Business School Press, 1999).

Table 2. Black-Scholes inputs for call options and launch options

| Call option on a stock | Launch option |
|--|---|
| S Current stock price | PV of benefits from launch (i.e., PV of terminal value = 14.46) |
| X Strike price | Launch cost (\$12 million) |
| T Time to expiration | Time to launch (2 years) |
| r Risk-free rate of interest | Risk-free rate of interest |
| σ Volatility of the stock price | Volatility of the value of the microbrewery (estimated from the market-traded prices of microbreweries = 40%) |
| D Dividend yield | Dividend yield of Portlandia until launch (clearly, equal to zero) |

for the first two years, \$500,000 would be spent. Then \$12 million would be spent in the first quarter of the third year to launch the product line. The business plan assumes the launch will lead to a sustainable business with a market value of \$22 million. (The value of the sustainable business is calculated as $M/S \times \text{Portlandia's sales}$, where M/S is the average market value to sales ratio for mature microbrewery companies.)

But the investors are put off by a discounted cash-flow analysis. Even under two optimistic assumptions—business conditions will support the sales forecast in the plan, and the launch will be made—the net present value of Portlandia after two years is *negative* \$230,000, as demonstrated in Table 1.

The entrepreneurs can sway the investors with a real options analysis. Portlandia's strategy is more complex, and its valuation is higher, than is recognized by the business plan. The plan fails to include the valuable option held by the start-up: Portlandia need not undertake the market launch. The launch will be

Table 3. Discounted cash-flow value versus real-options values

| DCF Value | Real options value | Real options value |
|---|--|--|
| Commit to development and launch. -\$230,000 | Commit to development but retain option to launch. \$1.13 million | Retain options to commit development in stages and option to launch. \$1.74 million |

"Any rule that you come up with is only going to be as good as your judgment," says Sealed Air's Hickey.

equipment components and communication networks. One proposal advocated plunging into the public-safety communication market (chiefly police radios). But the products and the market were brand-new, and M/A-COM would face a dominant competitor. These factors, together with discouraging present-value analysis, argued against the investment.

Real options analysis placed the proposal in a less restrictive light. "You kind of think of yourself as a venture capitalist," says Vaughan, noting the high-risk, high-return nature of the police-radio undertaking. "First you place small bets; that's the model."

Rather than projecting the outcome and discounting backwards to net present value, Vaughan and his colleagues treated successive investments as an exercise price on an option to proceed. Vaughan calls this the "buy option" phase. If developments satisfy expectations, two more phases follow.

Phase two features less uncertainty and possibly a lower expected return, where risk roughly parallels the decision to buy a share of stock in an initial public offering. In this phase, says Vaughan, you have faith that you're on the right track and that the fundamentals are sound, but factors seen and unseen still loom. After that comes phase three—the "buy the factory" phase—and that's where M/A-COM finds itself now. Having proceeded with its investment, the company has plentiful orders coming in for police radios, including a lucrative arrangement with the state of Pennsylvania.

Net present value would have derailed this project long ago, Vaughan insists. "It would have been difficult to sell this business case, because of the high level of uncertainty," he says. Real op-

tions analysis assembles diverse risks in a coherent fashion, Vaughan says, layer upon layer, like a papier-mâché creation. "It very much mimics the venture capitalist approach," he says, "by timing expenditures to the maturity of the opportunity."

Companies frequently exercise similar precision in design and manufacturing processes, Vaughan notes, but seldom in management. "Are managers supposed to be exempt?" he asks.

HANDLE WITH CARE

Real options "add richness and perspective I can't get elsewhere," says the oil industry executive. But like any metric that relies on judgment, he warns, real options must be used carefully. They are not tamper-proof. "Given enough volatility and time," he says, "I can make an option a very big number." Without solid, accurate measures of volatility, real options can lead companies astray. For evaluating an offshore oil lease, look at the history of oil-futures prices; for a petrochemical plant, look at historical futures and options contracts on margins.

Another pitfall: overestimating windows of opportunity. "It's an end-game problem," consultant Amram explains. An option's value will erode as commodity prices change, competitors rush in, or new technology intervenes. "The time you let uncertainty work for you is shortened," she warns. Companies undertaking oil exploration when prices are low, for example, need to recognize that an increase in oil prices will lure more activity, driving up the cost of oil services. In real options terminology, these developments mean that many options are

being exercised at once as competitors race for the same prize.

Some skeptics sound a more philosophical reservation: can intuition really be reduced to algorithms? "Any rule you come up with is only going to be as good as your judgment," says William V. Hickey, president and chief operating officer of Sealed Air Corp., a maker of protective packaging based in Saddle Brook, New Jersey. As the company's CFO, Hickey was an architect of a dramatic recapitalization. He is no stranger to rigorous financial analysis.

"We go through NPV, discounted cash flow, return on invested capital, all those things," says Hickey. "At the end of the day, we have an implied risk factor, but we've never scientifically put it into anything. If you attach too much faith to it, it might send you down the wrong path."

Doug Fears, CFO of Tulsa-based Helmerich & Payne Inc., a contract driller that also builds rigs for oil and gas exploration and conducts its own exploration activities, routinely applies decision trees and sensitivity analysis to capital investments. He concedes that measures more attuned to intuitive appraisals might enable firms to take the kinds of risks that produce above-market performance. But at the same time, he expresses a more fundamental reservation. "Part of the fun of business," he says, "is making intuitive guesses."

Will algorithms trump intuition? Cadence's Bingham doesn't see real options as a threat to intuitive judgment.

"I don't think the value of great judgment or intuition is any less in using a more sophisticated model," Bingham says. To the extent that real options analysis sheds more light on uncertainty, in his view, it provides a critical link between strategy and finance. Says Bingham: "Getting hold of real options will make a CFO more and more relevant and a valuable part of leadership."

In an uncertain world, that's the sort of vision CFOs rely on.

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