

EXPLOITING UNCERTAINTY

The “real-options” revolution in decision-making

This June, Enron Corp. will open three gas-fired power plants in northern Mississippi and western Tennessee that are inefficient—deliberately so. They will generate electricity at an incremental cost 50% to 70% higher than the industry's best. Most of the time, the production costs of these spanking new plants will be simply too high for them to compete.

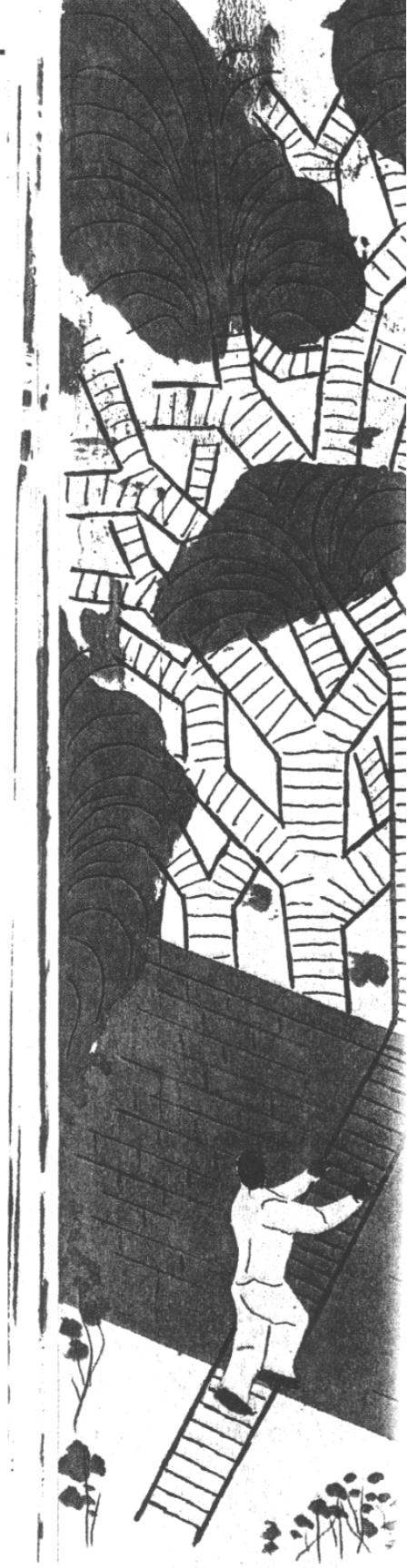
Enron hasn't gone crazy. By building less efficient plants, it saved a bundle on construction. It can let the plants sit idle, then fire them up when prices rise. Last June 25, the price of a megawatt-hour of electricity in parts of the Midwest soared—briefly—from \$40 to an unprecedented \$7,000. With such volatility, Enron executives figure they can make money from their so-called peaking plants even if they operate only a week or so per year.

What led Enron executives to this counterintuitive notion? A revolutionary concept in corporate finance called “real options theory.” In a nutshell, it says that when the future is highly uncertain, it pays to have a broad range of options open. Enron's new plants are, in effect, options: They give it the opportunity but not the obligation to produce electricity. Making money off high-cost power is no easy trick. But by using real-options theory, Enron's financial wizards figure that they can mine profits by calculating just the right time to run the plants, considering prevailing power prices and the costs of starting up and shutting down.

Real-options analysis rewards flexibility—and that's what makes it better than today's standard decision-making tool, “net present value.” NPV calculates the value of a project by predicting its payouts, adjusting them for risk, and subtracting the investment outlay. But by boiling down all the possibilities for the future into a single scenario, NPV doesn't account for the ability of executives to react to new circumstances—for instance, spend a little up front, see how things develop, then either cancel or go full speed ahead.

“AGILITY.” The New Economy, which is marked by rapid change and lots of uncertainty, cries out for a tool like real options. These days, says Hewlett-Packard Co. CEO Lewis E. Platt, “anyone who tells you they have a 5- or 10-year plan is probably crazy. This is the age of scenario planning. You need not only speed but agility.” Real-options analysis persuades companies to create lots of possibilities for themselves—for instance, by doing spade work on several projects at once. As events unfold, many options won't be worth pursuing. But a few could be blockbusters. With an options approach, “uncertainty has the potential to be your friend, not your enemy,” says Paul E. Greenberg, a consultant at Analysis Group/Economics in Cambridge, Mass.

Although conceived more than 20 years ago, real-options analysis is just now coming into wide use. Rapid change has exposed the weaknesses of less flexible valuation tools. Experts have developed rules of thumb that simplify the formidable math behind options valuation, while making real options applicable in a broader range of situations. And consulting firms have latched on to the technique as the Next Big Thing to sell to clients. “Real-options valuation has the potential to be a major



When the future is highly unpredictable, this theory says it

THE NEW MATH IN ACTION

Real-options analysis simply says that companies benefit by keeping their options open. Let's say a company is deciding whether to fund a large Internet project that could either make or lose lots of money—most likely lose it. A traditional calculation of net present value, which discounts projected costs and revenues into today's dollars, examines the project as a whole and concludes it's a no-go. But a real-options analysis breaks it into stages and concludes it makes sense to fund at least the first stage. Here's how it works:

EVALUATE EACH STAGE OF THE PROJECT SEPARATELY



Say the first stage, setting up a Web site, has a net present value of negative \$50 million. The second stage, an E-commerce venture to be launched in one year, is tough to value. But let's say the best guess of its net present value is negative \$300 million.

UNDERSTAND YOUR OPTIONS



Setting up the Web site gives you the opportunity—but not the obligation—to launch the E-commerce venture. In a year, you will know better whether that E-commerce opportunity is worth pursuing. If it's not, all you've lost is the investment in the Web site. However, the second stage could be immensely valuable.

REEVALUATE THE PROJECT USING AN OPTIONS MIND-SET

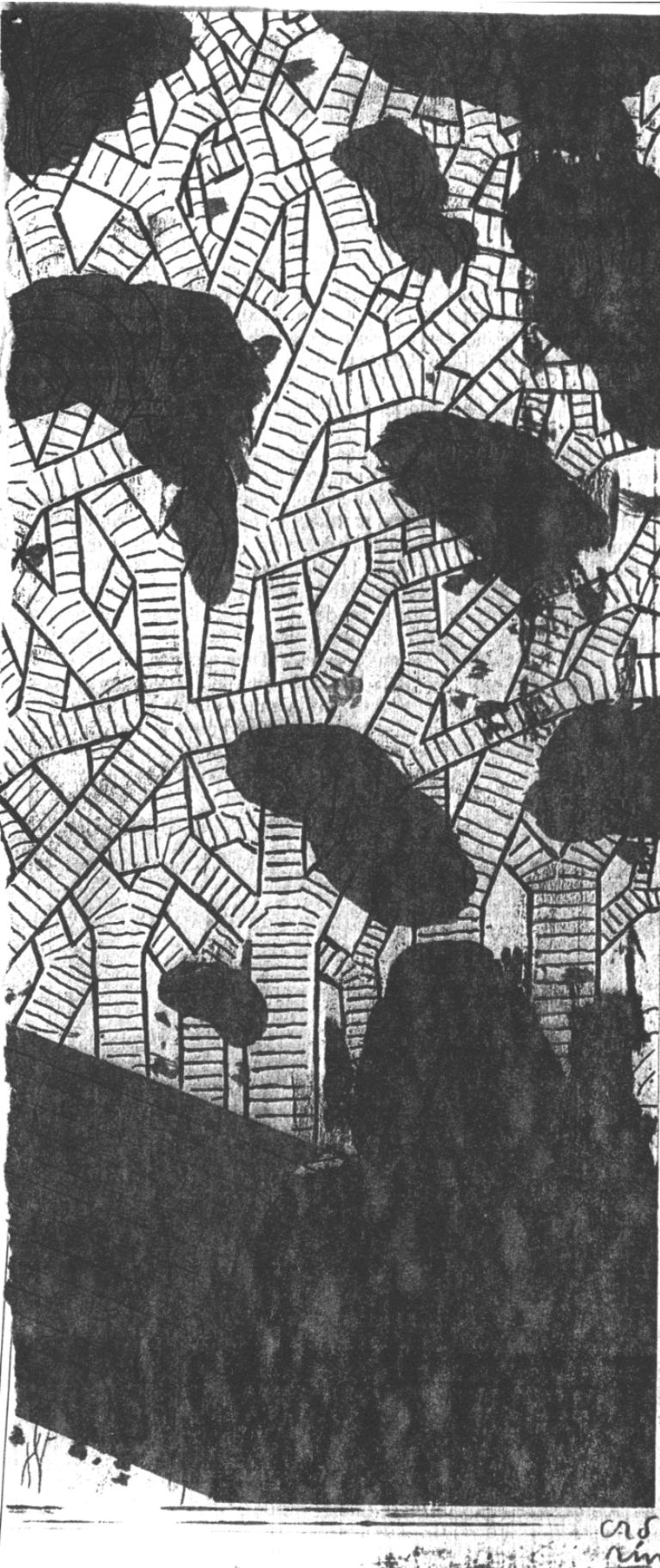


In the stock market, formulas such as Black-Scholes calculate how much you should pay for an option to buy, say, IBM at \$260 a share by June 30 if its current price is \$230. Think of the first stage of your Internet project as buying such an option—risky and out-of-the-money, but cheap.

GO FIGURE



Taking into account the limited downside of building a Web site and the huge—albeit iffy—opportunities it creates, real-options analysis could give the overall project a present value of, say, \$70 million. So the no-go changes to a go.



= pays to have lots of options open

business breakthrough," says Adam Borison of Applied Decision Analysis Inc., a real-options expert whose Menlo Park (Calif.) firm was snapped up last year by PricewaterhouseCoopers.

Enron President and Chief Operating Officer Jeffrey K. Skilling credits real-options thinking with helping Enron transform itself from a U.S. natural-gas pipeline company into a global wheeler-dealer that trades commodities including gas, electricity, water, and, most recently, telecom bandwidth.

"LOT OF SEEDS." Of course, not all of Enron's bets pay off. When it hit unexpected regulatory snags last year, it abandoned, for the time being at least, its effort to sell electricity to residential customers in California and Pennsylvania. But Enron executives calmly viewed the expensive push as an option that, in the end, just wasn't worth exercising. "It's like planting seeds," says Skilling. "There are a lot of seeds you know are not going to grow up into anything. Our objective is to have a lot of seeds planted."

With the help of faculty from Stanford University, Hewlett-Packard has

experimented with real options since the beginning of the 1990s. Example: In the '80s, HP customized inkjet printers for foreign markets at the factory, then shipped them in finished form to warehouses. Customizing at the factory is cheaper than customizing in the field. But HP kept guessing wrong on demand and ending up with, say, too many printers configured for French customers but not enough for Germans.

Executives realized that it would be smarter to ship partially assembled printers and then customize them at the warehouse, once it had firm orders. True, local customization costs more. But even though production costs rose, HP saved \$3 million a month by more effectively matching supply to demand, says Corey A. Billington, a former Stanford professor who directs HP's Strategic Planning & Modeling group.

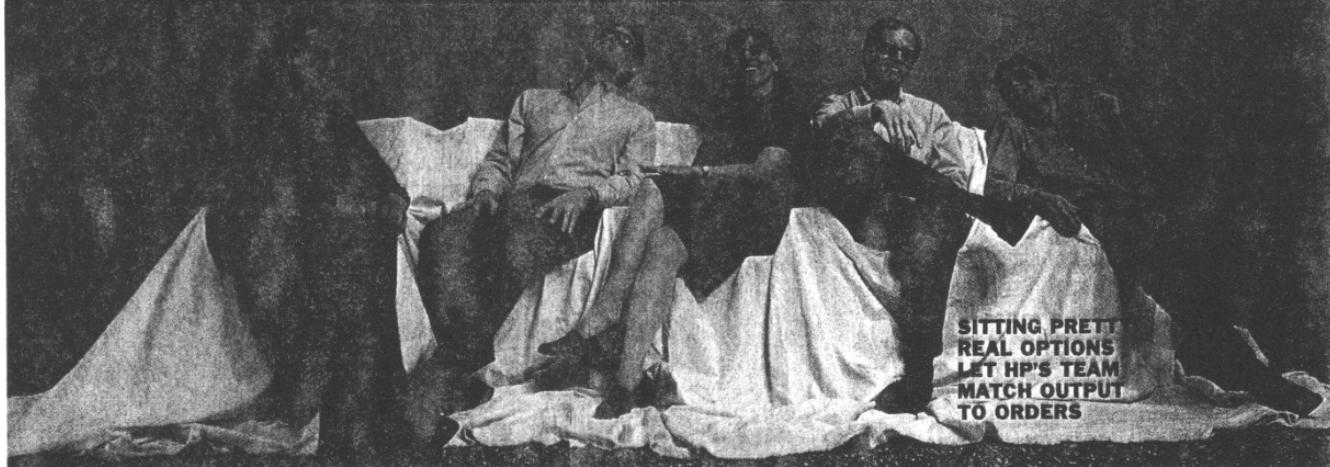
Common sense? Sure. But you can also view it as a neat solution of a real-options problem. Increasing the cost of production—anathema to your average engineer—was in effect the price HP paid for the option to delay configuration choices until the optimal time.

Since then, more units of HP have gotten the real-options treatment. Right now, the corporation is calculating the value of having inkjet mechanisms that work in products from different divisions. Building in such flexibility costs extra—and, with prices of basic printers plunging toward \$100, division managers aren't sure it's worth it. "They're saying: 'We can't afford to build in this extra stuff,'" says Jason F. Amaral, who works for Billington. HP's answer: Quantify the value of the flexibility to HP as a whole, then create incentives for the division managers to do what's in the best interests of the company.

PRICE IS RIGHT. The seeds of real-options theory were sown in the early 1970s. That's when Myron Scholes, Robert Merton, and the late Fischer Black made a Nobel prize-winning breakthrough in how to price financial options correctly. They realized the pivotal factor was volatility. Consider an option to buy a share of IBM at \$260 a share by June 30 when the current price is, say, \$230. If volatility is low, there's only a small chance the shares will ever hit \$260, so the option to buy

WHO HAS OPTED FOR REAL OPTIONS—AND WHY

This breakthrough technique is gaining followers fast



SITTING PRETTY
REAL OPTIONS
LET HP'S TEAM
MATCH OUTPUT
TO ORDERS

HEWLETT-PACKARD

HP wants to keep its component costs as low as possible. But it also wants its components to be versatile, to give it the option of using them in different products. That raises their cost. Real options help weigh the trade-off between low cost and flexibility.

ENRON

The Houston company noticed that natural gas was, in effect, an "option" on electricity because it could be used to generate power. It's building power plants near gas pipelines to produce electricity when prices spike, taking advantage of increased volatility.

CADENCE DESIGN SYSTEMS

This Silicon Valley outfit uses real-options valuation methods to break logjams in negotiations over computer-chip design licenses. Contracts are easier to hammer out when buyers and sellers speak the same real-options language.

AIRBUS INDUSTRIE

Airbus and its rival Boeing both offer generous options to airline customers to cancel or change orders. But airlines don't know how much those options are worth—compared with, say, a price cut. Airbus explains their value using real-options analysis.

ANADARKO PETROLEUM

Real options gave Anadarko the confidence to bid high for a lease in the Gulf of Mexico, where the potential was vast but uncertain. It won 100% of the Tanzanite lease and last July announced a "major oil and gas discovery" there.

Finance

them at that price isn't worth much. But if volatility is high, there's a good chance they will go above \$260. That makes the option to buy them at \$260 highly valuable. True, volatile shares can also plummet. But that doesn't matter because the outcome is the same at any price below \$260—the option is simply allowed to expire.

The Black-Scholes formula transformed financial-options trading in the Chicago pits and helped to create a global derivatives business with contracts whose face value today is in the trillions of dollars. Some experts think that real options will become even more important because they deal with real investments. Says Gordon A. Sick, a finance professor at the University of Calgary: "I would expect firms to expend much greater resources analyzing their real options than they do their financial options."

The term "real options" was coined in 1977 by Stewart C. Myers of Massachusetts Institute of Technology. Its earliest applications were in oil, gas, copper, and gold, and companies in those commodity businesses remain some of the biggest users.

Chevron

Corp. used real options in forming its (unsuccessful) 1997 bid for Elk Hills Naval Petroleum Reserve, a federal property in California. Anadarko Petroleum Corp. of Houston says real-options analysis gave it the confidence to outbid others for a tract in the Gulf of Mexico called Tanzanite that has proved rich in oil and gas. Anadarko paid more because Tanzanite's range of possible reserves was so broad. Says Michael D. Cochran, vice-president for worldwide exploration: "Most people looked at it and just saw the minimum case."

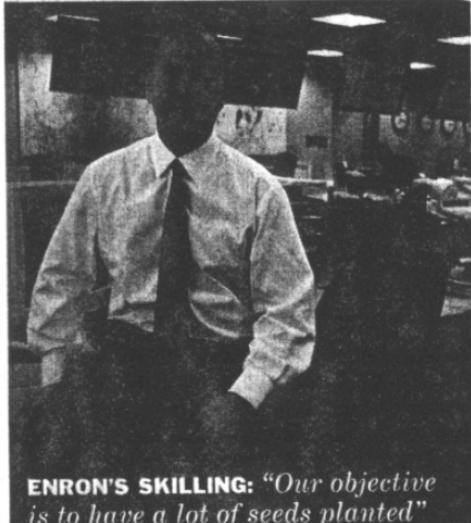
BETTER ANSWERS. What's hot now is the extension of real options beyond commodities—into biotechnology, pharmaceuticals, software, computer chips, and similar fields. This requires some innovation. The underlying asset of the option is no longer a traded product such as oil, whose going price can be plugged easily into a formula. Now, the asset that you get with the call option is something that's not traded—for example, a factory that hasn't even been constructed yet. Its present value must be

estimated from projections of its future cash flows.

That's not a simple calculation, to be sure, but it gives better answers than the methods that most companies use today to make major investment decisions. Strictly speaking, net present value theory says that companies should fund every project whose expected return exceeds the corporate cost of capital. But Treasury Secretary-designate Lawrence H. Summers, in his past life as a Harvard University economist, noted that companies set hurdle rates for proposals that are far higher than their cost of capital. That's a vote of no confidence in NPV.

"FAIL FAST." Real-options analysis helps decide when to kill projects that aren't working—following the Silicon Valley tradition of "fail fast."

Equally important, it helps decide when to keep projects alive. According to McKinsey & Co., a strict NPV analysis would have had Apple Computer Inc. quit the personal-computer business in 1995-96 because it wasn't earning its cost of capital. But real-options analysis says that a period of losses can be a worthwhile price to



ENRON'S SKILLING: "Our objective is to have a lot of seeds planted"

pay for keeping alive an enterprise that might earn big bucks in the future. Indeed, today Apple is making money, and its market share is on the rise.

One reason Silicon Valley is embracing real options is that the method abets collaboration between companies. Technology has become so complex that no company can supply everything it needs internally. A company creating an electronic product may need to acquire up to 15 intellectual-property licenses. That can be enormously time-consuming, notes Adriana G. Chiocchi, division counsel for worldwide services at Cadence Design Systems Inc. in San Jose, Calif. "If one deal takes months and you have 15 deals to do—hello? You're not going to be getting a lot of products out."

So Chiocchi's team has designed an options-based method for valuing licenses. It gave its model away to customers Intel Corp. and Toshiba Corp. for use in their negotiations, hoping for it to catch on as a standard. Says Chiocchi: "The feedback was fantastic."

To be sure, real-options analysis ha-