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What If . . . ?

BY [KATHLEEN MELYMUKA](#)

(February 04, 2002)

Imagine being able to look into the future to see how today's policies and initiatives will affect your company's profitability and competitive position 10 years down the road. That's the vision a community of scientists in Santa Fe, N.M., is trying to provide through the business adaptation of a new type of computer-based simulation.

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Nourished by the brainpower of Los Alamos National Laboratory and the Santa Fe Institute, a complexity think tank, more than two dozen start-ups

have been using supercomputers to experiment with simulations based on complex adaptive system theory. Businesses have been using computer simulations for years, but complex adaptive system modeling is different. Traditional models start with assumptions from historical data; complex adaptive systems start with the world as it is and track the results moving forward.

This kind of simulation might have useful applications for all kinds of industries, says Alexander Linden, an analyst at Gartner Inc.'s Frankfurt office. Financial services companies could use it to simulate capital markets, he says. Pharmaceutical and chemical companies could model the effects of different chemicals on organisms. The aerospace industry could use it to create materials that perform under stress. Airlines could learn to optimally balance cargo for the smoothest possible ride, and so on.

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Recently, several Santa Fe-based companies have brought the software for these simulations into the world of business, where early applications hint at their potential.

Insurance

In the early 1990s, after Hurricane Andrew led to catastrophic losses estimated at \$25 billion in the U.S., property and casualty insurers were forced to rethink their approach to risk management. Some Santa Fe scientists began working with big players in the insurance industry such as Swiss Reinsurance Co. in Zurich and Marsh and McLennan Cos. in New York. "Losses were so staggering that it shook the industry to its core," says Terry Dunn, president of Assuritech Inc., the Santa Fe-based commercial enterprise that grew out of the collaboration.



Credit: Richard Downs

Rather than try to better predict the likelihood of a hurricane, he says, the group looked at the real make-or-break equation: How do an insurance company's business plan, investments and capital flows respond when a hurricane hits? The simulator they developed models the environment within which the company operates in order to determine optimum capital strategies for surviving catastrophic losses.

The simulator features a "playing field" and "agents." The playing field is the natural environment in which catastrophes happen as well as the financial environment of capital flows. The agents are customers, capital markets, primary insurers, reinsurers and regulators. Agents interact through customer choices, contracts, partnerships and regulations. Finally, there are physical and financial wild cards such as hurricanes, earthquakes and recessions.

Assuritech creates a virtual copy of the business and the business universe. The model includes everything known about competitors, customers and the regulatory

environment as well as the company's investment portfolio and operating strategies: markets served, preference for profit or market share, desired investment growth rates and efficiency of capital, adjusted cost of capital, and so on.

When a "universe" of data has been programmed, the simulator, which can run on any high-end laptop, drops in random physical and financial catastrophes and tracks capital flows through the company on a quarterly basis for a virtual 10-year period to see how the organization fares compared with its competitors. The company's strategies can be adjusted to see how changes would affect the outcome.

For example, if the simulation shows that investing in gold futures seems more profitable than investing in stocks, the company can shift its capital to that segment and see how the change affects the bottom line. "The key here is that you get to model your world before you commit your resources," says Dunn.

"The business-as-usual model for an insurer is to project the future based on experience from history," says John Schienle, director of the California Housing Loan Insurance Fund, a Sacramento-based state agency that issues mortgage loans for low- and moderate-income people. The agency has been using the simulator for nearly three years.

"Assurtech's model lets us see what would result from various management actions based on simulated events," says Schienle. The agency can then adjust its strategies accordingly, he explains.

Without the simulator, Schienle says, this would be impossible. "There are so many factors involved in trying to model an industry, it's complex beyond what a human can imagine," he says.

Supply Chain Modeling

At Procter & Gamble Co. (P&G) in Cincinnati, Larry Kellam

AT A GLANCE

Practical Scenarios

- **Insurance:** risk exposure

- **Finance:** capital market behavior

- **Airlines:** aircraft load balancing, passenger management

- **Manufacturing:** supply chain optimization

- **Retail:** consumer buying patterns

- **Aerospace, automotive:** aerodynamics

- **Defense:** scenario planning

has been using complex adaptive system theory for two years in an effort to improve P&G's supply chain dynamics. "We're trying to move to a consumer-driven supply network," says Kellam, director of business-to-business supply chain innovation. "We are all about taking time, cost and cash out of supply chain to add value to the consumer."

As part of this effort, P&G has been working with Santa Fe-based BiosGroup Inc., a consulting and complexity modeling firm, to look at how different approaches might improve its supply chain efficiency.

BiosGroup developed models of P&G's supply chain and then tried new policies and approaches virtually. For instance, what if P&G relaxed its policies that delivery trucks had to be full and that pallets stacking products within the trucks could have only one type of item each? What if orders were checked and redirected at the last minute rather than based on customer projections? What if supermarkets and other customers shared information about planned product promotions that might change their supply needs?

By testing various scenarios, BiosGroup found several hundred million dollars in potential savings, and real-world tests with customers confirmed those findings. "None of these ideas was new," says Stuart Kauffman, president of BiosGroup. "They just couldn't quantify how important they were before."

P&G has embarked on a massive project in partnership with BiosGroup, software developer i2 Technologies Inc. in Dallas, MIT's Auto-ID Center and other organizations to find practical applications for adaptive theory. The initiatives include the following:

- Developing "smart" replenishment software for integration into P&G's enterprise resource planning system.
- Replacing universal product codes with electronic smart tags.
- Overhauling infrastructure to allow real-time demand signals between stores and manufacturing facilities.
- Embedding complex adaptive theory into a distribution resource planning tool to get inventory to where it's really needed regardless of what the purchase orders say.

It's a big job, and Kellam acknowledges that the results might still be five years away. "But if we do it right, we think we can take about half of all of our inventory out of the system, on the order of 20% of our cost and at least half of the time," he says.

Are the possibilities of complexity modeling worth exploring? "Absolutely!" says Gartner's Linden. "There's always an increase in accuracy if you deploy specialists like those companies near Santa Fe."

But the one thing they can't predict, he says, is the effect of complexity modeling on your bottom line. "You need to have the right data and know whether the prediction accuracy is really related to added business value," he explains. "Even if you do increase accuracy, the amount you invest may not justify the return. . . Nobody can tell you, and that may be why the industry is not growing as quickly as some people expected."

Characteristics of Complex Adaptive Systems

If you want to understand complex adaptive systems, think football:

Elements of a simulation	Elements of a football game
<ul style="list-style-type: none"> ▪ Defined space 	<ul style="list-style-type: none"> ▪ Football field
<ul style="list-style-type: none"> ▪ Interacting agents or objects that are intelligent and adaptive (a few dozen to a few hundred thousand) 	<ul style="list-style-type: none"> ▪ Players, coaches and referees interact within a set of rules, and they adapt based on what works
<ul style="list-style-type: none"> ▪ Agents have local information only and know what only some agents are doing 	<ul style="list-style-type: none"> ▪ Players see what others in their field of vision are doing, but not those behind them
<ul style="list-style-type: none"> ▪ Some random events such as a natural disaster or economic recession 	<ul style="list-style-type: none"> ▪ Wild cards such as weather and injuries that can affect the outcome

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