

# The secrets of the system

May 3 2012

---

As the United States seeks to reinvigorate its job market and move past economic recession, MIT News examines manufacturing's role in the country's economic future through this series on work at the Institute around manufacturing.

“Everyone, take your order slips and move the shipment to the left,” says Nelson Repenning, a professor of systems dynamics at the MIT Sloan School of Management. “Factories, brew beer.”

With that, six groups of high-achieving managers from a major multinational firm, ensconced in MIT's Building E62, check some small slips of paper, move piles of red chips along the tables where they are seated, and scribble numbers on some rudimentary accounting forms.

The executives are playing the Beer Game, a business simulation that is an institution at MIT, where management guru Jay Forrester invented it in the 1960s; every entering class in Sloan tries it en masse at the beginning of the academic year. The Beer Game is at once simple to play, difficult to master and full of lessons.

Among other things, the game illustrates the nonlinear nature of industrial and economic changes; the futility of blaming employees for problems beyond their control; and our general tendency to impose preconceived ideas on complex situations. Understood properly, Repenning tells the executives, the Beer Game shows that “operations must be managed as a system, not as a set of isolated activities.”

That seems like a lot to draw from a game played on printed plastic tablecloths with supplies you could find in a drugstore. But the Beer Game has been a durable teaching tool because it hammers home a core element of MIT management thinking: Every aspect of business is a system. A company is a system. A supply chain, which the Beer Game mimics, is a system of smaller businesses. A factory is a system of machines and routines. And when one small part goes awry, a whole system can fail.

“Somewhere in America, in some way, shape or form, a company is essentially playing the Beer Game every day,” says John Carrier, a senior lecturer at MIT Sloan who specializes in improving manufacturing operations. “They just don’t realize it.”

## **‘We’re terrible at this game’**

Each team in the Beer Game consists of people at four stations, representing a beer retailer, a wholesaler, a distributor and a brewery. The game lasts for 50 rounds, each standing for one week. The team starts off with some chips on the table, representing cases of beer. Each round, the retailer draws a number indicating weekly customer demand; players at the other stations write their expected demand on slips. The team circulates the slips and moves chips through the supply chain, but the teammates cannot communicate directly.

The goal is to run the supply chain as efficiently as possible. Each team’s four stations are penalized for an accumulation of inventory (50 cents per case of beer, per week), and for unfilled backorders (\$1 per case of beer, per week). The team with the lowest score over 50 weeks is the winner.

The session Repenning is running now is part of MIT Sloan’s executive education program. The executives are successful businesspeople, but

after several simulated weeks, one team loses its supply-chain equilibrium, and cannot produce enough beer. In 10 consecutive weeks, its wholesaler's unfilled backorders surge, from one to three, then five, then 10, 23, 34, 41, 51, 61 and 70.

“We're out of business,” jokes the executive in the wholesaler's role. From his perspective, he has not been given enough beer by the factory and distributor.

Still, a neighboring team's accumulation of backorders follows a more dramatic pattern of nonlinear growth: from 8 to 20, then 43, 62, 92, 97, 117, 147 and 152.

“We're terrible at this game,” says the executive playing the wholesaler for this second team.

Carrier, watching the game unfold, notes that this is a familiar pattern. “All it takes is one little spike by one person, and that propagates through the whole system,” he says. That applies to many kinds of industries: Forrester created the Beer Game partly based on his observations of the complexities of General Electric's attempts to manufacture refrigerators efficiently.

In the end, these two teams finish behind their peers, with accumulated costs of \$2,665 and \$2,599 (the average total is around \$2,000). Two other teams finish with \$1,417 and \$1,398 in total costs; and two teams do quite well, with totals of \$774 and \$684. The best possible score is \$200.

But even teams that perform relatively well at the Beer Game feel frustrated by it. After the game is over, in a subsequent group discussion, one member of the winning team tells everyone that the game felt “difficult, I was working in a silo, firefighting.” Another member of the

winners reported wondering: “What’s wrong with the rest of the team?”

Indeed, typical reactions to the Beer Game, Repenning tells the whole group, involve finger-pointing at teammates and bemoaning the rule that prevents communication among teammates (which might smooth out the supply chain).

## **Lessons from losing**

And then Repenning delivers the kicker: Not only do most teams struggle at the Beer Game, these analyses of it are wrong, too. “Your experiences with this game can systematically mislead you as to the nature of your problems and teach you exactly the wrong lessons,” Repenning says. “We are all quite prone to creating these stories.”

For one thing, if teams struggle at the Beer Game, it is not because individual members fail to grasp business supply-chain nuances. “CEOs of Fortune 50 companies do no better [at the game] than high school students,” he says. Moreover, teams whose members are allowed to communicate with each other perform no better than other teams.

Instead, as Repenning acknowledges, the Beer Game’s supply chain is poorly designed in one sense: The time lag needed to correct mistakes means it can take weeks for a misjudgment to get flushed out the system. Given that point, what are the real lessons of the Beer Game, according to Repenning? He suggests three ideas to the assembled group.

First, managers should study the workings of the whole system they supervise, rather than assuming employees failed.

“We have a strong tendency toward blaming people for the performance of the system they are in,” Repenning says. In psychology, this is known as the “fundamental attribution error.” In business, the consequence of

this is a tendency to fire people. However, Repenning says, “in any system of moderate complexity or beyond, [firing people] turns out to be a remarkably low-leverage intervention.”

The second lesson, Repenning says, is that “our behavior turns out to be hugely influenced by the context of the system we find ourselves in.” In the Beer Game, almost everyone, from those CEOs to the high school students, gets frustrated by the time lag that accompanies an accumulation of backorders, and starts ordering more and more beer, although doing so only makes the problem worse.

“They make orders as if the last order had disappeared,” Repenning says. “That’s the core reason the game is so unstable.”

This, in turn, leads to Repenning’s third main lesson of the Beer Game: We all use mental models to simplify reality, but those models often fail us. So instead of blaming people first, or rushing to create plausible-sounding but unverified hypotheses about why problems occur in business, managers need some cool detachment about what is really happening.

If they use that approach, Repenning adds, they can create a stronger, more durable company. In this vein, the executive education courses often feature intensive sessions on concepts such as “continuous improvement,” which encourage companies to refine their manufacturing systems on an ongoing basis.

“The role of leadership is to create a system in which any normal person will be successful,” Repenning concludes — drawing a clear lesson from an unexpectedly complex game.

*This story is republished courtesy of MIT News ([web.mit.edu/newsoffice/](http://web.mit.edu/newsoffice/)), a popular site that covers news about MIT*

*research, innovation and teaching.*

Provided by Massachusetts Institute of Technology

Citation: The secrets of the system (2012, May 3) retrieved 26 April 2024 from <https://phys.org/news/2012-05-secrets.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.