VIEWPOINT

When to Simulate

by Kellie T. Wardman and Daniel H. Kim

Systems thinking offers an array of tools—from systems archetypes to computer models—for improving the quality of decision making. Knowing which tool to use for a particular problem or situation, however, can be quite a challenge—especially for the beginner.

Deciding when to use computer models requires special attention, since they can require significant investments of time and money. While computer modeling is often a lengthy and intensive process, it can produce insights and action plans far beyond what is possible with pen-and-paper tools. So how do you know when to simulate? The following set of simple guidelines can help in that decision.

Modeling a Specific Issue

➟ It is important to have a specific problem or issue in mind before you begin modeling. If you are working on a particular issue that has a clear purpose, you will have more success in setting appropriate boundaries for the model and determining the amount of detail you will need. If you try to model your whole organization, you will quickly get bogged down.

➟ If you are not sure exactly where to start, the early steps of model building (identifying the important variables and how they relate) can help you flesh out some of the important issues. Starting with simple diagrams and building from there can also help you determine what to include in the final model.

Example: Attempting to model your entire manufacturing process without a clear sense of purpose can be difficult. Knowing, for example, that you want to assess the impact of hidden manufacturing delays can help you determine whether to include factors like purchasing or suppliers, or whether to chart information on a weekly or minute-by-minute basis.

Understanding Complex Behavior

➟ Humans are very good at understanding and articulating relationships. We can describe, for example, how marketing, production, and sales are related. We are not as adept, however, at simulating how those relationships play out over time. If we increase marketing by 15%, for example, what will happen to sales and production in the next year? Computer models can take such complex, non-linear relationships and show how they play out over time.

➟ Computer models offer vivid illustrations of how the structure of a system creates the behavior we observe. In essence, modeling means developing a structural picture of the problem and then simulating the behavior of the system under those assumptions. A model can also aid in linking past and present behavior by showing how both can be described by the same structure.

➟ Modeling can be very useful if long time delays are a key part of the problem or issue. While tools such as causal loop diagrams cannot adequately quantify the impact of delays in the system, computer models can clearly identify different kinds of delays and show how they affect a system's overall behavior.

Example: In order to investigate the rising cost of insurance claims, one property and casualty insurer built a model of its claims adjusting process. The managers involved in the process surfaced several non-linear connections between time pressure, productivity, and quality—all of which in turn had long-term effects on overall costs. Mapping and simulating these relationships revealed how a short-term focus on cutting costs led to a long-term erosion of quality—and ultimately higher settlement costs.

Formulating and Testing Policies

➟ Computer models can be very effective for developing and testing specific policies. For example, a computer model can allow you to test the results of different hiring, marketing, or inventory management strategies. Testing your ideas and assumptions about critical relationships can help you better assess the results of the policy interventions you make.

➟ Most policies have both short-term and long-term implications. Without some understanding of the long-term ramifications of a specific policy, we tend to favor decisions that will benefit us in the short term. Unfortunately, those short-term actions often undermine long-term sustainability or profitability. Modeling can reveal those trade-offs by making the long-term consequences just as real and present as the short-term ones.

Example: One heavy equipment manufacturer had a policy of adding additional plant capacity only when its backlog grew to six months. By the

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time the new capacity came on line, however, order volume had generally decreased (due to the long shipping delays) and the company was saddled with over-capacity until its order backlog grew again. This would spark another round of capacity additions, and the whole dynamic would repeat itself. When the company's managers built a simulation model, they discovered that their own capacity decisions were in large part responsible for the order swings. Testing different policies suggested that their conservative approach to capacity expansion might actually be putting the company at the greatest risk of losing customers over the long term, and might be unnecessarily constraining their growth.

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Simulation modeling is generally most effective when it is applied to a specific, focused problem. There are, however, particular situations where the lack of specific focus *is* the problem. In such cases, the *process* of modeling itself can help you gain a clearer understanding of a particular problem or issue (see "From Causal Loop Diagrams to Computer Models—Part II," August 1994). Since model building is a highly iterative process, as you cycle through the steps you can come to a greater level of clarity about what the most critical issues are. At that point, you will be in a better place to assess whether or not you should go further in the simulation process.

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SYSTEMS STORIES

A Journey Through Organizational Change

by Chris Strutt

In the 1970s and 1980s, Digital Equipment Corporation was a successful, thriving computer manufacturer, second only to industry giant IBM. The company's networking business, which was solving customer problems with leadership technologies such as Ethernet and DECnet™, was also very profitable. But by the late '80s, the company had become complacent and unfocused, hiring and growing in all directions. In the Networks and Communications group (NaC), signs of trouble were already evident. Small competitors were beginning to carve out niches for themselves with products that were faster, cheaper, and quicker to market. As a result, we began experiencing problems in our ability to deliver products predictably and with the quality customers demanded.

Recognizing this challenge, we began to streamline our product definition, design, and development processes. Our group vice president, Bill Johnson, instituted a formal process to review key projects and programs. While solving project issues did result in improved quality and quicker time-to-market, the data gathered in this phase gave us an indication that we were facing much deeper issues. We began to see that our problems were linked to long-term dynamics such as changing customer demands and the increasing complexity of our business environment, which would require a different approach than we had used in the past.

This was the start of a long journey for our group. Our path took many turns as we met new challenges and discovered new resources along the way, uncovering deeper and deeper levels of obstacles to our business success. The process involved people with varied roles who were willing to work together to try new approaches, learn from their mistakes, and try again. Our story will hopefully offer some guidelines for others in the middle of a similar discovery process (see "The Journey: Going Deeper into Causes").

A Systems Approach

The first phase of our journey was to address the immediate issues of customer satisfaction and quality. Customers were moving away from Digital proprietary computing environments, and were more often demanding multi-vendor "system solutions"—families of products that worked together to solve their business problems. As one key customer said, "We want to choose the best solutions regardless of who makes it. And we want everything to work together just as if it came from a single vendor."

To meet this need, we began experimenting with a systems approach to product design and delivery, which meant paying as much attention to the relationship between products as to the products themselves. This approach caused us to focus in a more disciplined and structured manner on actual market and customer requirements, forcing us to surface our assumptions about trends