
Strategy simulation and scenario planning: an application of generic system structures

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ABSTRACT

Using a generic model framework, a consortium comprised of three manufacturing firms and one service company was able to create realistic representations of their internal and external competitive environments and analyze the consequences of their competitive strategies. The interface designed with the framework has proven to be a useful tool to support decision makers when they present their findings and analyses to their colleagues. Strategy simulations and the resulting scenarios can be useful tools for understanding the interrelationships of different elements within a competitive system and for identifying critical leverage points that may help a firm create a competitive advantage over its competitors.

The Problem

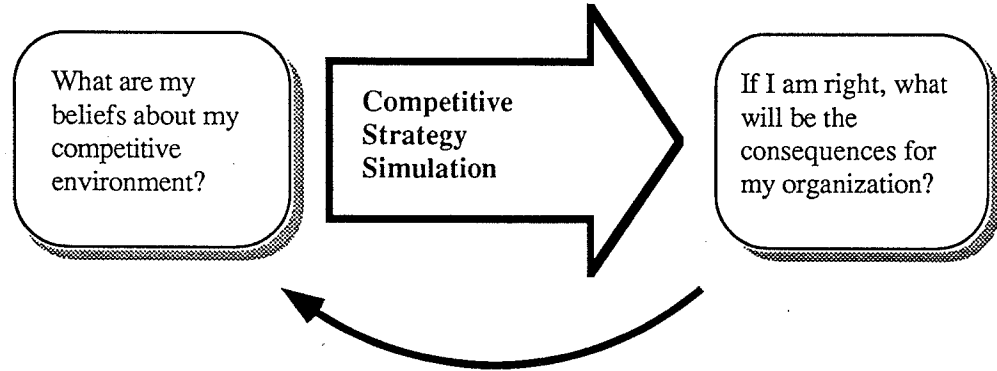
Even when systemic thinking appears to have been successfully accepted by an organization, decision makers may still feel uncomfortable using their new knowledge on real problems, or explaining a systems approach for solving problems to their colleagues. This difficulty exists not only in the field of systems dynamics; research at Johns Hopkins University and M.I.T. has shown that seemingly successful students are often incapable of solving problems that differ only slightly from those they learned in the classroom (Clement, 1982). In one case, physics students, when asked to explain what forces are acting on a coin after it has been tossed into the air, incorrectly replied that there were two forces: gravity and the original force of the hand. In fact, after a coin is tossed, only gravity has an influence on the coin.

These students were relying on a paradigm so strongly molded into their minds that they erroneously regarded their explanations as obvious or common sense. When faced with actual problems, individuals do not usually display a deep understanding of new concepts or knowledge to which they have been recently introduced. Similarly, individuals who have been recently introduced to system dynamics may not be applying it correctly or coherently to their strategic planning challenges.

One potential solution to this problem that has been recognized by other practitioners is to make learning more relevant by making instruction more realistic (Diehl, 1992; Senge and Lannon, 1990). Strategy simulations based on scenarios that represent real challenges faced by managers provide a vehicle that can compel managers to think about their organizations and environments in terms of linkages, interdependencies, and feedback. A competitive strategy simulation can help managers understand their competitive environment by allowing them realize the implications of their current assumptions (figure 1).



Figure 1. Diagram of Competitive Strategy Simulation



Another constraint faced by strategic planners is time. Traditionally, models that represent a decision maker's environment closely enough to be useful for learning can take months, even years, to build. Many managers and strategic planners are unable or unwilling to allocate the time and resources necessary for such an elaborate project. Also, managers interested in improving their systemic thinking skills typically have a particular issue in mind that requires resolution sooner than the time required to construct a model from scratch would allow.

To enable decision makers to gain the benefits of simulation-based scenario planning tools without having to invest considerable time and resources, we have been working with Gould-Kreutzer Associates, Inc. and MicroWorlds, Inc. to develop a generic framework to analyze competitive dynamics. This framework is designed to provide a way to examine strategic challenges, develop scenarios, and understand the consequences of competitors' strategies on managers' own organizations. Our generic competitive dynamics framework has four functions:

- Capture managers' beliefs and ideas about their competitive environment,
- Analyze the implications of managers' competitive strategies,
- Help managers apply System Dynamics concepts and learning to their own organizations,
- Define the managers' organizations' strengths and weaknesses.

The Research Consortium

To test the effectiveness of our generic modeling framework, we created and facilitated a consortium of four companies with different organizational and environmental structures. The consortium companies varied widely in their product and industry focus: one consortium company produced sophisticated testing equipment, one provided overnight package delivery service, one was a leading producer of

components for industrial machinery, and one produced and sold photocopiers. The consortium's overall mission was to encourage the member companies to work together to discover what strategies might make each successful in its market. To accomplish this, members identified, then analyzed the implications of, alternative competitive strategies, while searching for those factors that had the most influence on company's sales and market share.

Each member created a simulation using the generic framework that we developed. These simulations were used to analyze the consequences of different competitive strategies and to better understand competitors' strengths and weaknesses. Consortium members used their strategy simulations to discover what kinds of interactions and linkages were occurring in their industries and to find ways to take control of those interactions and use them to benefit their organizations. As a final step, members used their conceptual models and strategy simulations in presentations and internal workshops to explain their conclusions and to convince others in their organization of the efficacy of their analyses.


From our experiences with the consortium, we developed a simple procedure for creating scenarios of competitive dynamics (figure 2). Starting with our generic framework, consortium members were to create a rough outline of present conditions. These initial attempts usually resulted in broad representations with roughly accurate market share, sales, and costs. At this point, the consortium members would decide which sectors of the model were relevant to their particular industries. For example, some consortium members decided that after-market sales were nonexistent or trivial and chose to leave that sector of the generic framework turned off.


After developing this rough sketch, the consortium member then presented the model to internal industry experts to evaluate initial assumptions and fill in missing information. At this stage, we found that the initial model assumptions and the mental models of the industry experts were sometimes at odds. These initial model tuning sessions were useful in drawing out inconsistencies in the experts' intuitions of competitive dynamics and assumptions about their own and their competitors' companies.

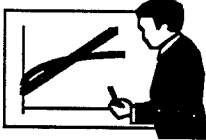
The consortium members then began to experiment with the model. They searched for the most important feedback loops in their models and tried to discover critical leverage points. Because the members understood that the strategy simulations they had created were based on feedback, they attempted to understand what kinds of relationships existed in their real environment and how decisions they made in the present could have an impact on the future. Decision changes and alternative initial assumptions were saved as different scenarios. The consortium members then used these scenarios as tools to help them convince their colleagues where the critical leverage points in their own organizations might be. After these workshops and presentations, the members would leave with a set of new questions and insights and begin another scenario iteration.



Figure 2. Steps Taken to Create a Strategy Simulation Scenario

1. Consortium members created a rough sketch of their competitors using available data. 

2.  Members then asked experts within their organizations to fill in missing information and review their assumptions.

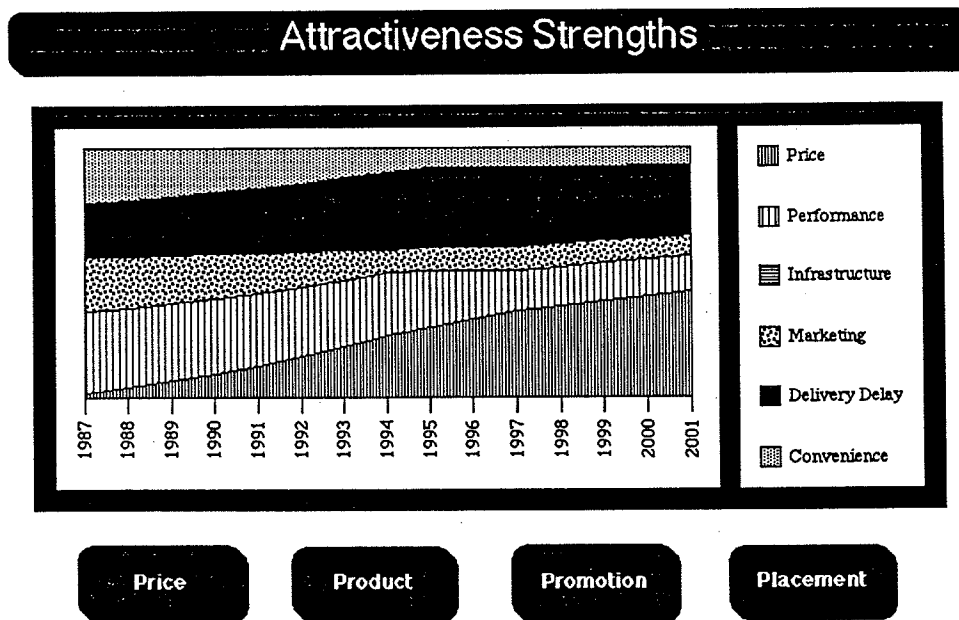
3. Finally, members simulated and tested the generic model, modified with their assumptions, and looked for relationships among different parts of their organizations and environments. 

Research Findings

We found that it was very important to provide an interface for the generic framework that used terms and examples familiar to managers and strategic planners. Most of the consortium members had some familiarity with system dynamics methodologies and some had considerable experience. However, their frame of reference for thinking about competitive strategy was largely based on frameworks of the type described in *Competitive Strategy* (Porter, 1980). In order to provide them with a starting point for thinking about the generic structures and to help them communicate their results to their colleagues, wherever possible we mapped system dynamics terminology into traditional competitive strategy frameworks.

An example of such a mapping appears below (figure 3). We mapped the words that described various sectors of the model (e.g., price, performance, infrastructure, etc.) into the four P's (i.e., Price, Product, Promotion, and Placement). Model users could examine and alter model assumptions by clicking on one of the four P buttons at the bottom of the graph *or* by choosing one of the words to the right of the graph. The four P's terminology was more familiar to the consortium members and their colleagues.

Figure 3. Interface Screen from Competitive Strategy Framework



Another insight we gained from the consortium was the importance of emphasizing that the generic competitive framework and the models that the members created were strategy tools, not forecasting tools. Because the simulations were simplifications of reality and because, in their real environments, many things could happen over which the members and their organizations had very little control, the strategy scenarios could not be crystal balls telling them what the future had in store. We explained that the simulations could however, tell them something about their organization's relative strengths and weaknesses or if, *ceteris parabus*, a particular strategy was better than an alternative strategy. To elaborate on this point, we presented several real and theoretical case examples using the competitive analysis framework as our evaluation tool.

There was some evidence from the consortium members that prior training in system dynamics concepts (e.g., causal loop diagramming, a grasp of behavior modes illicited from different simple generic structures) helped them better to grasp the usefulness and purpose of the strategy simulations they were creating, and communicate that purpose to their colleagues. Without prior experience in system dynamics concepts, the model user was uncertain how to explain the output generated by the strategy simulation the user created. With some prior experience in system dynamics concepts, the model user would immediately begin searching for the model structure and general principle that created the behavior generated by the simulation.

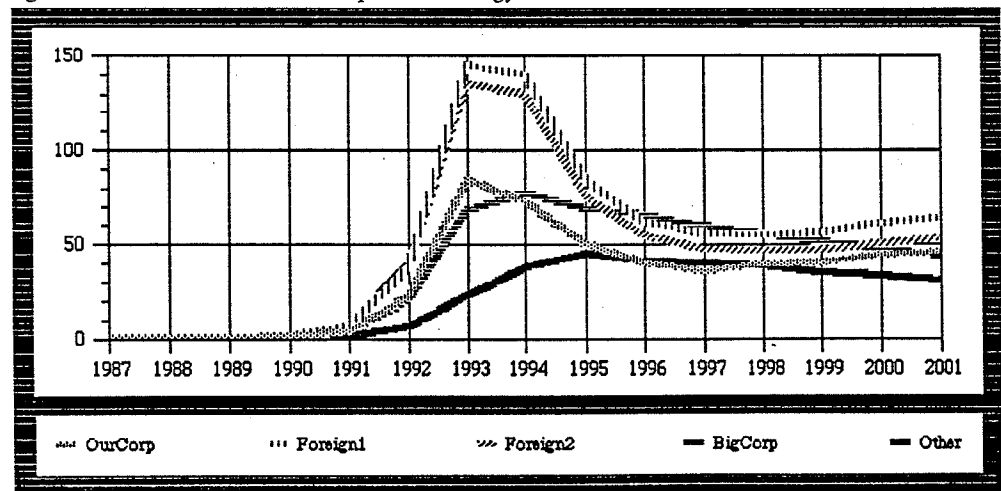
An Example

An analysis created by a consortium member who wanted to understand the impact of learning curves on his organization illustrates how the competitive dynamics framework, models, and resulting scenario simulations were used. This consortium member was a strategic planner for a large manufacturer of components for industrial equipment. The company was formulating its competitive strategy for an innovative product it was preparing to introduce. Similar products were being introduced by some of the company's competitors. In the past, foreign competitors had often succeeded in gaining substantial market share. The consortium member was looking for a way to leverage the firm's capabilities and develop a strategy to maintain market share throughout the product lifecycle.

To create the model, the consortium member gathered all available relevant information and created competitive profiles of the company and its four largest competitors. We then showed these competitive profiles to a divisional manager who critiqued them and filled in gaps in our information. Preliminary simulations revealed that there were inconsistencies in some of the data. We did further research and discovered that some of our assumptions were incorrect. Finally, with our revised assumptions, we created an initial scenario describing our assumed competitive environment.

Management believed that the needs of consumers changed over the product lifecycle. Product performance was very important at first, but as the product matured and competitive offerings became harder to differentiate, price became a more important factor. Historical information indicated the size of the potential market. Customers would convert from older technologies to this new technology depending on the size of the installed base. After the conversion to the new technology was complete, sales would depend entirely on replacement equipment. Initial strategy simulations indicated the rate of diffusion of the technology through the market place and its impact on sales (figure 4).

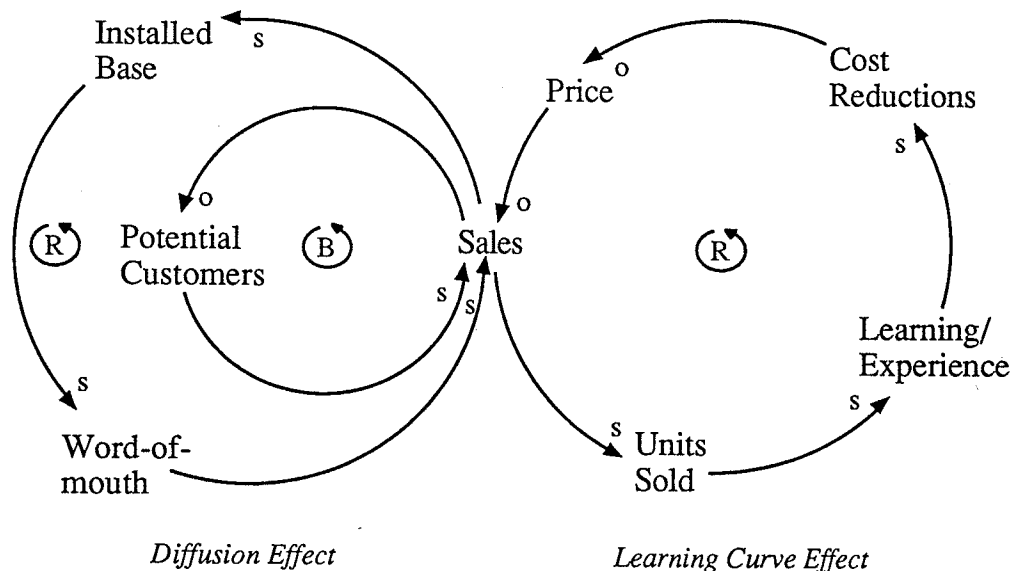
Figure 4. Sales Behavior from Competitive Strategy Simulation



As more units were produced and sold, manufacturers would work their way down the learning curve. Competitive pressures combined with cost reductions caused by the learning curve effect would result in price reductions. Because product performance was an important purchasing criterion at first, some price differentiation was possible, but as the product matured, prices tended to become very similar.

Our simulation indicated that our competitors' strategy of pricing slightly lower than the rest of the competition allowed them to gain higher market share. Lower prices encouraged customers to buy more product, which moved the competitor down the learning curve. Once an advantage in market share was gained, costs could continue to drop based on the high volume. After the growth period of the product lifecycle was over, the competitor would have a nearly impenetrable competitive advantage because other companies could no longer achieve the volume necessary to move as far down the learning curve (figure 5). The model also revealed a tendency of the industry to maintain too little capacity during the growth phase and too much capacity immediately following the growth phase.

Figure 5. Causal Loop Diagram of Diffusion and Learning Curve Interaction



The combination of rapidly reducing prices while increasing capacity during the growth phase and cutting back on capacity expansion at the peak of the growth phase could create a significant competitive advantage throughout the rest of the product lifecycle.



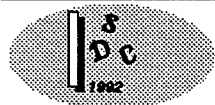
Conclusion

The application of a generic competitive framework as an aid to model building can help decision makers apply system dynamics concepts to their own organizations by creating realistic representations of their internal and external environments in less time than has traditionally been required to create a customized model. The strategy simulations and scenarios developed by the decision makers can be used to analyze the implications of alternative competitive strategies and to uncover inconsistencies in their assumptions and intuitions about the structure of their environments. These decision makers can then use this generic framework as a tool to communicate effectively their analyses to their colleagues.

When customizing generic structures to particular industry problems, system dynamics practitioners must beware of some pitfalls that may exist. To make model insights accessible, practitioners must understand and use the language of the intended audience. The model user must also be careful to remember that the resulting output is not a prediction of what *will* occur but rather, a tool for learning about and understanding the impact of policy decisions on an organization and its environment.

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