The model as a lens: combining modeling and data support systems to aid in executive decision-making

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ABSTRACT

System dynamics models and executive information systems have complementary strengths in aiding decision making. Information systems have vast data retrieval and presentation capabilities. Models provide a dynamic framework for exploring the long-term, systemic implications of decisions and policies. This paper reports on an attempt to combine the two approaches—using the model as a lens to structure and view data sets. This paper briefly describes the lens-based executive information system method and explores four tangible benefits of this integrated approach to decision-making.

Introduction

As decision-making aids, both system dynamics models and executive information systems have limitations that the other approach can help overcome. While models are useful for exploring tacit assumptions and for making mental models explicit, they lack advanced data manipulation and retrieval capabilities of information systems. Executive information systems, on the other hand, provide efficient ways to access data, but they fall short in helping the decision-makers reexamine their thinking or reframe the problem in a new way. An aphorist might say they help managers come to the *same* decisions, only faster.

I believe that it is possible to combine the two approaches and exploit their individual benefits. I propose to use models as a lens through which managers can look at the data in a way that supports better decision-making. Experience with early implementations of this approach seems to point out four common benefits of the lens-based system for improving decision-making:

- Questions become focused around core variables and leverage points
- Attention shifts towards seeing longer trends in dynamics over time
- Appreciation of the importance of interconnectivity increases
- Strategic assumptions are made explicit and get tested

Questions become focused around core variables and leverage points

Perhaps the most obvious benefit of a lens-based information system is that it makes data more readily accessible to the manager (as do all information systems). This improves the decision-making process simply by shortening the necessary lead time for getting information. Before, if the manager wanted to know what the capacity was of Competitor X in the Far East, she would ask her data analyst, who would usually take a week to come back with an answer. By that time, the manager might have forgotten why she asked the question in the first place. Worse, if the answer was surprising or unexpected, she might spend half of the next meeting arguing over the validity of the information. The information system component allows managers to shorten the information retrieval process and it provides a consistent, reliable source for data.

As the manager uses the system over time, the kinds of questions she asks the analyst begin to be influenced by the format of the model. The structure of the model—which variables are included or excluded—subtly affects the nature of what the manager considers when making a decision. For example, if it is easy to get information on capacity and inventory (since this variables happen to be included in the model) questions that concern competitor Y's capacity in Europe or a company's inventory of product Z tend to increase.

Attention shifts towards seeing longer trends in dynamics over time

Typically, not only the questions change, but also the format in which the answer is expected. All of the data in the model-based system is easily displayed in time series format. If the manager asks his analyst to give him the sales data of competitor X, the analyst will typically come back with data from the last several years. The data report standard in the organization changes. Before the introduction of the system, it might have been acceptable to present only the sales data of the last quarter and the last year. The change in the report standard changes the expectation of the manager, helping him develop a long-term viewpoint.

Appreciation of the importance of interconnectivity increases

As the manager becomes more familiar/experienced with the system, the use of the system tends to expand. In addition to analyzing past behavior, the system is used to understand future problems and opportunities. More attention is given to the connections between variables. If the manager asks the analyst for projections, for example, and the analyst comes back with projected sales forecasts, a natural question would be whether or not projected capacity will be enough to support the sales. Again, expectations change. Typically, it is no longer acceptable to compute straight linear extrapolations, but the analyst must be prepared to back up projections with feasibility tests and must be able to demonstrate that interdependencies have been taken into account.

Strategic assumptions are made explicit and get tested

Perhaps the most critical function of lens-based information systems is their role as a practice field for testing assumptions. The role of practice fields in management training has been widely reported on (Bergin 1990, Diehl 1992a, Senge 1990). I believe that practice fields are not only relevant to training but also to data analysis and managerial problem solving. The need for managers to surface and test underlying assumptions has been well documented (Rockhart 1988, Mason 1981, Morecroft 1988, Wack 1985a, Wack 1985b). As Henderson (1984) argue:

> The management of assumptions...can not be delegated. The assumption set is the domain of executive management and the responsibility for ensuring the validity of assumptions rests clearly with executive management.
> We suggest that a major implicit reason for existing ESS [Executive Support Systems] is to support executives in the analysis of critical assumptions.

Because of the real-time usability of the system, managers and analysts can explore assumptions on the spot, as they are discussing the results. Very often the process of exploring assumptions seems to begin with what system dynamics practitioner's might call partial model tests and extreme condition tests. Users typically have a need to perform first-hand plausibility tests of the model. For example, if a manager has a lot of experience with a particular market in the Far East, he might ask: "What target shipments does the model predict for our competitors in the Far East market?" Similarly, the manager might ask, "What if competitor X dropped out of the picture? What would the model say?" Again, the manager may have an intuitive feeling for what the result should be, and the model needs to come reasonably close in order for him to accept the model's outcomes. The model needs to pass all of these plausibility tests. It seems that the manager does not need to have created the model himself to believe in it, but he can develop an intellectual ownership of the model through this process.

To truly support the testing of assumptions, the system needs to be open enough to allow in-depth exploration of the model, without requiring extensive technical expertise. The technology we have been using, S**4: the Strategy Support Simulation System (Diehl 1992b) has a unique feature which supports such inquiries—the lens. S**4's lens feature is a confidence-building tool that allows the manager to probe deeper into any variable in a report that he feels uneasy about. The underlying assumptions are there for him to explore in a way that's not intellectually overpowering—one equation at a time. In this way, the lens allows him to interact directly with the model.

Conclusion

Although the lens-based executive support system has shown initial success in facilitating/improving the decision-making process, there are still some difficulties. While the model does provide a dynamic "lens" for viewing information in a more systemic fashion, that lens is not yet flexible enough to be changed to accommodate varying conditions (such as a new competitor entrant into the market) without substantial technical modeling expertise to change the underlying equations. Current

work toward creating model sectors which can be "plugged into" existing models go a long way toward creating a system of model lenses. What we ultimately envision is an adjustable lens system consisting of many stand-alone model sectors that executives can layer on top of their database to explore any strategic area of their business for real-time decision-making.

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