Meeting the Challenges of Strategic Thinking in Agribusiness:
The Potential with System Dynamics

Introduction

This document briefly describes some of the ways that AEC is applying the discipline of system dynamics (SD) to help organizations in the agricultural sector. System dynamics provides a very powerful way to help organizations analyze complex problems by allowing them to make intelligent strategic decisions. It involves facilitation of interaction among participants across the organization(s) and formal simulation modeling to help people understand structural and dynamic complexity. This is especially important in an industry such as agriculture that is undergoing dramatic structural changes at every level.

Application

We are using system dynamics to aid decision-makers in evaluating complex, strategic decisions. Here complex decisions are characterized by attributes such as:

- Causal ambiguity— Much may be known about how inputs correlate with outputs (whether it's sales person effort and customer purchases or agronomic inputs and yield), but precise relationships are not known.
- Time lags— The effects of decisions are spread over time both in terms of the implementation of the decision and the resulting outcomes.
- Feedback effects— Elements of the system respond, often in complex ways, to the implementation of the manager's decisions.
- Stochastic processes— Outcomes are affected by events (such as the weather in crop production) that managers don't control.

Benefits from Use of System Dynamics

AEC is employing system dynamic modeling in a number of settings, both in research and to aid business organizations. System dynamics is particularly helpful in business settings where significant behavioral changes are required, group dynamics exist, and adversarial relationships have been the historic norm. Our experience to date shows that in group decision settings, system dynamics can:

- identify and evaluate gaps in organizational knowledge,
- make complex interrelations explicit,
- determine the business and economic effect of time lags,
- develop common perspectives of the systems being managed, and
- build organizational intelligence.

Components

System dynamics consists of:

- Communication and discovery methods to clearly define the system of interest
- Visual communication tools to make individual viewpoints and perceptions explicit
- Computerized simulation models to test theories and to simulate alternative futures

Case Studies

System dynamics can be applied at different levels depending on the problem at hand. For example, at one level system dynamics can be used to build an understanding of how plants or animals respond to different management and environmental influences. While at another level, it can help discover the impediments to cooperation among participants of a value chain. A few examples are described below.

Enhancing Coordinated Value Chains

There is a need for a greater understanding of vertical and horizontal relationships in the agribusiness industry. Indeed, technological innovations and communication technologies are changing the nature of market relationships in the sector. To remain economically viable, firms across the value chain need to gain intelligence about the intricacies of participating in closely linked vertical business channels. Companies with these needs often include input manufacturing and distribution, production all the way to processing and other end-users in the value chain.

To address this need, AEC has developed an SD Value Chain Analysis (VCA) process. The VCA process is typically tailored to address the specific needs of an organization or of a group of organizations. The approach includes the use of facilitation and system thinking tools with the organization's planning or development team to help understand conceptually the dynamics of specific input manufacturing, production, merchandising, and processing activities. This process is documented and serves as a source of knowledge for developing the SD model structure. Next comes the development of the simulation model itself. After completion, the model is utilized to facilitate and support a broad range of management decisions. The VCA process can be used to evaluate investments and support other management decisions about alternative marketing channels, alliance formation, quality management, product time-to-market, etc.

Livestock Performance Dynamics

Livestock production systems provide an excellent example of a complex system. Drivers, or inputs, to the system (genetics, feed, environment, management, etc.) interact with each other within the constraints of a biological structure (breeding cycles, feed conversion, disease resistance, etc.) to yield output in the form of animals ready for the market. Further, there are often time lags before the impact of changing drivers is exhibited. For example, a management decision to cut costs by eliminating a vaccination will likely appear to be good in the short term, but may lead to declines in herd health in the future.

AEC has applied system dynamics to examine the livestock sector at two levels. First at the production level, modeling the dynamics of animal growth and the impact of changes in input drivers. Using system dynamics at this level has tremendous potential for helping managers of integrated livestock systems to build a better understanding of the system interactions.

At another level, a system dynamics model was constructed to evaluate the impact of enhanced information sharing across an entire livestock value chain (from producer to retailer). Using system dynamics at this level can be an effective way to examine the impact of policy changes or to better understand how alliances can improve efficiency and quality.

Building Strategic Culture

Firms providing products and services to production agriculture are facing important strategic decisions that will determine their success in the future. The notion that "the only sustainable competitive advantage is to learn faster than your competition" appears to be the only viable approach to remaining competitive in a world where the rules are changing daily. *Organizational learning* is a term used to describe the ability of an organization to create knowledge from within. Organizational learning is often constrained by inadequate internal communication systems and lack of a common strategic culture.

AEC has developed an extensive system dynamics model to help a large mid-western agribusiness to create a common strategic culture. One of the key challenges in this case was the broad geographic dispersion of "branches", which led to a variety of different strategic challenges. The model served as a common point of reference for management teams from across the organization to test assumptions and create dialogue based on the explicit structure of the model.