Chapter LIV
Complexity-Based Modelling Approaches for Commercial Applications

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ABSTRACT

Understanding complex socio-economic systems is a key problem for commercial organizations. In this chapter we discuss the use of agent-based modelling to produce decision support tools to enhance this understanding. We consider the important aspects of the model creation process which include the facilitation of dialogue necessary to extract knowledge, the building of understanding, and the identification of model limitations. It is these aspects that are crucial in the establishment of trust in a model. We use the example of modelling opinion diffusion within a customer population and its effect on product adoption to illustrate how the agent-based modelling technique can be an ideal tool to create models of complex socioeconomic systems. We consider the advantages compared to alternative, more conventional approaches available to analysts and management decision makers.

WHAT IS THE PURPOSE OF A MODEL?

"The best material model of a cat is another, or preferably the same, cat" (Norbert Wiener, Philosophy of Science, 1945).

Models in business are tools used to gain insight and understanding of a real system relevant to the business, and aid appropriate decision making.

Most often, businesses must understand complex socio-economic systems such as the economic environment in which they operate, the social and organisational systems that make up their operations, and the customers they serve. It is unusual for any model to be totally predictive, and obviously the definition of complete prediction is itself subjective. Socio-economic systems present additional problems. There are often problems in defining a model;

also measuring quantities in the real system, which correspond to input and output parameters in the model, can be very difficult. Additionally these systems are often non-linear, dynamic, and subject to stochastic influences.

An element of prediction is clearly important, however what is paramount is that the model should give useful understanding.

WHAT IT MEANS TO BE USEFUL?

All modelling techniques necessarily involve some degree of abstraction. There are simplifications of the processes described by the model, as well as simplifications due to the necessary drawing of boundaries in the modelling space. There may be limitations in the language used to describe the processes in the model, or restrictions on thinking due to the blinkered adherence to specific intellectual norms. There may be limits on the knowledge of the problem due to finite human cognitive ability or lack of accurate data on the system under study.

These sorts of limitations are common to all forms of representation of ideas or concepts, whether the ideas are in art, literature, or science. To be useful, these representations must effectively persuade and communicate the ideas to others. In modelling there can be an additional dimension to the representation process. The process of the creation of the representation can and should involve the user of the model. An effective model is a tool that facilitates dialogue and the generation of understanding in the minds of the users of the model. The construction of the model should lay down the knowledge of the system held by the user, and act as a tool to explore the extent and precision of that understanding. It is a process of converting tacit internal mental models to overt models that can be challenged and discussed. The modelling process should also reveal the assumptions that are made and any of the limitations outlined above.

THE USE OF COMPLEXITY APPROACHES IN MODELLING

Socio-economic systems are inherently complex. They are characterised by interactions. The form and outcome of these interactions can vary in quantity and sophistication. There are a number of different analytical techniques that could be applied to understand these sorts of systems. Where there are small numbers of participants, game theory can provide useful insights. This technique can represent decision processes that range in sophistication from the simple to the arbitrarily complex. At the other extreme, statistical physics approaches can provide understanding where there are large numbers of interactions, but with low levels of sophistication in the description of the decision process. These two extremes are limited in their application; they can be considered non-complex in the sense that they represent equilibrium solutions and there is little modification of behaviours by the participants. Most socio-economic systems display more complex

Figure 1. Illustration of the types of problems that can be addressed by different analytical techniques