

## Chapter 2.12

# Empirical Inference of Numerical Information into Causal Strategy Models by Means of Artificial Intelligence

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### **ABSTRACT**

The motivation for this chapter is the observation that many companies build their strategy upon poorly validated hypotheses about cause and effect of certain business variables. However, the soundness of these cause-and-effect-relations as well as the knowledge of the approximate shape of the functional dependencies underlying these associations turns out to be the biggest issue for the quality of the results of decision supporting procedures. Since it is sufficiently clear that mere correlation of time series is not suitable to prove the causality of two business concepts, there seems to

be a rather dogmatic perception of the inadmissibility of empirical validation mechanisms for causal models within the field of strategic management as well as management science. However, one can find proven causality techniques in other sciences like econometrics, mechanics, neuroscience, or philosophy. Therefore this chapter presents an approach which applies a combination of well-established statistical causal proofing methods to strategy models in order to validate them. These validated causal strategy models are then used as the basis for approximating the functional form of causal dependencies by the means of Artificial Neural Networks. This in turn can be employed to build an approximate simulation or forecasting model of the strategic system.

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## **INTRODUCTION**

Planning and implementing corporate strategy very often requires substantial efforts in gathering relevant data and information underlying the decisions to be met. Hence, the decision makers face at least two elementary issues: First, the planner has to be supplied with appropriate data about the underlying relevant key figures and business drivers as well as environmental information related to the market or competitors. This first function of data support as outlined before is the main focus of so-called management information systems (MIS). These tools usually employ powerful techniques to gather the necessary figures as a basis for strategic planning efforts.

Second, this raw data has to be arranged within decision models in order to reduce the variety and complexity coming with it: One characteristic of a complex strategic decision is that it is influenced by an immense set of business variables which have to be analyzed in this context. As a consequence data supporting tools do not provide appropriate aids for this type of entrepreneurial function: It is to reduce the complexity emerging from this amount of data which becomes the principal task of decision support systems (DSS). Hence it can be observed that the architecture of any arbitrary DSS is highly dependent of the managerial approach it is designed to support. It necessarily incorporates the notion of a mental model underlying the respective decision theory as well as techniques to derive decisions from these assumptions. Sprague & Carlson (1982) specify these two core components of a DSS as model base and method base, respectively. The former defines the structure of the decision model which arranges the raw data provided by a data support component, whereas the latter encompasses decision theoretic methods specifically designed to operate on the given decision model. According to the type of the model base, analytic techniques like optimization as well as statistical methods or stochastic approaches like simulation are used to

draw decisions from the raw data organized in the decision model.

The rest of the chapter is organized as follows: The following section provides review of the appropriate literature within the field of causal strategy planning techniques as well as of causality concepts. Consequently, specific causality criteria are defined on this basis. This definition is employed in the subsequent section in order to establish an approach for the automated proof of nomothetic cause-and-effect hypotheses. Since every single of these proven causal relations are characterized by an arbitrary unknown cause-and-effect function, this function has to be approximated in order to build a quantitative model base for DSSs. Therefore this chapter discusses appropriate approximation techniques and proposes a nonparametric approach for the universal approximation of arbitrary cause-and-effect functions by the means of ANNs. This chapter is concluded by the presentation of experimental results.

## **LITERATURE REVIEW**

### **Causal Strategy Planning Approaches**

A considerable number of recent approaches within the domain of strategic decision making proposes to organize business indicators in the form of causal models. The main task of these models is to visualize the cause-and-effect relations which the decision maker assumes to exist between the given variables and/or goals (Hillbrand & Karagiannis, 2002a).

One well-known example for this type of strategic decision methodologies is the Balanced Scorecard approach (Kaplan & Norton, 1992): The main idea behind this concept is that short term goals of financial nature like the improvement of profitability measures are usually influenced by long term objectives of non-financial type.

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