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Diagrammatic Decision-Support Modeling Tools in the Context of Supply Chain Management

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INTRODUCTION

Recent research (Keller & Teufel, 1998; Klaus, Rosemann, & Gable, 2000; Powell, Schwaninger, & Trimble, 2001) has clearly demonstrated that years of increasing competition combined with the ongoing demand to improve the bottom line significantly reduced the business capacity to achieve greater efficiency (profitability) and effectiveness (market share) solely along organisational functional lines. To complement the functional paradigm of business development, a *business process paradigm* has evolved allowing a holistic view of the business as an entity focused on specific outcomes achieved through a sequence of tasks (Keller & Teufel; Klaus et al.). Existing common understanding of the concept of *business process* being "a continuous series of enterprise tasks, undertaken for the purpose of creating output" (Scheer, 1999) laid the foundation for several successful attempts by major *business process* modeling and ERP (enterprise resource planning) vendors, such as ARIS (Davis, 2001; Scheer, 1999, 2000) and SAP (Keller & Teufel), to link *business process* modeling and enterprise resource planning.

Diagrams used for process modeling are generally purely descriptive, reflecting their origins in information systems design and software engineering (Forrester, 1968; Hirschheim & Heinz, 1989; Howard & Matheson, 1989; Snowdown, 2001). While they provide a holistic view of *business processes*, they are not effective in modeling *decision* objectives, alternatives, and pathways. *Decision* modeling diagrams, on the other hand, originate from operational research and therefore are very effective in modeling *decision* components.

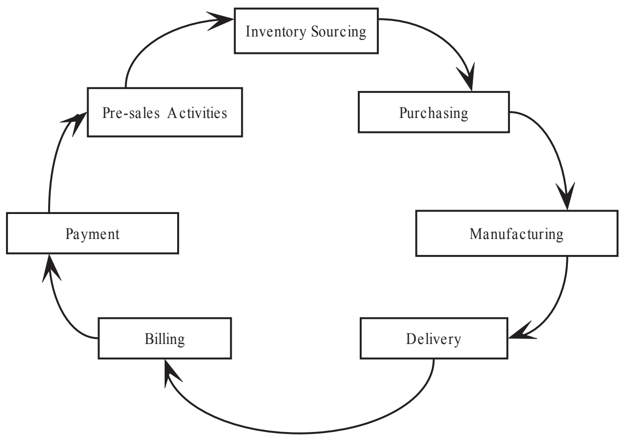
The objective of this article is to present a systematic and coherent view of business *decision* modeling diagrammatic tools. The discussion is structured around the process that can be regarded as the core of a business enterprise: the customer order management cycle (COM). Therefore, a simplified COM scenario as well as a generic *decision*-making model is introduced. A systematic and coherent view of *decision* modeling diagrammatic tools is presented.

BACKGROUND: A CUSTOMER ORDER MANAGEMENT SCENARIO MODELING AND DECISION-MAKING CONTEXT

Customer order management is one of the key components of *supply chain* management activities that, in turn, form an essential part of both modern management theory and practice (Ganeshan & Harrison, 1995/2001; Klaus et al., 2000; Scheer, 1999, 2000; Shapiro, 2001). A *supply chain* is commonly defined as a "network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers" (Ganeshan & Harrison). *Supply chain*s exist in manufacturing and service industries, they can vary in complexity significantly, and they often provide the basis for various e-business industry solutions (Ganeshan & Harrison; Klaus et al.; Scheer, 1999, 2000; Shapiro).

Throughout this article, a simplified customer order management scenario based on Scheer's (1999) customer order processing example is used to illustrate key modeling concepts. The scenario is set within a generic manufacturing business enterprise; however, it could be easily modified for the settings of the service industry. Diagrammatic representation of this scenario can be found in Figure 1.

Figure 1. Customer order management scenario diagram



In other words, a simplified customer order management scenario can be described as follows. A manufacturing business enterprise has performed some presales and marketing activities and has identified a new product for sale. Before the product is produced, the materials required to manufacture the product are ordered from the supplier and stored in the business inventory. For illustration purposes, it is assumed that materials can be purchased in small, medium, or large quantity. Similarly, the demand for the final product can be small, medium, or large. The production process does not commence until a firm order from the customer is received. Then, the manufacturing process is planned, the identified goods are manufactured, and picking, packing, and shipping activities are performed. In this scenario, it is assumed that once the goods are produced they are immediately shipped to the customer (i.e., only materials inventory is kept). Once goods are issued, the customer accepts the product and makes a payment.

It is assumed that the business has one strategic objective: to maximize the profit from the sale of the product. The profit is determined as the sales revenue less production costs, which include fixed costs of the components inventory and variable costs of the materials purchased from the supplier, shipment costs, and goodwill or penalty costs resulting from delays in customer order or product shortages.

Note that the degree to which the stated strategic objective can be achieved depends very much on two basic components: solid and reliable *business processes* and rational business *decisions* made within the enterprise. The rest of this section is dedicated to the description of a generic rational *decision*-making model in the context of a customer order management scenario discussed above. This model is used extensively in the discussion throughout the article.

As far as the *decision*-making activities are concerned, there exists a general consensus (Clemen & Reilly, 2001; Winston, 1994) that a *decision* typically involves a choice from possible actions or alternatives to satisfy one or several given objectives. An example of a relatively simple *decision* in the context of a customer order management scenario is the choice between a small, medium, or large quantity of materials to be purchased to maximize the profit (excluding manufacturing and shipment costs) from the production of goods.

The small, medium, and large quantities define three possible actions or alternatives available to the *decision* maker. Generally speaking, a set of possible actions or choices defines the *decision* variable space. To construct a *decision* model, *decision* variables should be selected to adequately quantify a set of possible actions. The *decision* variables could be discrete or continuous, and could take on positive, negative, or integer values depending on a specific *decision* situation.

The *decision* variable space is usually defined using a set of functional constraints on the *decision* variables. In the above example, the constraints limit the set of choices to four possible quantities: no order, or small, medium, or large order. In other *decision* situations, constraint functions could be quite complex including linear, nonlinear, and probabilistic functions.

Depending on the *decision* situation, there may be one or more states of the world describing circumstances that affect the consequences of the *decision* and are completely outside of the *decision* maker's control. In the customer order management scenario, the states of the world describe possible levels of demand for the product. Each level of demand can have a known or unknown probability associated with it and can be either static or dynamic. Some *decision*-making situations, such as a blending problem, require the *decision* maker to choose an optimal blend of materials to achieve a prespecified quality and quantity of the final product; they are fully deterministic and therefore do not explicitly specify the state of the world. In a *decision* model, states of the world are usually described by a set of environment variables.