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A simulation-based decision support system for business process planning

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Abstract

Over the last few years, there has been wide discussion in the field of economics research with regard to the process-oriented approach. Extensive restructuring took place in practice. To improve business processes, a generally applicable, object-oriented, simulation-based decision support system abbreviated as GEPSIS has been developed. It is used to model business processes and to evaluate different process alternatives quantitatively. The aim is to determine the optimal process. Within a business process context, tasks, work flows and decisions are influenced by persons whose behavior is not deterministic. Such a behavior cannot be described adequately taking crisp approaches. For this reason, consideration of uncertainty and vagueness is of special importance. Both stochastic and linguistic types of uncertainty are considered. The vagueness of verbal formulations is modeled using linguistic variables. Several specific procedures are developed for process control. They result from specific priority rules for the object classes. Furthermore, a knowledge-based procedure comprising approximate inference is developed. In this way, rules for the sequencing of workflow objects can be modeled approximating reality. The suitability of GEPSIS and the effects of the application of different procedures to process control are demonstrated. This is achieved by considering a mail order book and record store and analyzing its actual business – e.g. the order process. The example covers some typical flow structures which can be found in many order processing situations. © 2002 Elsevier Science B.V. All rights reserved.

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1. Simulation to support business process planning

Numerous methods to support the planning of business processes have been suggested, methods frequently based on a special technique for modeling procedure and graphical documentation [9]. The

modeling is used to structure the process so that the existing and alternative sequences of tasks can be analyzed systematically and comprehensively. They provide the basis for the analysis and evaluation of business processes. But these approaches only give a static view of the process. For modeling and analyzing dynamic processes, simulation is a well-suited method. Due to its great flexibility, its application is possible even in complex situations. In the past, simulation was applied only in particular cases to support

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the planning of office or administrative processes. Since then, however, numerous commercial software tools are available for the simulation of business processes. Bach [2] lists 97 tools that assist in business reengineering, thirty of which contain simulation tools. The special advantages of simulation are:

- (1) an opportunity for a quantitative analysis of several organizational measures where dynamic characteristics are considered;
- (2) the possibility of generating alternatives in a systematic way by modifications in identified weak points; and
- (3) the high flexibility as regards modeling and adequate consideration of stochastic influences (see [20, p. 6, 21, p. 18], for instance).

In the meantime, several authors describe successful applications of simulation for business process planning and reengineering. Davies [4], for example, considers office processes while Greasley and Barlow [8] use simulation modeling for reengineering a police custody process. Powerful simulation tools with graphic and animation capability support the principles of reengineering [13]. A point of criticism might be that application of simulation often requires high expenditure for the creation of a simulation model. It should be emphasized, however, that the expenditure strongly depends on the simulation software used and its capability with respect to the application under consideration. Further difficulties arise from the fact that different kinds of uncertainty and vagueness often occur in business processes. These uncertainties should be given due consideration in the simulation model. Most simulation systems only support the modeling of stochastic uncertainty.

Approaches which apply fuzzy sets and approximate inference methods in the context of simulation are relatively new and the literature is correspondingly scarce. Two different areas of interest can be distinguished. Some authors develop calculation schemes for fuzzy data, i.e., procedures which are used to obtain single realizations of uncertain variables. We will consider such a calculation later on. Others deal with state transitions dependent on fuzzy values of variables. These approaches refer to changes of state in simulation models. Wenstoep [18] suggests the use of linguistic variables for the input and for the output of simulation models. Milling [11] describes a System Dynamics model for the allocation of resources in a

management consultation company. According to his model, the role of human decision-taking in allocation has been modeled adequately using fuzzy sets. Fishwick [6] emphasizes System Dynamics too. He develops a concept of qualitative simulation with fuzzy input, fuzzy output and the respective handling of such values. The approaches of the latter can be characterized by the fact that they all use approximate inference. Approximate inference is well-suited for the modeling of the flows of business processes where uncertain, imprecise and vague information often occurs and the flows are not completely technically determined.

The generally applicable, object-oriented, simulation-based decision support system known by its acronym GEPSIS was specifically developed to improve business processes. GEPSIS is the abbreviation for the *Geschäftsprozeß-Simulations-System* which, in English, means “business process simulation system”. The stochastic and linguistic uncertainty of the data are considered. The vagueness of verbal formulations is modeled using fuzzy sets theory. Several specific procedures are developed for the process control. They are now available as standard components by which a multiplicity of alternatives can easily be analyzed. The procedures result from specific priority rules for the object classes as well as from a knowledge-based procedure comprising approximate inference is developed. In this way, rules for the sequencing of workflow objects in a business process can be modeled very close to reality. The suitability of GEPSIS and the effects of different procedures on process control are demonstrated. This is achieved by analyzing the actual business process in terms of order processing at a mail order book and record store.

2. The GEPSIS decision support system

Particular object classes are deduced for the modeling of flows. These classes contain defined attributes and behaviors. They are used to model the flow structure in accordance with a representation technique based on event-driven process chains [15]. Even complex functional dependences can be modeled. In contrast to event-driven process chains, the explicit representation of event nodes is omitted. Ten object classes are sufficient to enable the adequate

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