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AI in Business-Process Reengineering

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■ Business-process reengineering (BPR) is a generic term covering a variety of perspectives on how to change organizations. There are at least two distinct roles for AI in BPR. One role is as an enabling technology for reengineered processes. A second, less common but potentially important role is in tools to support the change process itself. The Workshop on AI in Business-Process Engineering, held during the national AI conference, allowed participants to learn about projects that are aimed at exploiting insights from AI.

Virtually any business can be viewed as a collection of processes that, taken together, respond to customer demands by inventing, producing, delivering, and billing for goods and services. These processes vary from business to business, but in the overwhelming majority of cases, these processes and the organizations that execute them have not been engineered in any meaningful sense; they have evolved over time in response to their business environments. Changing environments frequently destroy such companies unless they make a conscious and periodic, if not continuous, effort to reengineer these processes to exploit changes in suppliers, customer needs, and technological innovation. Viewing a business as a collection of customer-driven processes is the essence of *business-process reengineering* (BPR), a generic term covering a variety of perspectives, none of which is particularly rigorous, on how to change organizations. It is easy to dismiss BPR as hype, a management consultant's marketing slogan, but the phenomenon is real and extremely important. In 1993, 60 percent of the management letters appearing with Fortune 500 company annual reports explicitly discussed reengineering efforts that were currently under way. One analyst recently estimated the annual market for BPR services in U.S.-based companies at $1.8 billion; another predicts a growth of 20 percent each year from 1994 to 1996 (Caldwell 1994). To measure the long-term impact of this work, one must consider a multiple of this figure as the cost reductions and revenue enhancements brought about by today's reengineering begin to be realized over the next few years. There is hype, to be sure, but the phenomenon is real.

There are at least two distinct roles for AI in BPR. One role is as an enabling technology for reengineered processes. A typical success story of this type places an expert system in the hands of a single worker who is then able to perform many steps of a process for a single customer or order rather than has several workers in different departments handle the same case, dramatically cutting overall order-processing time. Some examples of this general story appearing at IAAI-94 were in the processing of insurance claims, identification of mental health needs, and collection and indexing of customer support hotline cases. Amy Rice and Robert Friedenberg (both of Inference Corporation) presented the participants of the Workshop on AI in Business-Process Reengineering (held during the 1994 national conference on AI) with examples of successful reengineering efforts that are based on an analysis of the flow of knowledge in the organization and use AI technology to capture and deploy the knowledge.

A report on the 1994 AAAI workshop held in Seattle, Washington

A second, less common but potentially important role for AI is in tools to support the change process itself. A current example is in the use of knowledge-based simulation to support the analysis of an existing business process and to model the performance of a proposed process. For example, the G2/SPARKS system (Yu 1991) provides a knowledge base of typical business processes and work products in service industries and makes it possible to rapidly assemble a stochastic simulation model. Such a simulation model serves the obvious role of estimating cost savings, order-processing times, backlogs, and the like. Because of the complexity of business organizations, all the familiar issues of acquisition, reusability, scalability, and comprehensibility turn up for such models. AI as a field has a great deal of accumulated experience and insight to offer in dealing with these problems as well as developing a framework for further research.

One project aimed at exploiting insights from AI in the area of modeling business processes is the TOVE (Toronto virtual enterprise) Project at the University of Toronto, presented at the workshop by Mark Fox and Michael Gruninger. TOVE encompasses a generic ontology for modeling business processes; a specific instantiation of the ontology describing a hypothetical enterprise in detail; and a test bed with tools for browsing, visualization, simulation, and deductive queries. As in any modeling effort, formulating the model requires committing to the particular reasoning tasks it is expected to support. TOVE uses the notion of advisers—each with a particular perspective on the enterprise—to inform and constrain the modeling effort. Examples are advisers for cost, quality, efficiency, incentives, and agility: The cost adviser requires that the model represent information about material and process costs, the incentive adviser is likely to require information about organizational structures, others will require the representation of time and state, and so on. As discussed at the workshop by Bob Young and Elaine Kant (both of Schlumberger Laboratory for Computer Science), many of the issues appearing in multiperspective modeling of engineered artifacts apply directly to large-scale modeling efforts such as TOVE.

Modeling and analysis of business processes is part of the broader task of designing a new business process, that is, tools for evaluating designs formulated by humans. An interesting and challenging next step is to use AI techniques to automatically produce new designs. Pramod Jain, Jie Liu, and Steve Wagner (all of Andersen Consulting) reported on a prototype system that proposes new process designs by using heuristic transformations of existing models. For example, the system would propose to delete processes or invert the order of pairs of processes. Although the prototype falls short of providing assistance to the analyst in actually evaluating the impact of the changes it proposes, it is an intriguing system for stimulating the creative process of producing a new design.

However, analysis of existing and proposed processes is only a small part of actually effecting change in an organization, and the scope for AI tools in this area is correspondingly large. As pointed out by David Bridgeland (Coopers and Lybrand) in his workshop position paper:

> The nature of designing a business process is quite different from that of designing a mechanical device because the components are fundamentally different. Sheet metal doesn't care how it is used or even whether it is used or not; employees do.

Implementing changes in an organization is an effort that is prone to failure—Michael Hammer predicts that two thirds of all BPR efforts now under way will fail (Caldwell 1994)—in large part because stakeholders in the organization resist changes that might diminish their power or otherwise disrupt their career and other plans. An intriguing question raised repeatedly in the course of the workshop was whether modeling tools could raise the likelihood of successful change, for example, by helping to anticipate the reactions of process participants to proposed changes. Eric Yu and John Mylopoulos (University of Toronto) presented work on modeling organizations using a multilevel framework in which one level, the actor dependency model, makes the relationships between actors explicit in terms of their dependence on other actors to achieve their goals. In a somewhat different vein, Gary Klein (MITRE Center for Advanced Aviation System Development) presented work that explicitly models the complex behavior of individual actors within a changing business process; in particular, the tendency for individuals to adapt over time to changes in the sources and quality of information that they use to make their decisions. More generally, using rich representations of agents' beliefs and intentions (for example, the framework of Cohen and Levesque [1990]) or a case library of past behavior (for example, the VOTE system [Slade 1991]) opens up interesting possibilities for sophisticated modeling and fine-grained predictions about agents' reactions to different proposed organizational designs.

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The workshop ended positively with the final discussion session. In the area of modeling and analysis of processes to support design, participants agreed with Mark Fox's position that enough is already generally known about knowledge representation to have significant impact on actual practice, provided, of course, that the nascent AI in BPR community in fact focuses its efforts outside the AI community and in communities where organizational modeling is already the focus of attention. In the area of supporting process change, participants seemed to agree that modeling stakeholders and their reactions to change and incorporating the knowledge upstream in tools for supporting business process design was an exciting possibility worthy of further research.

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