Chapter VIII
An Agent–Based Framework for Emergent Process Management

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ABSTRACT

Emergent processes are business processes whose execution is determined by the prior knowledge of the agents involved and by the knowledge that emerges during a process instance. The amount of process knowledge that is relevant to a knowledge-driven process can be enormous and may include common-sense knowledge. If a process' knowledge cannot be represented feasibly, then that process cannot be managed, although its execution may be supported partially. In an e-market domain, the majority of transactions, including trading orders and requests for advice and information, are knowledge-driven processes for which the knowledge base is the Internet; therefore, representing the knowledge is not at issue. Multiagent systems are an established platform for managing complex business processes. What is needed for emergent process management is an intelligent agent that is driven not by a process goal but by an inflow of knowledge, where each chunk of knowledge may be uncertain. These agents should assess the extent to which they choose to believe that the information is correct, and thus, they require an inference mechanism that can cope with information of differing integrity.

INTRODUCTION

Emergent processes are business processes that are not predefined and are ad hoc. These processes typically take place at the higher levels of organizations (Dourish, 1998) and are distinct from production workflows (Fischer, 2003). Emergent processes are opportunistic in nature, whereas production workflows are routine. How an emergent process will terminate may not be known until the process is well advanced. The tasks involved in an emergent process typically are not predefined and emerge as the process develops. Those tasks may be carried out by collaborative groups as well as

by individuals (Smith & Fingar, 2003) and may involve informal meetings, business lunches, and so forth. For example, in an e-market context, an emergent process could be triggered by "let's try to establish a business presence in Hong Kong." Further, the goal of an emergent process instance may mutate as the instance matures. So, unlike lower-order processes, the goal of an emergent process instance may not be used as a focus for the management of that instance.

Emergent processes contain knowledge-driven subprocesses but also may contain conventional goal-driven subprocesses. A knowledge-driven process is guided by its process knowledge and performance knowledge. The goal of a knowledge-driven process may not be fixed and may mutate. On the other hand, the management of a goal-driven process instance is guided by its goal, which is fixed. A multiagent system to manage the goal-driven processes is described in Debenham (2000). In that system, each human user is assisted by an agent that is based on a generic three-layer, BDI hybrid agent architecture. The term *individual* refers to a user/agent pair. The general business of managing knowledge-driven processes is illustrated in Figure 2.

Process management is an established application area for multiagent systems (Singh, 2004), although emergent processes typically are handled either manually or by CSCW systems rather than by process management systems. The use of these two technologies is not elegant and presents a barrier to a unified view of emergent process management.

In an experimental e-market, transactions include trading orders to buy and sell in an e-exchange, single-issue and multi-issue negotiations between two parties, and requests for information extracted from market data as well as from news feeds and other Internet data. In this e-market, every market transaction is managed as a business process. To achieve this, suitable process management machinery has been developed. To investigate what is suitable, the essential features

of these transactions are related to two classes of process that are at the high end of process management feasibility (Aalst & Hee, 2002). The two classes are goal-driven processes and knowledge-driven processes. The term *business process management* generally is used to refer to the simpler class of workflow processes (Fischer, 2003), although there are notable exceptions using multiagent systems (Singh, 2004).

The agent architecture described extends the simple, offer-exchange, bargaining agent described in Debenham (2004). The agent described here is driven by the contents of a knowledge base that represents the agent's world model in probabilistic first-order logic and manages emergent processes. Each message that the agent receives from another agent reveals valuable information about the sender agent's position. The agent aims to respond with messages that have comparable information revelation. In this way, it aims to gain the trust of its collaborating agents. The agent does not necessarily strive to optimize its utility and aims to make informed decisions in an information-rich but uncertain environment.

The emergent process management agent, Π, attempts to fuse the agent interaction with the information that is generated both by and because of it. To achieve this, it draws on ideas from information theory rather than game theory. Π decides what to do, such as what message to send, on the basis of its information that may be qualified by expressions of degrees of belief. Π uses this information to calculate and to continually recalculate probability distributions for what it does not know. One such distribution over the set of all possible actions expresses Π's belief in its own suitability in performing that action. Other distributions attempt to predict the behavior of another agent, Ω say, such as what proposals the agent might accept and of other unknowns that may effect the process outcome. Π makes no assumptions about the internals of the other agents in the system, including whether they have or even are aware of the concept of utility functions. Π is concerned

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