Ontological Foundations for Active Information Systems

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ABSTRACT

While passive information systems simply record and report on the observed states of things in the world, active information systems participate in the determination and ascription of state to things. They infer conclusions based on the application of rules that govern how things in the real world are affected when defined and identified events occur. The ontological foundations for active information systems must include constructs to represent such causal rules. Conceptualizing things and events as distinct ontological categories with existence and properties and representing them as entities at the conceptual level is sufficient for this purpose. The properties of an event include data values inherent in the event and rules that define how the states of affected things are changed when the event occurs. In this manner the state-history of a thing is represented by the sequence of events that have affected it. Future states of a thing can be predicted based on proposed or conjectured events. Such a conceptualization enables a parsimonious mapping between an active information system and the real world system it is intended to model.

Keywords: ontology; states; events; causal rules; active information systems; artificial systems

INTRODUCTION

The premise that an information system is fundamentally a state-tracking mechanism (Wand & Weber, 1990) is founded upon the ontological definition of an “event” as a chronologically ordered pair of states, \( <S_1, S_2> \), without any construct to represent the rules that govern the transition from \( S_1 \) to \( S_2 \) (Bunge, 1977; Wand & Weber, 1995).
While it is possible to conceive information systems in this way, doing so obscures an important component of its conceptual representation: the rules that govern state transitions. A more effective premise is that an information system is fundamentally an event-tracking mechanism (Allen & March, 2003). This premise is founded upon the ontological definition of an “event” as a causal occurrence that produces a subsequent state S2 from an initial state S1 by the application of rules and data that describe the event (Casati & Varzi, 1996; Davidson, 1980; Geerts & McCarthy, 2002). In this definition, ontology events and things both have properties and each constitutes a fundamental ontological category. We contend that it is appropriate to represent events as entities at the conceptual level and argue that doing is fundamental to the conceptual modeling of information systems that actively participate in organizational work systems (Alter, 2003).

There is a duality between events and states. Events cause states to change (including the event that brings a thing into existence) and states reflect the effects of events. Conceptually it is possible to derive the state of a thing at time t1 from its state at time t0 and the events that have occurred between t0 and t1 by the application of event rules and data. However, it is not always possible to derive the event rules and data from the states of a thing at times t0 and t1. If the sole purpose of an information system is to record and report on states that have been observed or proposed in some real-world, then deriving and tracking events may not be important. We term such state-tracking information systems “passive” because they do not participate in the real world system. They do not calculate, infer, or predict the states of things; they simply report on observations or proposed states.

Information systems that exhibit intelligence typically go beyond the recording of states (Alter, 2003). They ascribe state to things by applying rules associated with defined and identified events (Geerts & McCarthy, 2002). Events and their rules are a significant focus in such information systems. We term such event-tracking information systems “active” because they participate in the determination of states rather then simply record observations or determinations of state made outside their scope. Passive information systems are most appropriate for dealing with natural systems where natural laws govern the way the states of things change. Active information systems are most appropriate for artificial systems where organizationally or socially constructed rules govern the way the states of things change.

Active information systems need not implement the state-change rules for all events in the real world they are intended to model. The causal rules that govern state transitions when an event occurs may be unknown or they may not be of concern to the stakeholders (Ramesh & Browne, 1999). For such events the rule may be null. Its descrip-
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