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TOWARD A GENERALIZED ARCHITECTURE FOR INTELLIGENT REACTIVE MANAGEMENT SYSTEMS

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ABSTRACT

Work in progress is described, making the case for computer-based reactive management systems to support decision-making when there is a drastic, rapid change in the environment, which renders existing plans unworkable. The hypothesis is that a creative combination of information systems tools, including sane uses of artificial intelligence, can provide an integrated system to give such support. The system will perform five tasks: structuring the problem, monitoring/interpreting the environment, updating the model, gathering organizing internal data, and facilitating the man-machine interface.

EXISTING SYSTEM TYPES

An accepted taxonomy for describing the functions of information systems uses three basic categories: transaction processing systems (TPS), which are used to update existing databases; management information systems (MIS), which report the status quo to management; and decision support systems (DSS), which employ modeling tools and comparison techniques to assist managers in making decisions (Keen and Scott Morton, 1978). The focus for these systems is almost entirely upon recording, reporting, and planning. They have the expectation of a predictable environment, but sometimes events are so far removed from what might be expected that planning breaks down, and consequently, existing computer systems fail to provide support.

Promising attempts to deal with crisis situations have used expert systems (ES) to provide guidance. Expert systems constitute a type of artificial intelligence.
They model the human problem-solving capability of an individual who is accomplished in a given domain of expertise (Gallagher, 1988). Like more traditional systems, though, expert systems still primarily serve the planning context. Additional uses of artificial intelligence are needed to build reactive systems.

SYSTEM TYPES BY MANAGERIAL NEED

To see the information system implications of a breakdown in the ability to plan, it is helpful to relate system types to managerial needs. Sutherland
(1984) considers four types of managerial activity:

1. Operational management seeks to optimize efficiency in routine activities.
2. Tactical management is concerned with maintaining equilibrium and ensuring proper distributions within resource constraints.
3. Strategic management formulates contingency plans and strives for competitive positioning.
4. Directive management defines organizational mission and goals, and makes long-range plans.

Figure 1 gives examples of applications picturing the relationship between system type and managerial need. Systems supporting each of these management needs are subject to failure in out-of-the-ordinary circumstances. Operational systems are subject to overload if demands on the system exceed the transaction-handling capability. Tactical systems may be rendered useless by having one of the independent variables take on a value that is outside the range of the system. Strategic systems fail because it is not possible to be prepared for every situation. Directive systems fail when events are unforeseen. In each case, rapid response is required, and the supporting information system must have the ability to assist reevaluation in the light of

MANAGEMENT NEED (TIMEFRAME)	SYSTEM TYPE TPS	MIS	DSS	ES
Operational (Immediate)	Employee Paychecks	Payroll Reports	Process Control	Equipment Repair
Tactical (Short Term)	Status Updates	Status Reports	Inventory Planning	Production Scheduling
Strategic (Long Term)	Indicator Monitoring	External Inputs	Marketing Campaigns	Distribution Planning
Directive (Horizon)	Automated Conference	Annual Reports	Mission Planning	Contingency Planning

FIGURE 1: EXAMPLE APPLICATIONS OF SYSTEM TYPE BY MANAGERIAL NEED

unexpected factors. The kind of management decisions required in such circumstances are reactive, characterized by the need to respond rapidly to previously unencountered and unforeseen events.

NEW APPROACHES

Some new methods have been used successfully in isolated applications to speed awareness, especially the biologically based artificial intelligence methods that mimic the processes found in nature. These methods include genetic algorithms (GAs), neural nets, and simulated annealing. GAs are based upon the laws of natural selection. Neural nets are connectionist models, deliberately patterned after the organizational structure of the human brain. Simulated annealing utilizes the concepts of condensed matter physics. Generally speaking, all may be used to identify near-optimal solutions, and all can learn by incorporating new results into the existing definition of the environment. What is lacking is to incorporate these new methods into systems providing standard functions.

The system architecture is expected to comprise five modules: data gathering, monitoring/recognition,/ update, status reporting/early warning, causal analysis, and recommendation. The system will be tested by a simulated business environment. The work will have the potential to advance inquiry in a neglected but necessary area of information systems: support for decision-makers faced with the need to respond rapidly when the environment suddenly and drastically changes.

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