Chapter 51
Cognitive Mapping in Support of Intelligent Information Systems

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ABSTRACT

This chapter provides a review of the recent applications and trends on cognitive mapping techniques in support of the design and development of intelligent information systems. Cognitive maps are inference networks, using cyclic directed graphs for knowledge representation and reasoning. Cognitive mapping techniques are widely used to analyze causal systems such as industrial marketing planning, risk management, and product planning. Four knowledge management categories are adopted in this chapter to portray different applications of cognitive mapping techniques in the design and development of intelligent information systems. These four categories are knowledge creation, knowledge storage/retrieval, knowledge transfer, and knowledge application.

INTRODUCTION

Cognitive mapping techniques consist of a set of procedures to capture perceived relationships of attributes related to ill-structured decision problems that decision makers have to face. This paper provides an overview of the application of cognitive maps (CMs) in the design and development of intelligent information systems. Here, CM is used as a set of techniques to identify subjective beliefs and to portray those beliefs and their relationships externally as follows:

- Causal mapping is used to investigate the cognition of decision-makers. A causal map represents a set of causal relationships (i.e., cause and effect relationships) among constructs within a system. For example, Figure 1 shows that better sanitation facilities, causing an initial improvement in

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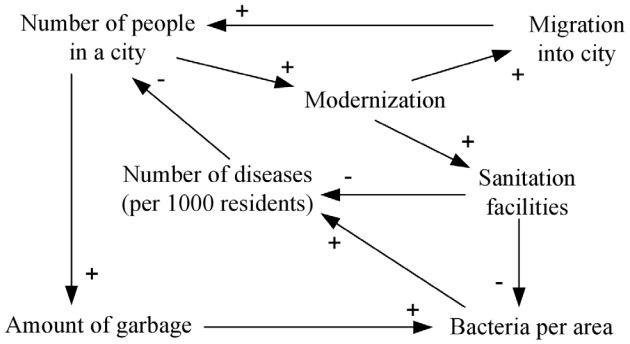
Figure 1. Causal map for public health issues



health, led to an increase in the city's population. This growth led to more garbage, more bacterial, and therefore more disease. Causal map aids: 1) in identification of irrelevant data, 2) to evaluate the factors that affect a given class of decisions, and 3) enhances the overall understanding of a decision maker's environment, particularly when it is ill-structured.

- Semantic mapping, also known as *idea mapping*, is used to explore an idea without the constraints of a superimposed structure. A semantic map visually organizes related concepts around a main concept with tree-like branches. Figure 2 depicts different types of transportation, organized in three categories: land, water, and air. This technique facilitates communication between end-users and system analysts in support of information requirements analysis.
- Concept mapping is a useful tool for organizing and representing concepts (events or objects) and their interrelationships in a particular domain. Each concept is designated with a label. The relationship between two concepts in a concept map is referred to as a proposition; propositions connect concepts to form a meaningful statement. Relationships between concepts are associative. For example, in Figure 3, two concepts of "plants" and "flowers" are associated via "may have" that form the proposition of "plants may have flowers." Describing complex structures with simple propositions improve quality of conceptual modeling in the development of information systems.

Figure 2. Semantic map for different types of transportation