

Cognitive Mapping in Support of Intelligent Information Systems

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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 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.

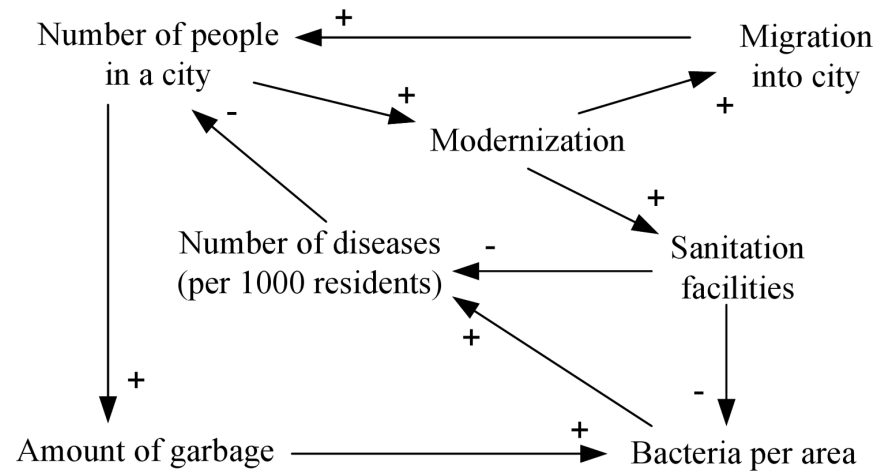
- Concept mapping is a useful tool for organizing and representing concepts (events or objects) and their interrelationships in a particular domain. Each concept is designated with a label. The relationship between two concepts in a concept map is referred to as a proposition; propositions connect concepts 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.

BACKGROUND

Cognitive Map (CM) has been employed to capture, store and retrieve expert knowledge in support of the design and development of intelligent information systems. CM is a representation of the relationships that are perceived to exist among the elements of a given environment. Taking any



Figure 1. Causal map for public health issues

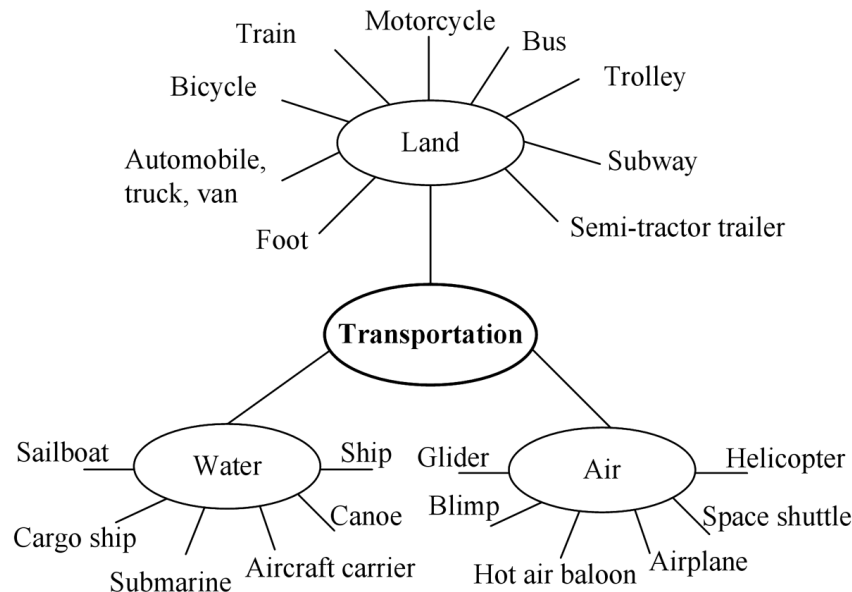


two of these elements, the concern is whether the state or movement of the one is perceived to have an influence on the state or movement of the other (both static and dynamic relationships can be considered) (Montazemi & Conrath, 1986). CMs have been used to describe experts' tacit knowledge about a certain problem, particularly in ill-structured decision problems (Axelrod, 1976; Montazemi & Chan, 1990; Amer et al. 2015). Tacit knowledge is personal knowledge, shared

and exchanged through direct and face-to-face contact among actors (Eden, 1988).

There are different perspectives of knowledge within organizations (Nonaka, 1994). Thus, it seems appropriate to use knowledge management categories to identify different applications of cognitive map in the design and development of intelligent information systems. Alavi and Leidner (2001) provide a framework that is grounded in the sociology of knowledge and is based on the

Figure 2. Semantic map for different types of transportation



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