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# A Computational Model of Initial Representation Formation for DSS

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## Abstract

*Initial Representations of a problem can be used in the problem structuring process to create a model of the problem at hand. We propose a framework for a computational model of initial representation formation that can be used in the context of a decision support system. Such a model can be used to assist in the intelligence phase of decision making by helping structure the problem and can eventually be extended to provide support to the learning function in a DSS that uses intelligent agents.*

## Introduction

Certain classes of decision-making situations encountered in business involve solving ill-structured problems. Such problems are characterized by either the lack of a clearly defined goal or a solution that is clear and exact. The problem solver has to create the problem structure by defining the problem – specifying the goals and specifying what determines the end of the problem-solving process. Decision Support Systems (DSS) are frequently used to aid managers in making decisions when facing ill-structured problems. However, DSS are typically not able to assist the decision-maker in the process of defining the problem or structuring the problem; they typically can assist the decision-maker only when most of the characteristics and information about the problem are known.

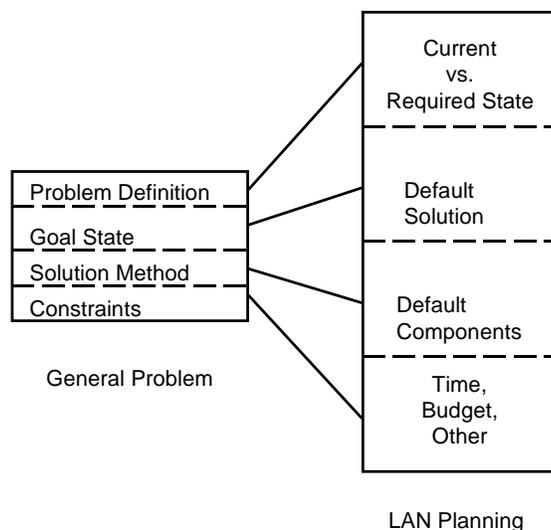
Creating *Initial Representations* (Simon, 1973) are one way of structuring an ill-structured problem. The initial representation is the problem solver's first impression, or initial mental model, of the problem. The initial representation imposes boundaries on the reasoning process by guiding the problem solver during the search for information and in the application of solution methods. This problem representation continues to be modified during the solution process till the goal is reached.

In this paper, we propose a computational model of the initial representation process. The program will serve to implement a process model of the initial representation process (Abraham, 1997) and also to provide a facility to test the model using actual business data.

## Motivation

The motivation for studying this process stems from criticism of research in the area of Decision Support Systems. Stohr and Konsynski (1992) point out that researchers in this area have neglected to study the process of problem structuring which is a very important phase of problem solving and hence, the decision making process. Our prior research (Abraham, 1997) addressed this criticism with the aim of gaining a better understanding of the problem structuring process. The proposed research will take it one step further by developing a computational model of the process. When this model has eventually been tested fully, it may be used to enhance systems that support decision making.

Developing a computational model is an accepted method of demonstrating the functionality of the model and thereby validating it (Buchanan, 1988; Simon, 1969). This step is seen as a necessary phase in significant AI projects because it affords the ability to test complex cognitive or process models in a practical manner.



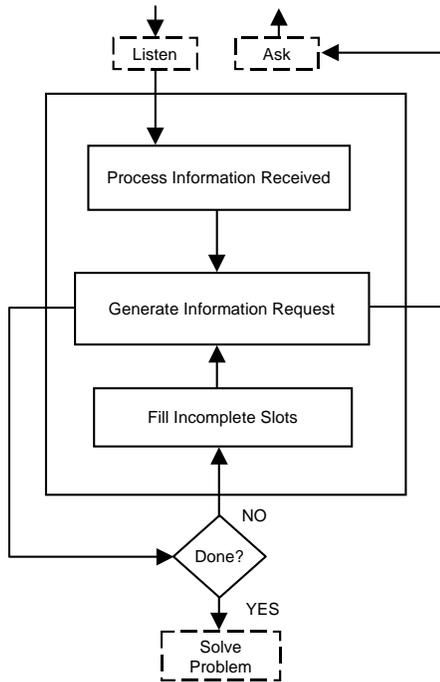
## Process Model of Initial Representation Formation

There are two basic components needed in the computational model, the actual process of initial representation and a structure that stores the initial representation of the problem.

The structure can be represented using an object with four basic slots. The example shown here uses the domain of LAN planning to illustrate the content of the slots. The structure is used by the Initial Representation Processor, described below, to store information about the problem during the initial stages of problem solving. When the problem structuring process is completed, the initial representation structure serves as a collection of information about the problem during the solution process.

The Initial Representation Processor, shown below, is an iterative process that seeks to find information to fill the initial representation structure. It parses the information in the problem space and assigns it to

a slot in the Initial Representation Structure. When all the information available has been processed, it checks to see if there is sufficient information (goal state and problem definition are known) to solve the problem. If this information is not available, it formulates a question to be posed to the human decision-maker, and the answer from the decision maker is parsed to get information to fill the slots in the Initial Representation Structure.



The Listen and Ask modules are used to pose questions to the human user and to take the responses and make them usable to the Initial Representation Processor. The problem solution process itself would be beyond the scope of the problem structuring phase.

A critical component of this model is the DONE? Predicate which checks the Initial Representation Structure to see if problem solving can be started. This module is very important because it determines **why** the initial representation process is not complete and **what** types of information would help complete the problem structuring stage.

With all the modules of this model, the level of domain knowledge that is required to make the processor work in an important factor. The information that is stored in the Initial Representation Structure describes the specific problem that is being solved and therefore the knowledge needed to parse and assign the information as well as to check for completion of the initial representation process are domain specific. From a research perspective, this raises the issue of generalizability of the computational model.

### Research Problem

The research problem proposed to be addressed is stated as follows:

*How can the initial representation process be modeled using a computer program?*

This general problem statement may be broken down into the following more specific questions:

1. How can the process model and the domain knowledge be best represented?
2. What kind of data and/or knowledge is needed to develop and test the model?
3. What kind of interface is needed for the task?
4. What are other domain specific issues that affect the design of the computational model?

By answering these questions, we will be able to develop a computational model of initial representation formation.

The domain that will be used for this task will be audit planning. While the earlier process model was developed using LAN planning, that domain changes rapidly, especially information about LAN technology, to allow for meaningful data collection for this study. Audit planning shares most of the features of the LAN planning problem with the added benefit of being more stable for research purposes.

### Current State of Project

At present, data is being collected from an auditor using concurrent verbal protocols of an auditing problem. The data that is needed is the domain knowledge necessary to build the Initial Representation Formation model. The model will be implemented using LEVEL5 Object, an object oriented application development platform that incorporates rules and can be integrated with other software easily.

By the time of the conference, the author expects to have a prototype system that will carry out the initial representation formation in audit planning problems. Test results will also be presented at that time. Future work includes using this model to support learning in DSS that use intelligent agents (Abraham and De', 1996).

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