Decision Support as Knowledge Creation: A Business Intelligence Design Theory

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ABSTRACT

The primary purpose of decision support systems (DSS) is to improve the quality of decisions. Since decisions are based on an individual's mental model, improving decision quality is a function of discovering the decision maker's mental model, and updating and/or enhancing it with new knowledge; that is, the purpose of decision support is knowledge creation. This article suggests that BI techniques can be applied to knowledge creation as an enabling technology. Specifically, the authors propose a business intelligence design theory for DSS as knowledge creation, a prescriptive theory based on Nonaka's knowledge spiral that indicates how BI can be focused internally on the decision maker to discover and enhance his/her mental model and improve the quality of decisions.

Keywords: Business Intelligence, Cognitive Mining, Decision Instances, Decision Support Systems, Inductive Learning Algorithms, Intelligent Tutors, Knowledge Creation, Mental Models

INTRODUCTION

The purpose of decision support systems (DSS) is to improve the quality of decisions (Holsapple & Whinston, 1996; Keen & Scott Morton, 1978; Turban & Aronson, 2005). Since decisions are ultimately based on the decision maker's mental model(s) (Argyris & Schön, 1996; Weick, 1995), improving decisions is achieved by updating and enhancing the decision maker's mental model (Johnson-Laird, 1983; Kaplan & Kaplan, 1989; Qin & Simon, 1995).

Mental models are enhanced through knowledge creation (Nonaka & Takeuchi, 1995; Simon & Longley, 1981); i.e., through the combination and assimilation of relevant explicit information (e.g., trade journals, group discussions, new facts, written procedures), and by the creation of new knowledge through tacit mental analysis (e.g., evaluating/comparing mental models, generating insight(s), integrating ideas, developing causal relationships) (Alavi, 1994; Nonaka, 1994; Nonaka & Takeuchi, 1995; Senge et al., 1994).

Given that business intelligence (BI) technologies provide historical, current, and predictive views of business operations to enhance the comprehension/understanding of fact-based interrelationships, we suggest that BI is an appropriate enabling technology for knowledge creation. Specifically, we propose and develop a business intelligence design
theory (BIDT) for DSS as knowledge creation. This BIDT provides a prescriptive theory that indicates how a design process can be carried out in a way that is both feasible and effective. Our BIDT addresses both the product of the design (i.e., the class of systems being designed -- DSS) and the process of the design (i.e., the selection and application of the appropriate BI technologies to knowledge creation in a DSS). While BI is normally focused on large internal (or external) data sources (e.g., data mining in fraud detection, competitive intelligence), our BIDT focuses BI internally on the decision maker, and on the discovery and enhancement of his/her mental model(s).

This article’s primary contribution to the literature is twofold. First, it proposes a unique BIDT for DSS as knowledge creation, based on Nonaka’s (1994) knowledge spiral, including separate kernel theories for each of his four types of knowledge creation. Kernel theories are theories from the natural or social sciences that govern the goals and construction of the system; i.e., theories that address the requirements for improved mental models, knowledge creation, and decision making using a DSS. These kernel theories and the associated process design methods are drawn from, and integrate components of, five distinct literatures: cognitive science, the theory of learning, artificial intelligence, knowledge management, and decision theory.

The second contribution of the article is the identification and application of several instance-based research systems, and the associated BI technologies, to the design methods of the BIDT. The integration of these instance-based systems demonstrates one way of building a DSS as knowledge creation.

The article is organized as follows. In the next section we propose the BIDT product design for decision support as knowledge creation. In the following section, we propose process design kernel theories for each of the four types of knowledge creation in Nonaka’s knowledge spiral, as well as testable design process hypotheses. Then, we provide an example of an instance-based DSS as knowledge creation that satisfies both the product design hypothesis and the process design hypotheses of our BIDT. And finally, we discuss several potential applications and research directions of DSS as knowledge creation.

**PRODUCT DESIGN THEORY**

According to system design theory (Steiger & Steiger, 2007; Walls, Widmeyer & El Sawy, 1992), a product design theory should include one or more kernel theories from the natural or social sciences that govern the meta-requirements (i.e., theories that address the requirements for improved decision making and problem solving), a set of meta-requirements or goals to which the kernel theory applies, a meta-design (i.e., a class of artifacts hypothesized to meet the meta-requirements or goals), and a testable product design hypothesis that can be used to determine whether the meta-design satisfies the meta-requirements. Each of these product design components is discussed below.

**Product Design Kernel Theory**

We propose Nonaka’s theory of knowledge creation as our product design kernel theory. Nonaka (1994) states that there are two forms of knowledge: explicit knowledge and tacit knowledge. Explicit knowledge is defined as knowledge that can be expressed formally and can, therefore, be easily communicated or diffused throughout an organization. In business, explicit knowledge might include trade journals, executive reports, speeches, project reports, etc. On the other hand, tacit knowledge consists of subjective expertise, assumptions, and insights that an individual develops from being immersed in an activity or profession for an extended period of time. Tacit knowledge is so ingrained in the decision maker’s mind that it is taken for granted and thus not easily verbalized or communicated. This tacit knowledge is critical in decision making since it is the primary source of problem definition.
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