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# The Data Warehouse: A Knowledge Creating Resource?

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## Abstract

*With the growing interest and development in knowledge discovery in databases (KDD), the data warehouse has been pushed to the forefront as a source of knowledge creation. As new information technologies (ITs), data warehousing technologies have been primarily studied from a technical perspective, and are under-researched from organizational and behavioral perspectives. Hence, the broad objective of this paper is to address the gap in prior work by examining the processes through which organizations successfully deploy and use data warehousing technologies, and how usage can contribute to organizational learning.*

## Introduction

In order to survive in an increasingly turbulent global environment, corporations must become learning organizations, capable of continuous adaptation (Hayes, Wheelwright, and Clark 1988; Senge, 1992.) With the growing interest and development in knowledge discovery in databases (KDD), the data warehouse has been pushed to the forefront as a source of knowledge creation. Data warehousing technologies have the potential to support the cognition and decision-making of managers by providing capabilities that facilitate the 1) capture and dissemination of the crucial organizational resource of knowledge, and 2) ad hoc and non-structured knowledge discovery in databases (KDD). In essence, they are theorized as contributing to individual learning. With this in mind, the main purpose of this research project is to provide a model of adoption for these technologies, focusing on factors which affect their use, and how patterns of use can ultimately result in individual learning.

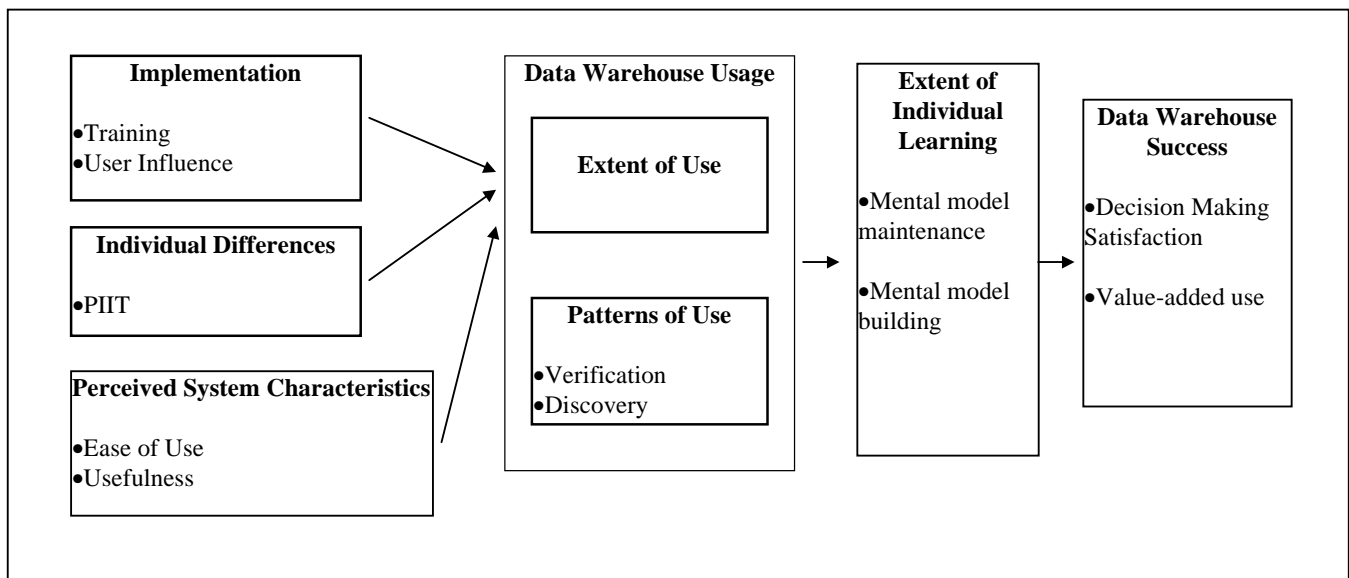
Broadly stated, the research questions are : 1) What are the technological, social, and individual level antecedents of the usage patterns of data warehousing technologies?, and 2) How are these usage patterns related to different types of individual learning, and does this add value to individual decision-making processes? The research model underlying the study is presented in Figure 1. This model is grounded in several well-established theoretical bases including the diffusion of innovations, new technology implementation, and organizational learning. The theoretical framework is organized around three themes. First, the reader is given an overview of the nature of the technologies. Second, the diffusion of innovations literature is used to highlight key considerations in IT adoption decisions. Third, the managerial cognition literature is drawn upon to frame the discussion on learning as it relates to technology use. An underlying assumption of this research is that individual learning is an antecedent of organizational learning. Hence, this framework forms a basis for understanding how these technologies can contribute to experimentation and exploration, factors crucial in developing an organization truly capable of learning.

## Theory and Hypotheses

A data warehouse incorporates data from a variety of sources into a single repository. It is conceptually similar to a physical warehouse because it is populated with data from a wide variety of sources, according to specific instructions, and in a way that allows easy retrieval for individual customers (i.e. users) (Van de Hoven, 1997.) Further, it is designed to support the extraction of useful information for decision support and exploration (Fayyad and Uthurusamy, 1996,) and therefore falls within the realm of decision support systems (DSS) and executive information systems (EIS). In general, these systems are meant to enhance executive intelligence and decision-making, and ultimately, organizational performance (Straub & Wetherbe, 1989) by supporting poorly structured decision-making tasks. The EIS and DSS streams of literature were subsequently used to derive the proposed model of adoption for data warehousing (as seen in Figure 1).

Within these streams of literature, IT adoption and use by individuals has been approached from different theoretical perspectives. A number of organizational, individual, and technological antecedents have been found to have an impact on the successful implementation and deployment of an information technology. Similarly, measures of IT success fall into six main categories of variables: system quality, information quality, use, user satisfaction, individual impact, and organizational impact (Delone and McLean, 1992.)

The model presented above addresses antecedents and consequences of individual use of the data warehouse by depicting IT success as a process construct (as suggested by Delone and Mclean, 1992) that contains 4 stages: antecedents of use, use, individual learning, and data warehouse success. The variables in each stage will be briefly discussed.



**Figure 1. Model of Adoption for the Data Warehouse**

#### *Antecedents of Use*

- Training is an important factor because it can expedite learning from two perspectives: Training can provide users with a better understanding of a technology, which is consistently related to accurate interaction, and subsequently high task performance (Sein and Bostrom, 1989.) Also, training can aid in the interpretation and utilization of the results generated from the data warehouse.
- The importance of user participation is a recurrent theme in the IT adoption literature. However, as Barki and Hartwick (1994) note, (user) influence is an important consequence of user participation. This is deemed especially relevant in this context because the data warehouse has to support decision-making styles of a variety of users.
- Innovativeness captures an individual's predisposition to adopt new ideas, things, products, or practices (Goldsmith, 1986.) Its influence is primarily domain-specific, and with that in mind, PIIT seems appropriate. PIIT is defined as "the willingness to try out new information technologies" (Agarwal and Prasad, 1998.)
- Perceived ease of use and perceived usefulness are beliefs found in prior work to be consistently related to technology adoption.

#### *Data Warehouse Usage*

- Extent of use - the degree to which the data warehouse is used to support those activities which it can support.
- There are two types of knowledge discovery activities that can be supported by the data warehouse. The first is verification, in which the system is limited to verifying a user's hypothesis. The second is discovery, in which systems find and facilitate multiple interpretations and representations of new patterns (Brachman et al., 1996.) In this context, verification and discovery are the methods through which decision-makers acquire knowledge, and are deemed analogous to what are generally described in the behavioral literature as focused search and scanning, respectively.

#### *Extent of Individual Learning*

- Mental model maintenance and mental model building are terms coined by Vandenbosch and Higgins (1996) to refer to single-loop and double loop learning, respectively.

#### *Data Warehouse Success*

- Decision making satisfaction - the extent to which use of the data warehouse is perceived to result in improved decision-making.
- Value-added use - the end-user's perception of the value of the data warehouse

Based on the above, the following hypotheses will be tested.

- H1:** Training has a positive effect on the extent of use of the data warehouse.
- H2:** User influence in the design and the development of the data warehouse has a positive effect on the extent to which it is used.
- H3:** Personal innovativeness in IT is positively related to the extent of use of the data warehouse.

- H4a:** Perceived usefulness of the data warehouse is positively related to the extent to which it is used.
- H4b:** Perceived ease of use of the data warehouse is positively related to the extent to which it is used.
- H5a:** Verification is positively related to mental model maintenance.
- H5b:** Discovery is positively related to mental model maintenance.
- H5c:** Discovery is positively related to mental model building.
- H6a:** Mental model maintenance is positively related to decision-making satisfaction.
- H6b:** Mental model building is positively related to decision-making satisfaction.
- H6c:** Mental model maintenance is positively related to the perceived value of the data warehouse.
- H6d:** Mental model building is positively related to the perceived value of the data warehouse.

### **Method**

Empirical testing will take the form of a cross-sectional survey. Respondents will be analysts, as well as middle and upper level managers - the typical target group for data warehousing technologies, and sites will be selected where these technologies have been implemented for at least six months. The survey has been developed, and is currently undergoing pilot testing and subsequent revisions. To date, a few organizations have expressed their willingness to participate in the study, and the current focus is on gathering contextual information at these sites before proceeding with data collection. This has involved interviewing key actors in the data warehousing initiatives, including project leaders and end users, attending data warehousing user meetings, and participating in training sessions.

### **Expected Contribution**

The study is expected to contribute to theory as well as practice. The theoretical contributions of this paper lie in its extension of the diffusion of innovations and new technology implementation streams of literature, by examining the robustness of relationships posited in prior work in the context of a new technology. From a pragmatic point of view, as the antecedents of usage are examined, results of the study could be utilized by those responsible for implementing the new IT to better plan technology implementation and diffusion. Furthermore, managers can hope to gain insight into the potentially beneficial outcomes that can result from the use of such technologies.

### *References*

References available upon request from author (kag8836@garnet.acns.fsu.edu).