Analytical Knowledge Warehousing for Business Intelligence

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INTRODUCTION

The Information Technology and Internet techniques are rapidly developing. Interaction between enterprises and customers has dramatically changed. It becomes critical that enterprises are able to perform rapid diagnosis and quickly respond to market change. How to apply business intelligence (BI), manage, and diffuse discovered knowledge efficiently and effectively has attracted much attention (Turban *et al*., 2007). In this chapter, an "analytical knowledge warehousing" approach is proposed to apply business intelligence, and solve the knowledge management and diffusion issues for decision-making. Analytical knowledge is referred to a set of discovered knowledge, i.e., core of BI, which is extricated from databases, knowledge bases, and other data storage systems through aggregating data analysis techniques and domain experts from business perspective. The solution approach includes conceptual framework of analytical knowledge, analytical knowledge externalization, design and implementation of analytical knowledge warehouse. The methodology has integrated with multi-dimensional analytical techniques to efficiently search analytical knowledge documents. The techniques include static and dynamic domains and solve problems from the technical and management standpoints. The use of analytical knowledge warehouse and multidimensional analysis techniques shows the promising future to apply BI and support decision-making in business.

BACKGROUND

As businesses continue to use computer systems for a growing number of functions, they face the challenge of processing and analyzing huge amounts of data and turning it into profits. In response to this, enterprises are trying to build their business intelligence (BI), which is a set of tools and technologies designed to efficiently extract useful information from oceans of data. Business intelligence which introduces advanced technology into enterprise management (such as data warehouses, OLAP, data mining), not only provides enterprises with the ability to obtain necessary information, but also to turn them into useful knowledge that will improve an enterprises' competitive advantage (Xie *et al.*, 2001). The functions of business intelligence include management of data, analysis of data, support of decision, and excellence of business (Liang *et al.*, 2002). Business intelligence system queries a data source, uses techniques such as online analytical processing and data mining to analyze information in the source, and reports the results of its work (Ortiz, 2002). Business intelligence tools enable organizations to understand their internal and external environment through the systematic acquisition, collation, analysis, interpretation and exploitation of information (Chung *et al.*, 2003). However, the primary challenge of BI is how to represent the sets of knowledge discovered by using advanced technologies, manage, and diffuse them. In most cases, enterprises build knowledge management systems. However, these systems do not consider the dynamic characteristics of knowledge activities (Maier, 2007).

In an enterprise, the structure of knowledge activity, which depicts activities in the knowledge life cycle (Alavi and Leidner, 2001) and potential issues in the process, is dynamic (Figure 1). Two systems are observed in Figure 1. The lower part of Figure 1 shows the "knowledge activity" main system, which projects internal and external changes. The upper part of Figure 1 depicts the system, which starts from requirement of solution approach, and is followed by knowledge sharing, knowledge innovation, knowledge similarity, knowledge externalization and break through knowledge. Furthermore, there are two "feedback" mechanisms

in each system. In Figure 1, the solid line represents the flow and relationship between each knowledge activity. In contrast to the solid line, the dashed line represents the model of barrier of knowledge activity, which often occurs in the real world. Note that the dash line also shows "adjusted" feedback, which brings in an adjusted (opposite) function into the system.

Some business approaches focus on the "enhanced" feedback (solid lines) in order to increase effectiveness of Knowledge Management (KM) and decision-making (Alavi and Leidner, 2001). However, those approaches are merely temporary solutions and in ad hoc manners. Those approaches become dysfunctional eventually. Therefore, a leverage approach (i.e., focusing on improving the adjusted feedbacks, which is represented by the dash lines in Figure 1) is practical and desirable to achieve effectiveness of BI in decision-making.

To model analytical knowledge in an explicit and sharable manner and avoid the ineffectiveness of applying BI in decision-making, it is required to makes clarification of the following issues:

1. Businesses are required to efficiently induce the core knowledge domain (Dieng *et al.*, 1999) and make efforts on high-value and applicable knowledge.
2. From standpoint of technology, knowledge is required to accumulate itself and then be shared with other sources.
3. The lack of well-structured knowledge storage has made the integration of knowledge spiral activities impossible (Nonaka and Takeuchi, 1995).
4. Based on the AK warehousing, the paper uses the multidimensional technique to illustrate the analytical knowledge. The proposed analytical knowledge warehousing eventually stores the paths of analytical knowledge documents, which is classified as non-numerical data.
5. Analytical techniques are used to project potential facts and knowledge in a particular scenario or with some assumptions. The representation is static, rather than dynamic.

MAIN FOCUS

This chapter is based on the data warehousing and knowledge discovery techniques: (1) identify and represent analytical knowledge, which is a result of data analytical techniques, (2) store and manage the analytical knowledge efficiently, (3) accumulate, share, distribute, and integrate the analytical knowledge for BI. This chapter is conceptualized in Figure 2 and illustrated in five levels:

1. In the bottom area, there are two research domains: the left side corresponds to the data storage system

Figure 1. The dynamic structure of knowledge activity in enterprise