Chapter 11
Knowledge Innovation Through Update Propagation in Collaborative Data Sharing Systems

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ABSTRACT
Innovative knowledge discovery comes through collaboration of knowledge in educational systems. In a collaborative educational system the heterogeneity of data in different learning management systems presents many difficulties for data sharing; some of these difficulties are how to integrate data, produce results for user queries, and find the correct data from heterogeneous learning management systems. In the past few years, various educational system architectures have been proposed; however, issues related to sharing data from different systems have been given less attention. Considering the lack of collaboration of knowledge this chapter investigates a problem of sharing of innovative knowledge among collaborative educational institutes. The knowledge is shared by propagation of updates. Updating innovative knowledge is done by propagating update from the originating source to other collaborative partners. The author examines update propagation in both cyclic and acyclic networks. Moreover, the authors considers cases where a source is temporarily unavailable or offline.

INTRODUCTION
Knowledge sharing deals with the knowledge exchange between heterogeneous Knowledge Base Systems (KBSs). Sharing of knowledge between knowledge base systems are different from the data integration systems (Lenzerini, 2003; Halevy, Ives, Suciu, & Tatarinov, 2003). Schema-level mapping and data-level mapping, a.k.a mapping tables are considered for creating acquaintances between knowledge bases systems, where the knowledge update between two systems is processed pair-wise. Schema-level mapping (Miller, Haas, & Hernandez, 2000) is used to resolve knowledge structure heterogeneity between two
knowledge sources and mapping tables are used as the form of data-level mappings (Kementsietsidis, Arenas, & Miller, 2003) for different knowledge vocabularies, which contains a set of data associations between data values in two sources. The use of mapping tables in the case of query answering or data updates introduces the following ideas. 1) Semantics of query answering or updates in autonomous knowledge base system which relies on the translation of queries or updates queries between sources through the mapping tables. 2) The notions of sound and complete translation are to characterize the relationship between translated queries or updates. 3) The definition of the mapping tables is not only the association between data values but also the association between pairs of translated queries and updates.

**SYSTEM MODEL**

The system architecture under consideration is shown in Figure 1. Our cooperative KBS consists of a set of sources with local knowledge base system \( \{KBS_i, \text{ for } 1 \leq i \leq m\} \), where each \( KBS_i \) is a pre-existing autonomous knowledge management system contains knowledge data source. Each system provides a set of services to share and access its knowledge locally and remotely. For example each system provides acquaintance services for creating acquaintances with other systems, query service for retrieving information over the network, and update service for updating local and remote knowledge. Once a system joins the network, it can establish acquaintances with other systems exchanging their schemas and use services exists in local system and its acquaintances. An acquaintance is a connection between two systems and is established by generating mapping tables (Kementsietsidis et al., 2003) on both systems. The acquaintances are transient since each system is fully autonomous and joins or leaves the network at its own will. Formally, we can define our collaborative KBS as follows.

*Figure 1. System model*