



Use Case 2 in Health – Business Cases Hospital Information System

KW Partner: VUB Star Lab

1 Overview

Challenge

Data in a healthcare information system is dispersed and heterogeneous in a setting where speed of access and common presentation are important

Solution

Integration and subsequent mediation of medical databases at the semantic level

Why a Semantic solution

Solutions focused on integrating databases tend to ignore the underlying meaning of the data and its structure so that an intelligent consolidation and presentation of data is not possible

Key Business Benefits

Speed of access to the required data is vitally important in a healthcare setting as well as a common view on the data by different users

This use case deals with the issue of database integration in the domain of healthcare. An expanded description of the use case can be found at [1].

Health care organisations such as hospitals may have several dispersed data sources containing interrelated information. For example, there may be a central repository which contains administrative information of all patients registered at the hospital. Additionally, each division holds additional (or even the same) information about the diagnoses and treatment of the patients that they have dealt with. As information stored about a patient in one division may be relevant to a (para-)medical professional seeking information from another division, an unified search is highly desired.

Two further challenges in this case are that:

- (1) data may be stored in very different ways, from totally unstructured text (e.g., notes written by a physician) to highly structured repositories (e.g., medical relational databases),
- (2) access must be achieved within an efficient time frame.

Keys components

Existing Software

Middleware for database integration

Research and development

Data wrapper (RDBMS -> ontology)

Query mediation

Semantic matching

Ontology engineering

Technology locks

Database to ontology mapping algorithm

Intuitive graphical mapping interface

Ontology model mapping

2 Current Practices and Technologies

2.1 Typical business practices

The typical approach is based on the syntactic coupling of relational databases based on their structure, and the exchange of information through messaging. This is however only a partial solution as no use is made of semantics, i.e. the meaning of the information.

Language and Computing N.V. (L&C) and VUB STARLab collaborated to integrate dispersed relational databases using ontologies as the central conceptual knowledge schema.

In this case the ontology is one from the medical domain containing over 2 million medical concepts interrelated by over 5.3 million relations. In order to enable this, L&C wants to extend its ontology management server LinKFactory® (see review of current systems) with a component to integrate information from external relational databases. VUB STARLab developed a suitable language able to define a coupling between a relational database and an ontology in a natural manner and provided a methodology for creating such a coupling.

2.2 System requirements Analysis

From the analysis and work done so far the following requirements stand out:

- Greater accuracy in the matching of database to ontology concepts in order to reduce the amount of human involvement in the initial mapping generation
- Better visualisation approaches for data and ontology structures and their mappings
- A tighter semantic coupling between the database and the ontology
- Methodology for interpreting an ontology and expressing its relationship to a non-ontological data structure
- Resolution of differences in ontological models
- Handling of very large and complex ontologies and application databases

2.3 Review of the current systems

L&C's ontology management system LinKFactory®¹ is a framework designed for building, managing, and maintaining large and complex ontologies. It adopts a typical 3-tier architecture:

- LinKFactory® Workbench: a client application to manage the LinKBase ontology (client tier)
- LinKFactory®: the server interface, receiving and answering user requests, holding the business logic and requesting data (application-server tier)
- The data layer accessing the underlying database. This database contains all information the LinKFactory® server needs to operate (user information, ontology content and maintenance information) (data-server tier)

As a preliminary step, L&C has already developed the MaDBoKS system (Mapping Databases onto Knowledge Systems) as an extension to LinKFactory® (see also Figure 1, screenshots reproduced from [1]):

- A module for the LinKFactory® Workbench providing GUIs and features in order to conveniently and semi-automatically map (relational) databases onto the LinKBase® ontology (or any other ontology contained within the data-server tier).
- A mediation layer extending the data access layer of the ontology server and provides the necessary mediator agents and database wrappers.
- Modules for the LinKFactory® Workbench enabling the graphical browsing/querying of the semantically mapped databases at ontology level.

¹ <http://www.landcglobal.com/pages/linkfactory.php>

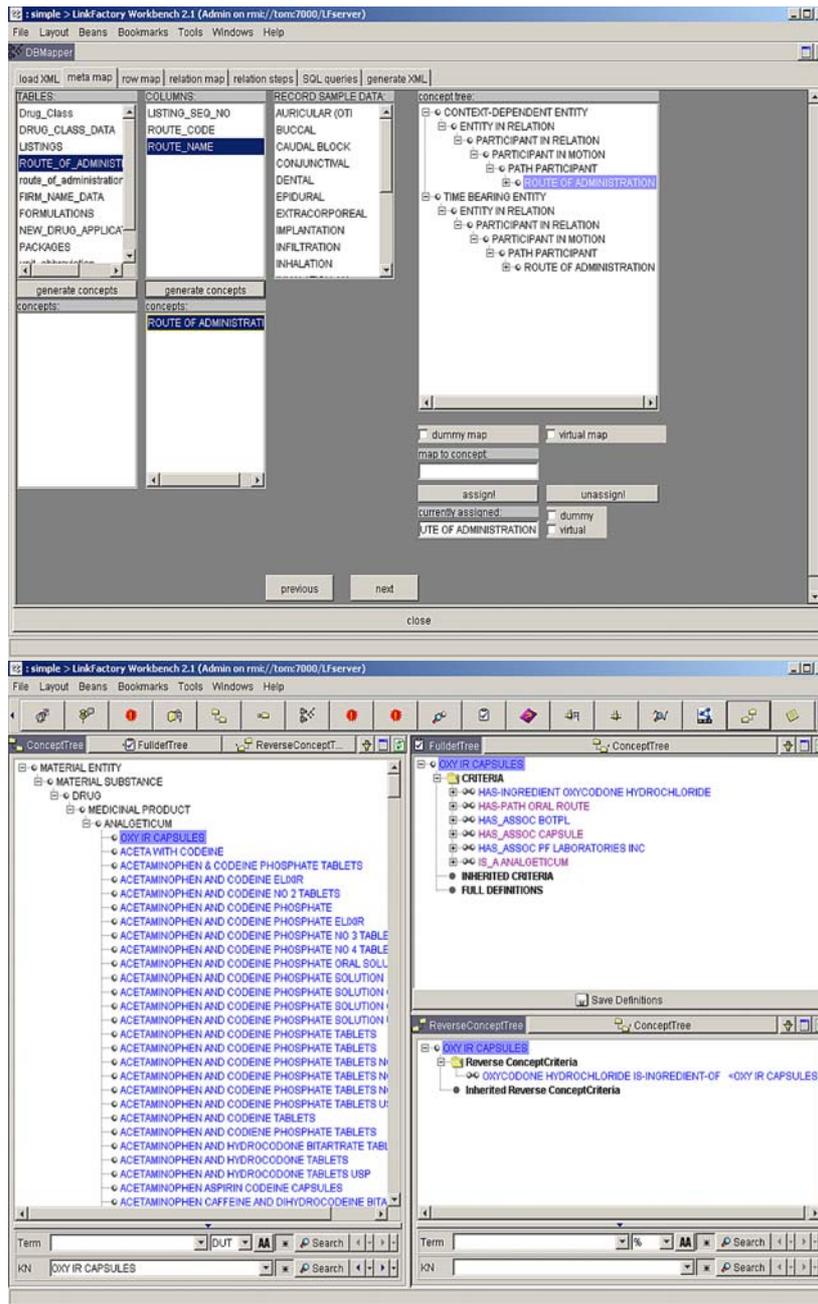


Figure 1 – Screenshots of LinkFactory® Workbench

References

- [1] Deray, T. and Verheyden, P. (2003) [Towards a Semantic Integration of Medical Relational Databases by Using Ontologies: a Case Study](#). In Meersman, R., Tari, Z. et al. (eds.), *On the Move to Meaningful Internet Systems 2003: OTM 2003 Workshops*, LNCS 2889, Springer-Verlag, pp. 137-150.