Applications Based on Ontology or Database

Ladislav BUŘITA[a]

[a]Communication and Information Systems Department, University of Defence, Brno, Czech Republic and
Department of Industrial Engineering and IS, Tomas Bata University in Zlín, Zlín, Czech Republic, e-mail: ladislav.burita@unob.cz

Abstract

The article presents two approaches to the creation of applications working with information: an approach driven by ontology or the one driven by a database. The first approach is represented by the application based on Knowledge Management System supporting cooperation of military universities (MilUNI) , and the second approach is introduced by the application based on Database Management System Postgres for processing the information about university science and research (IS- SID). The article presents the structure and functions of the applications. The approaches are compared, which results in stipulating their potential benefits and problems of the specific applications development.

Key words: ontology, database, KMS, DBMS, ATOM, MilUNI, Postgres, IS-SID

1. Introduction

The article presents the experiences of the systems development the primary aim if which was to process data and provide information to users. The development environments of these systems, their data models and principles of operation have been changing, and thus it is appropriate to summarize and assess them to identify the main trends in their development.

The two important trends in data processing and information systems have taken shape:

1. Ontology driven systems.
2. Systems with a database basis.

2. Software ATOM for the Ontolgy Driven Systems

For the creation of ontology driven applications we use the Knowledge Management System (KMS) ATOM (Aion Topic Maps engine) [1]. One of the goals and benefits of the ATOM is to support the implementation of projects of knowledge systems, especially effective development of powerful web applications.

This has necessitated some extensions or specification of the Topic Maps (TM) standard, such as changes in the processing of occurrences of classes, work with associations and development of the user interface.

2.1 ISO Standard 13 250: Topic Maps

The TM model consists of three basic elements: topic, association between topics, and occurrences of the topics [2].

It is standardized in ISO/IEC 13250:2003. The topic contains a denominated subject of interest. Each topic represents just one subject. It is a place in TM where all known information on the given subject is available by means of relations and occurrences.

The subject is a part of the real world, which is described in TM. Each subject is represented by one topic and it can be anything: a person, thing, entity, process, etc.

Associations represent relationships between topics; they are bidirectional, and express relationship between subjects. Occurrences are formed by information relevant to a given topic; they can refer to information or they might just contain it.

2.2 Characteristics of ATOM

ATOM is a KMS for sharing data; it is a non-programming web database SW that does not require special knowledge and can be used for intranets; it can be used as a construction kit for building web applications with powerful information retrieval, and for various encyclopedias, dictionaries, knowledge bases in applications where wiki approaches are not sufficient enough. The complete ATOM solution includes three layers (environments):

1. ATOM Studio: Ontology Designer, user administration, batch data in/output module.
2. Data Editor: Includes data into database via the ontology.
3. User Portal: Approach to knowledge system.

At first, create the ontology of your problem domain in the Ontology Designer. You can design the ontology by drawing, which is similar to drawing on a flip board, or writing it through filling in forms and using pre-prepared templates and adjusting them to your needs. Immediately, you can enter data through the forms which are generated from the ontology in the Data Editor. And after that you are able to work with data, perform information retrieval or even visualize them and complete access by user portal.

3. The MilUNI - Ontology Driven Application

The content of an application is defined in the ontology. The ontology definition is an important procedure that follows an analysis of the domain of interest. The most important part of the ontology consists of classes that formulate the term structure of the domain. The MilUNI ontology contains the set of classes like ARTICLE, COLLECTION, PERSON, ORGANIZATION, etc., se the Fig. 1.

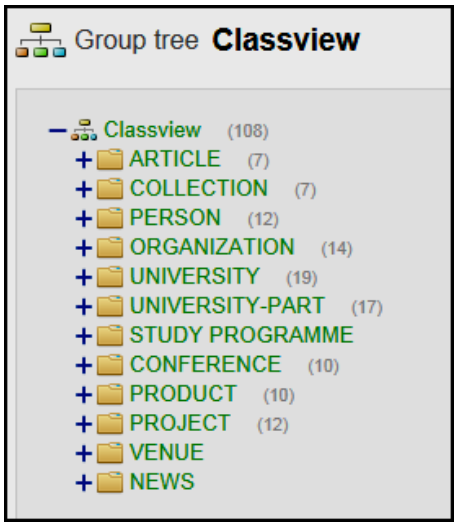

Fig. 1 Class view in the ontology

The application has, according to the rights set for users, two forms. As a portal for a common user to get the information needed and as an ATOM SW interface for a qualified user for entering and editing data, or as a system administrator for editing ontology and managing users.

3.1 Content of the application

The main feature of the MilUNI is a user friendly access to the information about the structure of the system, its main educational areas, the program of the faculties' education, list of departments, research and conference activities, etc. MilUNI includes data from public sources on about 100 universities and their 300 organizational parts (faculties, departments). They are situated in 40 countries and 130 cities, see Fig. 2.

The most common way to obtain the required information is browsing the knowledge base of a selected class, such as UNIVERSITY; see an example in Figure 2. Required data about the university can be obtained, then its field of study, the list of its academic staff and students, and perhaps even their publications at conferences.

3.2 User Portal

The User Portal (UP) covers data, information, and knowledge in the system to shield users from the details of implementation. The UP is prepared as a typical portal template that is designed for any similar type of applications, see Fig. 3 and 4.

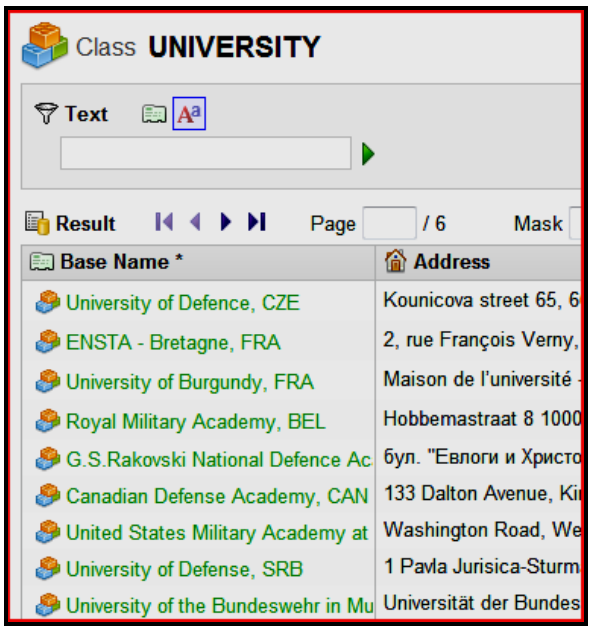

Fig. 2 Set of universities

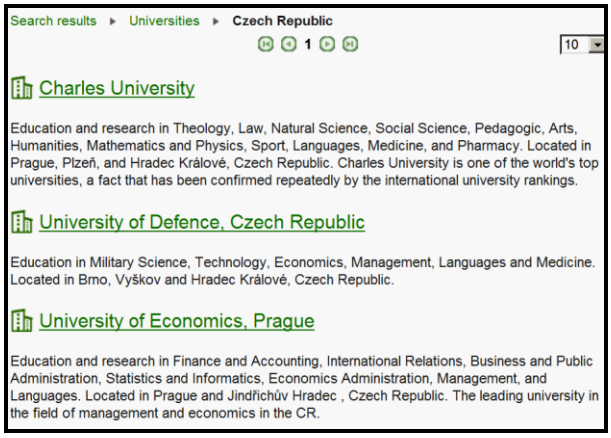

Fig. 3 User Portal – search results

Fig. 4 User Portal – page with detail information

4. Relational Database Management System

Relational database management system (RDBMS) has been the platform for data storage and retrieval for more than 40 years. The platform is highly successful; many information systems have been created with the RDBMS data layer (Fig. 5).

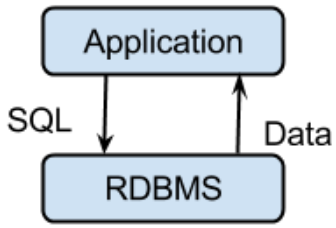

Fig. 5 Applications with the database layer

IS-SID background database system is Postgres, but any RDMBS with SQL language support can replace it. Early applications with database background were developed using structured methodologies. In such methodologies the data are the core of the application; usually the simple create, read, update and delete (CRUD) operations are available.

In today's applications, the focus is more on the user interaction and data structures are usually created based on interactive and iterative methodologies with UML support.

The PostgreSQL boasts sophisticated features such as Multi-Version Concurrency Control (MVCC), point in time recovery, tablespaces, asynchronous replication, nested transactions (savepoints), online/hot backups, a sophisticated query planner/optimizer, and write ahead logging for fault tolerance [3].

5. IS for Scientific Information Division

The goal of the project is to support day-to-day activities associated with research and development at university.

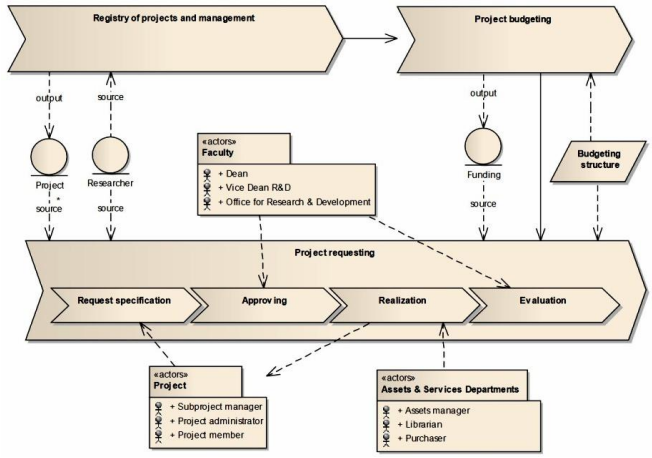

Fig. 6 The requesting process

The following processes are implemented in the system:

- The process of building the register of the scientific results by university members.
- The support for material, books and business trips using requests based system.
- The main processes are supported by many simpler and technology processes and files; see an example in Fig. 6.

IS-SID is a web based application. The database layer serves only as data storage. The application logic is moved to the web application server. User experience is enhanced using Rich Internet Application techniques (interactive forms, dialogs and screens).A detailed view of the user interface is presented in Fig. 7.

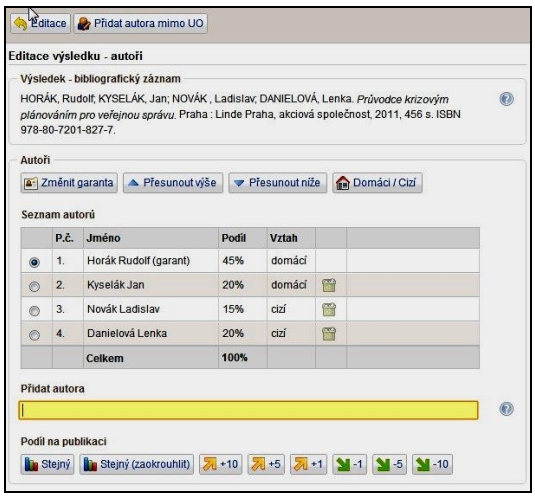

Figure 7 Rich user interface example

6. Comparison of Both Approaches

The comparison of these two approaches is executed in the creation of the application data structure and in the development environment used. The evaluation is not based on the comparison of both approaches (in terms of which one is better or worse), but as a commentary on each of the options so that the readers could compare the differences themselves.

6.1 Creation of the application data structure

The data structure in the database is flat, only simple associations between tables, 1:1 and 1:N, are supported. The database schema is a product of standard methodologies, e.g., structured (Entity Relationship Diagram, Relational Data, Model) or iterative (Use Case Realization). The custom application then defines more complex associations between data elements.

In the ontology driven application the data structure is stored in the ontology. It is defined by classes with characteristics (class attributes) and associations between classes. However, the data structure also consists of other elements, such as group- trees (predefined classifiers or taxonomies); e.g., geographical layout (continent – country – city).

The creation of ontology is a complex task and its successful accomplishment lies in the quality analysis and in good knowledge of the subject area (domain of interest). Some partial design or verification procedures for creating ontologies can be partially automated. Ontologies of functional applications are under constant development in accordance with the changes in the subject area as well as in the application objectives.

The implementation process of ontology in the ATOM Studio is quite an easy and clearly stated task if the previous analytical phase has been successfully managed. The ATOM SW huge advantage lies in the wide variety of data types for class characteristics and the possibility of virtually any organization of associations. Another significant benefit is the ability to make changes in the ontology, which is immediately reflected in the data. The flexibility of ontology is an important factor in achieving dynamic applications.

6.2 Application development environment

The application development is independent on the database management system. The interface between application and data storage is strictly defined; it is based on SQL Language. Developer skills are required to build even a simple application. But any web technology can be used to develop an application. In our case the combination of the following technologies is used: JavaScript/jQuery UI, PHP/CodeIgniter.

The development environment of the ontologically driven application based on SW ATOM is a stable, but closed modular system in which the user is not focused on the development of the application itself, but only on its content and structure. The instances of classes connected by relationships and appropriately supplemented by group- trees, hierarchies, and other elements, form the knowledge base of the applications.

The content of the user portal is built in the ontology in such a way that the different parts of the portal are filled with the content: the main page, the page of the resulting search list in the knowledge base and the page of the detailed view; all according to the user requirements.

7. Conclusions

The criteria subjected to comparison show the differences in the definition of the data structure. While the database schema allows only a table structure with simple relationships, the ontology defined structure allows variety of classes and relations of any cardinality.

The development environment of both applications is quite different. While the database approach is based on the creation of a custom application, the ontology application SW is closed. The user interface of the database access is determined by the developed application. The ontology driven application can change the interface by the fulfillment of the ontology.

Acknowledgement

The article is prepared as a component of the research project for the Development of the CIS Department, Faculty of Military Technologies, and University of Defence *Prospective Technologies in Communication and Information Systems.* It introduces some outcomes of the solutions in area of Information System and Knowledge Management Systems. The results of the research are part of the education process within the University of Defence, Brno.

About Author

Ladislav BUŘITA was born in Kutná Hora in 1945; studied at Military College in Vyškov; since 1970 has been holding command positions; 1970-1975 graduated from the Military Academy in Brno in the field of computer science; in 1975-1980 worked at the General Staff Computer Centre in Prague and in 1980-1987 at the Research Institute of the Military Topography Survey in Prague. Since 1987 has been working at the CIS Department at the Faculty of Military Technology (FMT) University of Defense (UoD) in Brno as an assistant professor, head of section, head of department, and academic worker (pensioner). Since 2007 has been a member of Thomas Bata University in Zlín, Faculty of Management and Economics. Finished his academic studies (for CSc. degree) in 1985; became an associate professor in 1991 and a professor in 2003. A member of the UoD and FMT Academic Board, a member of the MoD Board for Defense Research; has been in charge for the FMT Research Program and Defense Research Project MENTAL; has published several university textbooks and books in the fields of informatics, interoperability and project management; publishes papers and gives presentations at national and international conferences.

References

[1] AION CS company and software Aion Topic Maps Engine (AToM), AION CS, Zlín, Czech Republic 2013, <http://www.aion.cz/>.

[2] PEPPER Steve. *The TAO of Topic Maps*, 2012, <http://www.ontopia.net/topicmaps/ materials/tao.html>.

[3] PostgreSQL About. Available online. URL: <http://www.postgresql.org/about/>.