Application of the Financial Industry Business Ontology (FIBO) for development of a financial organization ontology

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Abstract. The article considers an approach to a formalized description and meaning harmonization for financial terms and means of semantic modeling. Ontologies for the semantic models are described with the help of special languages developed for the Semantic Web. Results of FIBO application to solution of different tasks in the Russian financial sector are given.

1. Introduction

Multiple financial organizations use terms for concepts which meaning is informally defined by their interconnections and specifics of these organizations' operations. Financial specialists use a lot of complex interconnected concepts, including those defined by international standards (e.g., IFX) and settlement systems (e.g., SWIFT) developed to provide global financial services.

Discrepancies in understanding and usage of the terminology by different financial bodies influences efficiency of cooperation which largely depends on common comprehension of semantics behind the terms, whether the same or different. For example, such terms as *debit* and *credit*, while with some limitations, may be used to mean the same in different fields of finances.

Development of the efficient software is as well largely dependent on correct understanding of various terminology. For example, coordination of works between organizations is currently carried out by transmission of documents (more often electronic ones) or oral messages from one company to another and their following manual processing to introduce the data into an information system. At that, one organization may use (including its software) the term "*agreement*" to denote a document describing relationships between parties, while another will call the same document "*contract*". A communication failure appears during the data exchange process, as well as a need to harmonize the name of the document. At the same time, different organizations may use the same word "*loan*", while details of its use will be different (however insignificantly) depending on organization's specifics. Solution to this issue is possible by means of a formal description of concept's meaning which helps to resolve that "*agreement*" and "*contract*" are the same document, as well as to describe peculiarities of the concept of "*loan*".

2. Ontologies as application domain theories

A new concept of the World-Wide Web (WWW) has being in development for the last 15 years. This concept is known as the Semantic Web or Web 3.0 [1]. The very term Semantic Web was introduced by Tim Berners-Lee, a creator of the World-Wide Web, in September of 1998. The underlying idea of the Semantic Web is a formalized description of the concepts and corresponding terms to describe data

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and information in the network. Such descriptions allow for their processing by computers. The Semantic Web may be seen as an effective way to present the data in the World-Wide Web or as a globally interlinked database [2]. Within the framework of the concept, a number of technologies (languages, tools, projects) was developed for formal description of data semantics and data management.

Important point is that the use of technologies developed within the Semantic Web framework is not limited to creation of WWW tools, but allows for formal description and management of concepts in different software systems [3, 4].

Ontologies, their description language and management tools are among the central elements of the Semantic Web [5].

Ontologies are descriptions of certain application domains of knowledge which include sets of concepts and links between them. Complex application environments usually use not one, but a set of ontologies differing in the level of abstraction of the concepts described.

Different languages may be used for ontology description. Such languages as RDFS [6] and OWL [7] were developed within the Semantic Web framework. These languages have different capabilities facilitating creation of detailed concept descriptions and performance of logical inference. RDFS allows description of concept hierarchies and relations between them. Logical inference in RDFS is defined by a set of rules. The OWL language is based on a solvable mathematical logic (Description logic) and its logical inference is based on automated theorem proving. Ontologies allow for harmonizing comprehension of semantics behind any terms used on the basis of their formal description. It creates a possibility to integrate data [8] from several diverse sources (e.g., databases, spreadsheets) and describe their coordination [9]. A large number of ontologies has already been developed to describe general concepts appearing in different fields of human activity. Suggested Upper Merged Ontology (SUMO) [10] and Sowa may serve as examples of such ontologies.

3. FIBO: an ontology for finance industry

Currently, an OMG consortium, which is concerned with object-oriented technologies and standards, leads an international organization aimed at development of business ontology for a financial industry (Financial industry business ontology, FIBO) [11]. The FIBO ontology contains semantic linking between the financial concepts, descriptions of their meaning and practice of professional usage. In particular, FIBO describes such basic concepts as legal entities, market data and financial processes, structure and contractual obligations of different financial instruments.

There are two ways to represent an ontology in FIBO: formal description of the concepts and their interconnections in OWL, as well as their description in a natural language using financial industry dictionaries. Formal OWL description is made with a Protégé ontology editor widely used in semantic modeling. It is expected that FIBO has to become a *lingua franca* of the financial industry supporting automation of business processes. It is intended for use by software developers, business analysts and other participants of the financial sector. Business terms and definitions described in FIBO may be used as a reference model, to which financial organizations can link their own (local) models. A possibility to create logical data models, which get their formal semantics from FIBO, arises. Application ontologies may be created on the base of FIBO to support query processing with logical inference.

FIBO structure

In actual practice, FIBO is not a single ontology, but rather a set of a fair amount of ontologies divided into modules and submodules. Modules (submodules) include sets of shared ontologies. Ontologies constituting FIBO are interlinked with «uses» relationship – one ontology may use, extend and elaborate concepts described in another ontology (or several other ontologies).

All the FIBO ontologies are based on the top level ontology including categories called «sections». The sections include description of different types of basic entities (e.g., independent / linked, real / abstract, etc.). The top level ontology uses the FIBO Foundations, a core module containing a large number of submodules. FIBO Foundations serves as a base of other modules being currently

developed, such as FIBO Business entities and FIBO Indices and Indicators. Such modular formal model allows for separate description, application and extension of concept groups contained within separate modules.

FIBO Foundations core module

The FIBO Foundations module includes a set of general concepts which are further used to describe semantics of financial concepts (and corresponding terms).

This module describes general concepts which are not unique for the financial industry, but they are necessary to describe the financial concepts. This module may be used outside of the FIBO framework, e.g., to create other domain ontologies or an organizational ontology.

FIBO Foundations includes a set of basic legal, contractual and organizational concepts. Concepts available in other general ontologies (industrial standards) are not included into this ontology. However, in some cases FIBO Foundations uses a Proxy concept to link to concepts described in other general ontologies.

For example, such proxies are used for (address) and (country). There are two reasons for this: concepts used in the financial industry are usually more specific than corresponding non-financial concepts.

Examples of such may be seen in contracts or transactions, included in FIBO Foundations for further elaboration within other specific ontologies. The second reason to use proxies is that characteristics of some financial concepts are often used interlinked to other non-financial concepts (e.g., country, jurisdiction, address, etc). Such concepts are included in FIBO Foundations to be linked from other FIBO specifications.

Basic modules contain all the necessary components allowing for description of financial industry in general terms.

An FIBO Business Entities module is not a part of FIBO Foundations and is actually created on its basis. It is a model of business concepts represented in the terms of financial industry as used in reference and financial documents of different organizations.

This module contains description of ontologies connected to business entities, including legal entities of different forms of business ownership, control relationships and ownership relations. The FIBO Business Entities module also contains detailed requirements for generation of diagrams and reports for business experts. The Business Entities module includes a set of submodules allowing for description of legal entities, corporations, partnerships, trusts, ownership and control, functionally-defined business entities.

In particular, the Legal Entities submodule contains ontologies defining formal basis of legal entities and business entities.

The Corporations module contains ontologies describing companies that issue their shares. Ontologies defining concepts related to types of partnerships and their characteristics are included in the Partnerships module. The Trusts module consists of ontologies defining different types of trusts and related facts. The Ownership and Control module describes different aspects of ownership and control and their application to relations between business entities. The Functionally Defined Business Entities module contains ontologies describing subjects in accordance with their function. The Business entities module describes entities different from those used in the Russian Federation, thus it can be used as a basis for further elaboration.

4. Possible applications of FIBO

The FIBO ontology may be used to attain the following objectives:

1. Creation of custom FIBO-based ontologies on behalf of countries and organizations, describing peculiarities of meaning and use of financial terms. It will allow for formalization of the terminology harmonization task by coordinating ontologies used by different countries (organizations). Coordination of ontologies may be performed by resolving tasks of financial ontology display [12].

2. Creation of ontologies for new domains of financial industry by merging and developing existing ontologies.
3. Development of application software using financial ontologies and allowing for implementation of the language interface between a business and information technologies.
4. Use of semantic technologies to implement common data storage methods (e.g. relation databases) and to create new types thereof (e.g., triplet storage).

5. FIBO as a basis for financial organization of Russia

Different ontologies may be developed on the basis of FIBO for the Russian financial market – models of the Russian financial market with the aim to improve data exchange, harmonization and integration between Russian and international financial organizations.

Let us consider a process creating an ontology of the Russian financial organization with the FIBO ontology.

Thus, we analyzed and refined concepts (terms) described in FIBO and selected those more fitting the financial sphere of Russia. Then, the terms in the specific domains were elaborated, new types of concepts were added, as well as attributes and links between them reflecting specifics of the Russian finances. The result was creation of the prototype ontology of the financial domain of Russia (Russian FIBO, RFIBO).

RFIBO may serve as a base to create ontologies for different branches of the financial sector, such as state finance, business finance, etc.

After elaboration and extension of the branch ontology, an ontology was created for an operating Russian microfinance organization.

This ontology was applied to a task of information integration [13] from diverse distributed data sources to draw up a report "*Weighted averages of total cost for consumer microloans*" for the Central Bank of the Russian Federation. The sources of information used (MySQL and 1C databases) lack support for distinguishing between different categories of microloans and such categories cannot be defined. Besides that, the MySQL database contained just the payment schedule as per the contract, while the 1C database contained only the record of the actual receipt of the borrower's money, that is why the arrears report had previously been drawn by the organization employees manually. This task was solved by means of merging ontologies of the both data sources and creation of a new common ontology from them.

6. Conclusion

Use of semantic modeling and ontologies allows for formalization and exact definition of financial terms. A prototype of the Russian financial ontology and an organizational ontology was created on the basis of FIBO. It allows for improved solutions of automation tasks for the financial sector and development of a more advanced software.

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