

Ontology of Services in the Guarantee Fund

Saša Arsovski,

Guarantee Fund of the Autonomous Province of Vojvodina, Novi Sad, Serbia

E-mail: sasa.arsovski@gmail.com

Abstract— Creating and using ontologies for Service Oriented Architecture (SOA) should speed up and automate the work of state administration and create prerequisites for technical and organizational interoperability for different government agencies. This paper proposes an approach to building an ontological model of the electronic services of the Guarantee funds. Authors also present a methodology for ontology construction and implementation in the Guarantee fund of the Autonomous province of Vojvodina. The main peculiarity of our approach is a proposed relationship between the services and administrative procedures. This relationship is modeled in such a way, that the service profiles are semantically represented as members of the administrative procedure class. The modeled Guarantee fund service ontology is the basis for the implementation of SOA and represents a link between business requirements and IT solutions. The modeled ontology of the electronic public services shows a portion of an ontology that describes the public electronic services of the Guarantee Fund.

Keywords— *Ontology, Electronic Services, Guarantee Fund*

I. INTRODUCTION

In the last few years, information and communication technologies have been used for the provision of public services, improvement of managerial effectiveness and promotion of democracy, a development that is commonly termed as e-government. The implementation of electronic public services is a process which implies the determination of objectives and actions necessary for the modernization of the business and the inclusion of as many citizens as possible in the activities that are the responsibility of the financial funds of the state government. The process is very complex, and can be divided into several groups of activities: planning, design, implementation and training. The term public broadcast service in this context will be considered as a set of tasks that a citizen or company may perform with the services of the Guarantee Fund, mediated by electronic communication mechanisms and a set of activities performed between the APV Guarantee Fund and commercial banks, the Association of Serbian Banks. Service-Oriented Architecture (SOA) is a flexible set of design principles used during the development and integration of computer systems. A system based on SOA functions as a system of interoperable services that can be used within multiple separate systems. SOA also enables users of the services and Web-based applications to be aware of the existence of SOA. XML is commonly used to connect to the SOA services. SOA defines the ways of implementing different

applications for the Web-based environment and uses multiple implementation platforms. Instead of defining the API, SOA defines the communication protocols and functions. SOA divides service functions into separate units and allows the individual services and their functions to be available over the network, so they can be reused and combined in the development of new applications.

IBM defines SOA as “an integration architecture [1] approach based on the concept of a service. The business and infrastructure functions that are required to build distributed systems are provided as services that collectively, or individually, deliver application functionality to either end-user applications or other services”. In SOA, information systems are divided into services, so that every service performs a meaningful unit of work that is related to a business process. SOA allows businesses to retain their existing assets, instead of replacing them with more expensive systems. A new layer can be established to add new functionality on top of existing assets to respond to market changes without the need to spend time and money on new systems.

There are many benefits of SOA, including increased business agility and flexibility; reduced IT development costs; the ability to re-use existing assets and to integrate them with future assets; the ability to integrate disparate IT systems so they can communicate with each other; ability to create a flexible IT infrastructure that can meet the business needs with the ability to support future enhancements; and a reduced total cost of ownership (TCO) by extending the life of assets and utilizing non-proprietary technology [2]. These benefits highlight why SOA has become a buzzword into today's business world as organizations need to deliver richer business solutions faster and at lower costs.

There are three stages in the evolution of an SOA model including: Development of Web Applications, Development of Composite Applications, and Automatization of Business Processes. Web Application Stage focuses on providing rich client-based solutions for internal and external users. This can include web-based CRM, ERP or other applications that can be accessed through a browser [3]. The second stage of Developing Composite Applications includes providing information and data from a variety of sources and making this available for internal and external customers. These requests would include building multiple applications that could be accessed through a single portal, web based desktops for users, and role based access for different users [3]. Automating

Business Processes is the stage where the application, data, and infrastructure allow users to access data in a timely manner to perform their roles. At this stage, the organization should be able to consolidate multiple business systems into a single system [3]. This should allow business users to change their processes into one end-to-end business process management, requiring new governance and organizational models that will represent this new single system.

As organizations mature around their own implementation of SOA, a governance process must be established in order to continue to reap these benefits. Governance is defined as a set of processes, tools, and organizational structures that are essential to delivering SOA benefits. The primary responsibilities of the SOA governance should include: publication of standards and best practices, advertisement of SOA achievements, and the promotion of re-use at a project level [4]. There are many tools available to help facilitate the management of these governance processes and to store all of the metadata throughout the lifecycle of a service. [5] These tools are commonly referred to as SOA Repositories [4]. The primary purpose of the repositories is to store detailed metadata in order to manage and govern the assets throughout development and into production. The repository should also store other types of metadata that include process mappings, business rules, relationships, reference data, documentation, etc. Beyond storage, the repository allows greater governance as workflows can be setup to trigger certain approvals to make sure that services are reviewed by decision makers. In most of the modern applications of SOA, XML and XML Schema provide a unified syntax and vocabulary definition mechanism for messages. However, the XML Schema language addresses structural aspects only, leaving semantics of a defined vocabulary implicit. This leaves a problem with semantic interoperability among processing components unsolved but, on the other hand, does not restrict the flexibility in defining domain-specific vocabularies. An ontology can provide a domain vocabulary, semantics of which is precisely defined in terms of ontological primitives.

Our work is motivated by the problem of applying ontologies [6] in the design of applications for the e-Government domain. The created ontology should meet the following conditions:

1. To provide an explicit representation of knowledge of administrative processes, participants and documents in the credit funds.
2. To explicitly present the elements that make it possible to provide the groundwork for automatic generation administrative act which is a result of executing administrative procedure.

Main advantages of the created ontology which will be described hereinafter are a representation of the administrative procedure business logic with semantic description of the electronic services.

The paper is organized as follows. The second section provides an overview of the standards for building ontology for services. The third section presents an identification of the public services provided by the Guarantee fund APV. The

fourth section presents Guarantee fund service ontology. The fifth section shows the created ontology for the public services of the Guarantee fund APV and compares it with Open Group technical standards. In the final, sixth section, concluding remarks and directions for further research are given.

II. GUARANTEE FUND PUBLIC SERVICES IDENTIFICATION

State development funds are interventionist mechanisms by which the state affects the development of small and medium enterprises [2]. These are institutions set up by authorities of different levels (state, province, local government) and whose activity is aimed at stimulating the development of small and medium-sized enterprises while reducing risk and transaction costs related to the implementation of stimulating instruments (e.g. loans) of Small and Medium Enterprises. Operations of the fund are regulated by the following documents: APV Guarantee Fund Statute, Rules of Operation of the Guarantee Fund APV, annual work program of the Guarantee Fund of APV.

The first step in creating a Guarantee fund service ontology is defining the basic concepts, relations and limitations of the given domain. The basic administrative activities that are common to all development funds are as follows: Registration of participants of the competition, Analysis of the submitted documentation, assessing the risk of funds placement, the decision on funds placement, and Type of placement. It is noticeable that the administrative activities are almost identical for all state development funds, regardless of the type of fund and type of placement.

An important role in the development of the ontology represents the conceptualization and organization of knowledge. The task of conceptualization is to transform informal knowledge into an ontological concept with the help of professionals in their field of ontology modeling.

TABLE I. GUARANTEE FUND PUBLIC SERVICES IDENTIFICATION

Public Service	Description
Receipt of tender documents.	Checking the completeness of tender documentation Receipt of tender documents
Preparing documents for the Commission for issuing guarantees	Preparation of hits registered participants call screening solvency
Evaluating credit rating of the participants	Analysis of the creditworthiness and risk factors Draft proposals for the issue of guarantees
The formation of the decision to issue guarantees	The formation of the decision to issue guarantees
Preparing documents for the signing of guarantee	Preparation for the issuing guarantees

III. GUARANTEE FUND SERVICE ONTOLOGY

The tasks of conceptualization from informal knowledge to an ontological concept with the help of professionals in the area that can be modeled by the ontology play an important role in the development of an ontology conceptualization and organization of knowledge.

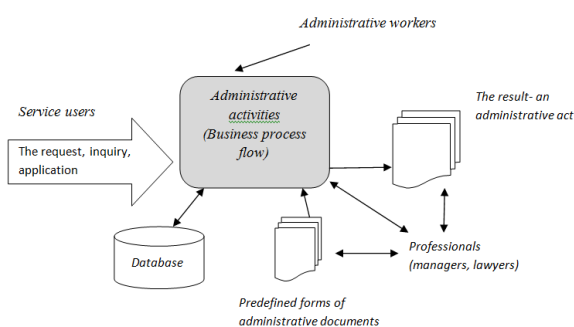


Fig. 1. A simplified model of the activities of state development funds

Fig. 1 shows a simplified model of the activities of the Guarantee funds. In this paper, administrative activities are represented with ontology concept *Procedures*.



Fig. 2. Core classes of the Guarantee fund ontology

Core classes of the Guarantee fund ontology are shown on Fig. 2. An ontology of the electronic services of the Guarantee Fund is modeled following the recommendations described in the technical standards for the creation of the ontology of the electronic services in SOA as a W3C recommendation. Basic concepts of the ontology are defined based on the analyzed elements of the domain. In the case of Guarantee fund ontology, administrative procedures are defined as ontology class.

Communication between administrative procedures and services is presented by an atomic process. The generalization (superclass-of) and specialization (subclass-of) of ontological concepts is represented by the taxonomy (Cohen, 2007) of the main concepts of the ontology.

Below is a detailed description of the service ontology of the Guarantee Fund, which defines business activity presented by the administrative procedure and representation of the business activity (services).

A. The Participants concept

All participants in procedures are represented by this concept. Three subclasses of the Participants class are defined:

- Financial_institutions
- Public_administration

-Clients.

The generalization (superclass-of) and specialization (subclass-of) of the Participants class is shown on Fig. 3.

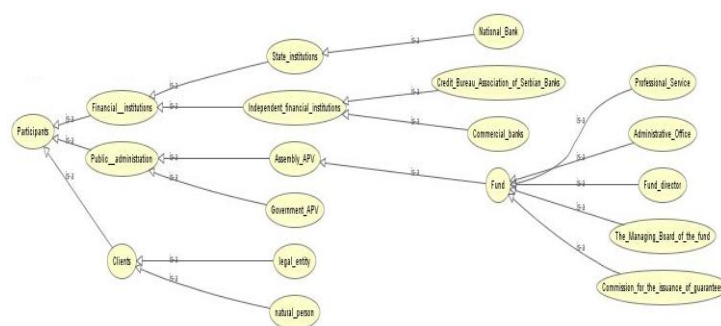


Fig. 3. Extension of the Participants class

a) The Financial_institutions concept

This ontological concept describes financial institutions that cooperate with the Guarantee Fund, as well as the external participants, in carrying out work procedures of the fund. Two groups of financial institutions were identified: 1. State institutions - The National Bank. 2. The Independent financial institutions: Commercial banks, The Credit Bureau Association of Serbian Banks

The National Bank belongs to the national institutions responsible for the monitoring and implementation of monetary and fiscal policy. In addition to the National Bank, in this group are the tax Administration, the Agency for Business Registers, etc. The Credit Bureau and Commercial Banks are market-oriented financial institutions that perform their activity independently of the state. The properties of these concepts are *SubClass* of and *haveService*. The property *SubClass* of describes the structural position of the concept, while the property *haveService* indicates the existence of external services that are invoked during the execution of procedures.

b) The Public_administration concept

The classes described by the concept *Public_administration* represent the organizational structure of the state administration in AP Vojvodina and the place and role of the Guarantee Fund of APV in this organizational structure. The classes identified in the taxonomy of the Fund are, as follows:

- Managing Board
- Fund director
- Professional Service
- Administrative Office
- Commission for the issuance of guarantees

c) The Clients concept

The classes described by the concept *Clients* represent participants who are allowed to apply for Fund open competitions. The classes identified in the taxonomy are: Legal entity, Natural person.

B. The Documents concept

The concept Documents is created by analyzing all of the documents identified in the Guarantee Fund of APV. Three groups of documents were identified: 1. Administrative acts, 2. Planning acts, and 3. General acts.

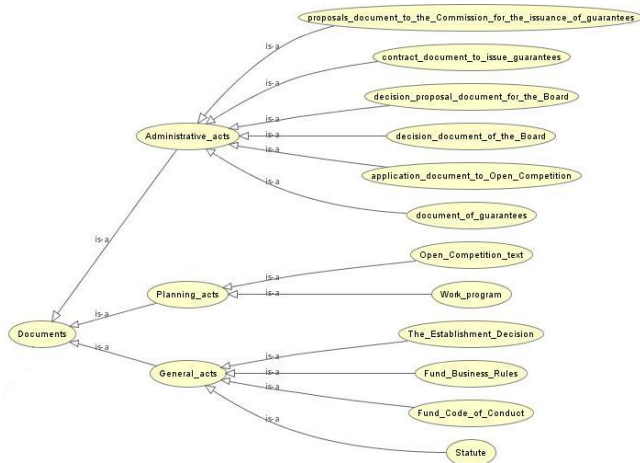


Fig. 4. Documents concept taxonomy

a) The Administrative act concept

As defined above, administrative documents are the product of administrative tasks within business procedures. Semantic descriptions of documents that have been identified as a result of the execution of administrative tasks are given below. If we look at the documents as a product of administrative tasks in the case of the Guarantee Fund of APV, the following documents that appear as a result of the execution of administrative tasks in the business process of issuing a guarantee can be identified:

- The application document to Open Competition
- The proposals document to the Commission for the issuance of guarantees
- The decision proposal document for the Board
- The decision document of the Board
- The contract document for the issuing guarantees
- The document of guarantees

The administrative act concept is a *subclass* of the Documents concept. In addition, it is associated with the property *Producedby* that describes it in terms of the administrative procedure which produces the document of the Administrative act type, and the property *FillBy* which determines the entity from the Participants taxonomy which fills out a pre-defined form (Benner-Lee *et. al*, 2001) of the document of the Administrative act type.

b) The Planning_act concept

Documents belonging to this group are created each year. This group includes the following documents:

- Work program

- Open Competition text

Apart from their property *SubClass*, which defines hierarchical relations among documents, they are associated with properties that describe them in terms of creation and approval:

- *Createdby* – defines the entity from the Participants taxonomy that created the document
- *Acceptedby* – defines the entity from the Participants taxonomy that had approved the document.

c) The General_acts concept

The documents that determine the legal framework of the fund belong to this group. In the case of the Guarantee Fund of APV, these are the following documents:

- The Establishment Decision
- The Statute
- The Fund Business Rules
- The Fund Code of Conduct

Apart from their property *SubClass*, which defines hierarchical relations among documents, they are associated with properties that describe them in terms of creation and approval:

- *Createdby* - defines the entity from the Participants taxonomy that created the document,
- *Acceptedby* - defines the entity from the Participants taxonomy that approved the document.

The basic concepts of ontology are defined based on the analyzed elements of the domain. In the case of the Guarantee fund, administrative procedures are defined as ontology concepts. Communication between administrative procedures and services is presented by an atomic process. In the case of the guarantee fund, each service belongs to only one procedure that is defined in the ontology. Services are described by service profile properties.

The generalization (superclass-of) and specialization (subclass-of) of ontological concepts is represented by the taxonomy of the main concepts of the ontology of the Guarantee Fund of APV Voivodina.

C. Procedure concept

The Procedures concept represents a taxonomy of the administrative procedures of the fund. This taxonomy is created based on operational procedures for issuing guarantees and procedures relating to the creation of planning acts of the fund. In addition, the taxonomy contains procedures related to the utilization of the documents that define legal and regulative framework of funds within the state administration. The taxonomy is shown in Fig. 5. The taxonomy of the Procedures concept consists of following classes: Planning_procedures, Operative_procedures.

a) Planning_procedures concept

This concept describes the procedures aimed at planning annual activities of the Fund. The outputs of these procedures are various documents that contain activities that are to be performed in a calendar year, and related financial resources. The following procedures have been identified: Creating an annual work plan document and creating an open competition document. The properties of classes defined in the concept describe these procedures as follows: *SubClass* of – identifies the structural position of the concept within the Procedures taxonomy. *HaveOutputDoc* – identifies the document that results from performing general administrative procedures. *PerformedBy* – identifies the perpetrators of the procedure. *GeneralActsReferenced* – identifies all *General_Act* concepts, which are a legal/regulative basis for the created planning document.

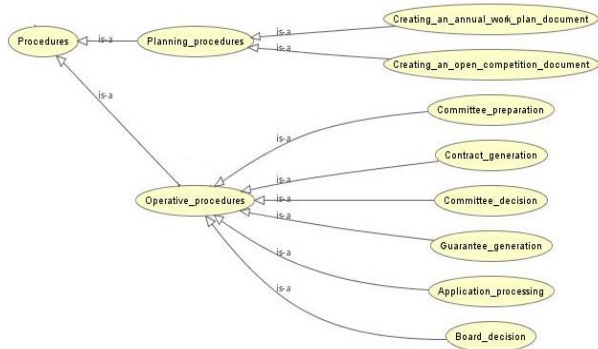


Fig. 5. The Procedures taxonomy

b) Operative_procedures concept

Each task is executed within a Procedure. Each task has input data that an administrative worker or system should fill out, and the result of the execution of the task is an administrative act. The Procedure contains only one task with the corresponding input and output data, which is filled out, by an administrative worker or system. The full Procedure is composed of one or more procedures, while Operative_procedure is composed of one or more tasks.

In the case of the Guarantee Fund of APV, the Full procedure is the procedure of issuing the guarantee. The following classes are identified by analyzing the Operative_procedures concept: Application Processing, as shown in Table 2, Committee Preparation, Committee Decision, Board Decision, Contract Generation, Guarantee Generation.

Each class and subclass of the ontology within the concept of the Operative_procedures has input data. Properties dataProperties describe input data of each Operative_procedures class.

An administrative worker or service fills input data into pre-defined Document template(s) corresponding to an Administrative task. Document template is an active document that contains a code aimed at invoking a service presented by InternalServices profile. It serves as a starting point for a new document creation. *Individuals* of each Operative_procedures class represent corresponding service and corresponding document template that is filled with input data during the execution of an administrative task.

Result of an Administrative task execution is a custom administrative act – Output document. Output documents of an administrative tasks have their corresponding Object_Properties. These properties describe all relations between an Administrative task and concepts Documents (*Producedby*, *FillBy*) and Participants (*Performedby*).

Fig. 6 shows the extension of the Application_Processing class aimed at processing applications on open competition. The Protégé tool is used for modeling, and RDF-Gravity, RDF Graph Visualization Tool for visualization.

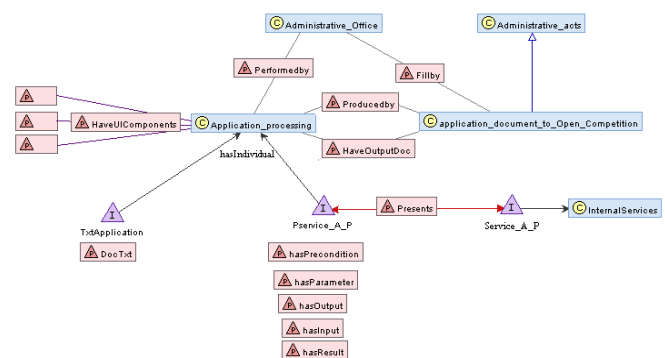


Fig. 6. The extension of the Application_Processing class

The procedure Application_processing is executed by the Administrative_Office. The document application_document_to_Open_Competition is the result of the execution of Application_processing procedure. The procedure for application processing has a unique document template TxtApplication. The service profile Pservice_A_P describes the electronic service invoked by the procedure Application_processing. Mutual relations of ontological classes may be summarized as follows:

Operative_procedures - has subClass - Application_processing
Application_processing - PerformedBy - Administrative_office
Application_processing-HasOutputDoc- ApplicationDocument
Application_processing-hasindividual-Pservice_A_P
ApplicationDocument- ProducedBy - Application_processing

TABLE II. DEPICTS APPLICATION_PROCESSING CLASS, PROPERTIES AND RELATIONS OF THE OPERATIVE_PROCEDES CONCEPT

Class (Operative_procedures)				
Class Name	Properties/Domains		Individuals	
	Relations	DataProperty	Name	Property
Application_Processing	SubClass of HaveOutputDoc Performedby haveUIComponents	ID,Name, Adress Location,PIN Amount,Description	Txtapplication	DocTxt: „Application.doc“
			Pservice_A_P	hasInput,hasOutput, hasPreconditions, hasParameter, hasResult,Presents

Services that are triggered by the specified Operative_procedures during their execution are presented by their profiles (Pservice_A_P,etc.).

The following classes are defined: InternalServices and ExternalServices. Internal Services are the services that are provided by the Fund, while External services are those that are provided by third parties like banks, other administrative bodies, etc. Both have same properties, SubClass of and availableOn. The property SubClass identifies the structural position of the concept within the Services taxonomy, while the property availableOn – indicates a service provider URI.

Members of the class InternalServices (Service_AP etc.) are presented by the PresentedBy property, as shown in Table 4. This property points to the service profile (P_Service_A_P) that presents the service. The service profile is described using the following properties: *HasInput*, *HasOutput*, *HasLocation*, *HasPrecondition*, *HasResult*, *Presents*.

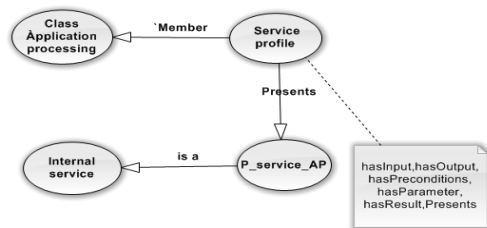


Fig. 7. An ontological representation of services

Fig. 7 shows the relation between service profile and service class. Classes of internal services that are invoked for executing the work procedures of issuing guarantees are described in Table 3.

TABLE III. THE SERVICE CONCEPT AND THEIR PROPERTIES.

Name	Properties	Individuals		
	Relations	Name	Property	Property Value
Internal Services	SubClass of availableOn	Service_A_P	Presented By	P_service_A_P
		Service2		MService2
		Service3		MService3
		Service4		MService4
		Service5		MService5
		Service6		MService6

IV. CONCLUSIONS

In this paper, authors identify and analyze the electronic public services of the Guarantee Fund APV and present a method for the semantic description of electronic services using semantic markup standards that provide service-oriented architecture systems. We analyzed the Open Group technical standards for the creation of SOA Ontology and the W3C recommendation for creating ontologies for public electronic services, and compared them with our modeled service ontology of the Guarantee fund. Our ontology explicitly presents the elements that make it possible to provide the groundwork for creating components of the information system on the basis of knowledge of administrative processes and documents. Using the Open Group technical standards we verified the created Guarantee fund service ontology.

Further research should focus on the development of standards for describing and creating ontologies of the administrative processes within the domain of public administration. In this way, we would ensure, among other things, the basis for fast and efficient creation of information systems of the state administration, standardized in the aspects of interaction, visualization, maintenance and generation.

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