Ontology Driven Government Services Inventory and Business Process Management

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Abstract. In this paper, the experience obtained in the e-government project of Turkey is described, which consisted of three parts: inventorying all services and processes in all governmental agencies; modeling several of the processes identified with the help of Extended Event Driven Process Chain technique; and execution via transforming the model to a Business Process Management tool that allowed business activity monitoring. Due to size of the project, and the limitation of the paper, main focus will be on the inventorying. The paper first discusses the ontology design for Public Services in Turkey and the process of developing the ontology based services inventory management, as the basis for e-Government gateway. Then the discussion follows on how this ontology can establish the basis for the service-based process design and finally the pilot implementation for the selected citizen-centric processes is presented.

Keywords: public services ontology, government services inventory, service oriented process management.

1 Introduction

Turksat is the public enterprise charged with the management of e-Government gateway, namely the turkiye.gov.tr site in Turkey. It is essential that the electronic services be provided on top of common understanding of the public value delivery concepts, and as per the Information Society Action Plan [*1*], the Administration Development Agency (IGB) is responsible for the management of the inventory of government services, provided to the citizens, businesses, other public agencies and to the employees of the agency. IGB first designed an Excel spreadsheet to record the information on existing services and sent the template out to all agencies to be filled in, which resulted in thousands of lines due to the lack of common understanding as to what a service is. Following a two year study, the resulting consolidated document was not consistent, contained different levels of details, lacking direct service delivery tasks, and the need for a controlled vocabulary was immediately recognized. Then, IGB subcontracted Turksat to deliver the inventory, based on international standards.

A team of experts, led by team leader delivered the Public Services Inventory through an ontology based model, capturing details in a comprehensive field study in

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Erzincan. This work resulted in only 950 services, with the exception of port management, and customs. After establishing the model for the Public Services Ontology, the team also modeled three important services to the citizens using extended Event Driven Process Chain model [*2*], applied the process models to a Business Process Management engine, and delivered the running portal structure with almost no direct coding for the software development.

In this paper, the authors would like to share their experience and the models developed within this 6-month study, which will establish the basis for all the e-Government services in Turkey. To complete the inventorying part, the analysis team created a high-level view on the agencies functioning that ties up such concepts as Service, Business Process, Laws and Regulations, etc.

1.1 Ontology and the E-Government

Ontology is the science of analyzing structures of objects, properties, events, process and relations in every area of reality [*3*]. Ontology in the knowledge domain means specification of conceptualization. That is, ontology is a description of the concepts and relationships that can exist for an agent or a community of agents.

Ontology models are designed to be used as a medium of knowledge sharing and reusing; together with a set of individual instances of classes (concepts), it constitutes a knowledge base. Common components of ontology models include:

- Classes: collections, concepts, kinds of things that have certain things in common
- Individuals: instances, objects, or elements of classes.
- Attributes: aspects, properties, features, characteristics, or parameters that objects (and classes) can have
- Relations: Properties, slots, ways in which classes and individuals can be related to one another

The ontology models were developed:

- to share common understanding of the structure of information among people or software agents,
- to enable reuse of domain knowledge,
- to make domain assumptions explicit
- to separate domain knowledge from the operational knowledge, and
- to analyze domain knowledge [*4*].

Within the context of the aforementioned descriptions, ontology model is a must for any domain of knowledge that has a wide range of contributors and agents. That's why a concrete ontological model of government services will be a basic starting point for:

- developing a common explicit model for all government services,
- sharing the same types of methodology among all agents of public services,

- business analysis and redesign of government services in order to eliminate redundant tasks and reduce bureaucracy, which is a common problem in public services worldwide,
- establishing a concrete infrastructure for e-government applications, and
- being able to perform an impact analysis among the objects of the model, to the extent that, the administration should be able to answer questions such as what happens if an article of a certain regulation is changed, what would be the effect of this change on the processes, authorities and other classes of the public services; and what needs to be done at the organizational, data, legislative, and process levels to be able to move the service delivery channel to electronic or mobile media.

1.2 E-Government, One-Stop Public Service Delivery and Erzincan Province Pilot Project

The efforts towards establishing a one-stop service point for all public services has a long history in Turkey, in fact over ten years, and some important progress has already been made, but it's far from being adequate. One of the shortcomings of these efforts is that, there has not been any attempt towards modeling all government services which will include all regulations, responsibilities, processes, and other objects within the public value delivery chain, with their relations and attributes for every government service. Such type of a model will form a structured public service inventory and will form the knowledge base among all stakeholders in the management of public services as well as the process and data integration within e-government.

Erzincan Province Pilot Project (EPP) was planned by IGB through Turksat to serve the ultimate need for the development of such a model in the area of public management and to achieve e-government integration and management.

The EPP Project was implemented in cooperation with Turksat, Erzincan governorship and TNS Consultancy. It took about 6 months, with an extensive field work, performed by 7 consultants and 5 local employees. Firstly, a model was established by the consultants and then a field work lasting for about 4 months had been carried out. In this field work, 28 local government agencies were visited and all services of those agencies were analyzed through formal data collection mechanisms and modeled accordingly. The total number of services modeled is 950. Later, the model was implemented on Software AG's CentraSite program development environment, and all model parameters for each instance of service inventory were transferred into the electronic environment.

In the project management of EPP, budget, human resource, and time management techniques were integrated to provide a concrete and controlled management environment. At the beginning of the project, the purpose, scope of the project and methods which were going to be used in the project stated explicitly and management accepted them for achieving the expected results.

The main steps of the project were:

1. Project Orientation,
2. Development of field work application model,
3. Formation of notation for business analysis activities,
4. Training of the field work employees for standardized data collection,

5. Data Collecting for model development in Erzincan Province,
6. Development of the Ontological Model and the software development, using CentraSite software platform,
7. Transferring the field work data to the CentraSite,
8. In-depth analysis of the selected three public services, using predefined notation,
9. Integration of these services to electronic servicing environment (www.turkiye.gov.tr), and
10. Preparation of project report and closure.

The analysis and model building phases were divided into ten categories:

1. Analysis of taxonomic structure of government legislation.
   In this step all government legislations were analyzed and categorized. They were ranked according to their priorities in general public management. For example, a law accepted by National Assembly dominates a bylaw and a by-law dominates a mandate. Those relations were listed and categorized in order to build the taxonomic relations.
2. Analysis of hierarchical structure of public institutions.
   In this step, a general hierarchical structure of public institutions was analyzed and categorized according to their rank in public management. This provided a solid base for the work flow of public services.
3. Analysis and categorization of public services.
   The categories of government services were classified according to service users. This was done in parallel with the approach widely used in e-government theory and applications.

   GC: Services given from Government to Citizens
   GB: Services given from Government to Business
   GG: Services given from Government to Government
   GE: Services given from Government to Public Services

4. Building the ontological model.
   In this step, first version of the generic ontological model was built. This model included:
   - Classes: Group of substances which share the same existence relationship in public management domain,
   - Instances: Elements of classes,
   - Relations: Types of relations among the classes, and
   - Attributes: Descriptors or values that are generally associated with individual classes.

   The first version of the ontological model was a generic model for public management which included all activities from planning to the application phase.
5. Forming questionnaires in parallel with ontological model.
   In this step, questionnaires that would be used in the field work were prepared. This was done in parallel with the ontological model. However, it didn't include all answers needed by the model, mainly due to the inability in obtaining values of some attributes from the field work.
6. Compiling questionnaire data collected from EPP field work:

This phase included:

- Training of local team members about the project, method, and inquiries.
- Forming visiting groups and organizing their assigned public agents.
- Initial visits to the public agents and discussion of the results.
- Revision of the questionnaires.
- Completion of the fieldwork.

7. Programming the Ontological Model and transferring fieldwork data to electronic processing environment.

   In that phase, all data collected from the fieldwork was transferred by using a programmed version of the model in Software AG's CentraSite programming environment

8. Designing a model for a selected public service for the application of the generic ontological model.

   Green card public service was selected in order to validate the generic ontological model. The service responded to all aspects of the model in terms of classes, instances, relations and attributes.

9. Integration of the selected pilot service to electronic servicing environment.

   Using extended Event Driven Process Chain model, and submitting the selected Green Card process model to a Business Process Management engine delivered the running portal structure with almost no direct coding for the application development.

10. Feedback and monitoring of the model.

    The model was revised upon the field work experience.

2 The Ontology of Government Services of Turkey

The developed Ontological Model has 21 classes. In the determination of these classes, the nature of public services, their servicing environment, effects to the public and their representation in strategic management of public agencies were taken into account.

Each one of these classes has its own instances. For example, the service class has 950 instances, which refers to all of the public services captured in the EPP Project. The total number of relations among these 21 classes is 166, and the total number of attributes is 110. Table 1, depicts a brief outline of the ontology developed as the first major step of this study.

Table 1. The Overview of the Ontological Model

Class	# Relations	Description	Key attributes
Service	17	The name of the public service presented to the user	Type of service, medium of application for service, medium of declaration for the result, service channel, the category of service, mean time of service, total number of services per year

Table 1. (*Continued*)

Class	# Relations	Description	Key attributes
Regulation	6	All regulations related with service including traditional (non-legislative) ways of performing service, processes and activities	Types, number, date of acceptance, date of application, date of removal, related legislative article
Process	18	Set of functions/ activities to complete service delivery	Cycle of the process
Entity			
User	3	User of the service (citizen, business, public agency, employee)	Depending on the type of user date of birth, gender, citizenship, residency, date of death type of the business, date of foundation, date of close
Unit	3	User of the service	Type of unit, date of foundation, date of close
Plan	10	Any type of plan including strategic plan which has a relation with service	Date of start, date of end, responsible authority
Activity	12	Step of a process	Mean time to complete, average delay time, maximum and minimum times for completion
Input	6	All sorts of documents and data used during the production of the service	Type of input, main or supplementary, electronic or hard print
Output	5	All sorts of documents and data generated during execution of the process	Type of output, main or supplementary, electronic or hard print
Role_1	9	The role of authority delivering the services	Function and type of role
Role_2	1	The role of applicant demanding the service	Function and type of role
Article of the Plan	4	Any article of any plan that has a relation with the service	The article number, chapter, associated goal, goal indicator, performance indicators, responsible authority
Article of the Regulation	5	Any article of any regulation that has a relation with the service	Type of regulation, number, article number
System	2	The system, either manual or electronic, used in the service delivery	Type of system, accessibility, interaction with other systems

Table 1. (*Continued*)

Class	# Relations	Description	Key attributes
Source	3	The source used in the service delivery	Type (human, IT, information, time, budget, moveable assets, fixed assets and their descriptive attributes such as amount, unit, capability)
Risk	7	Any type of event that will negatively impact service delivery or diminish the benefit of the service	Type of risk, probability of risk, impact of risk, risk mitigation
Control	7	Specific activity to check the compliance (ref. Internal Control)	Type, phases, frequency, place
Critical Success Factor	3	An element that is necessary for a service to achieve the expected result	Type, degree
Result/ Benefit	3	A clearly defined outcome	Type of benefit and result
Indicator	9	A numerical measure of the any value related with service and other or other classes	Type of indicator, minimum, maximum, value

The entities in Table 1 can also be represented as given in Figure 1:

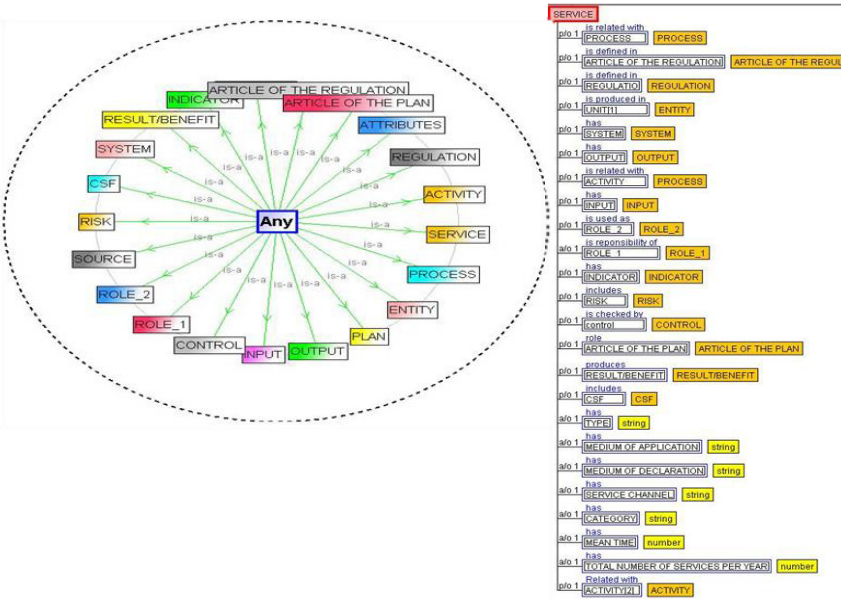

Fig. 1. Classes of the Model

Since the focus is on the service delivery, a closer look at the Service Class would be appropriate. The Service class can be represented as given in Figure 2:

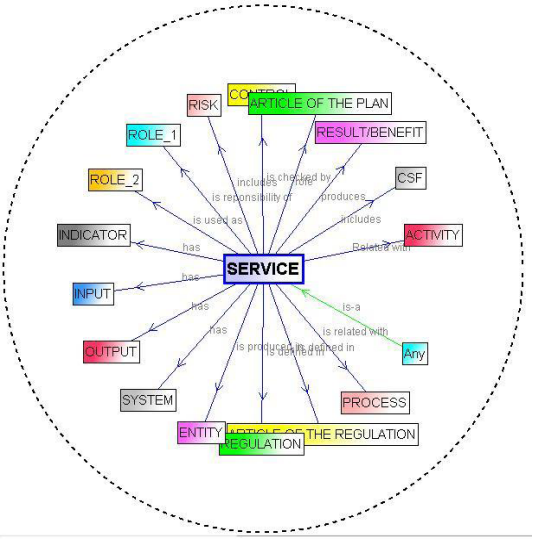

Fig. 2. Service Class and Relations

A further study on the Service class reveals the type of relations with other classes, dimensions and cardinality, as given in Table 2.

Table 2. Tabular View of Service and its Relations

SERVICE	Type of Relation	Class	Relation
Service	is produced in	UNIT	M:N
	is defined in	REGULATION	M:N
	is defined in	ARTICLE OF PLAN	M:N
	Uses	SYSTEM	M:N
	produces	OUTPUT	1:M
	is for	USER	M:N
	is related with	PROCESS	M:N
	is responsibility of	ROLE_1	M:N
	includes	CSF	M:N
	includes	RISK	M:N
	is checked by	CONTROL	M:N
	Uses	RESOURCE	M:N
	Uses	INPUT	M:N
	produces	RESULT/BENEFIT	M:N
	is defined in	ARTICLE OF REGULATION	M:N
	Has	INDICATOR	M:N
	is used as	ROLE_2	

At this stage, the relation between the Service and the process is of M:N type, however, as further refinement occurs, another entity, called Business Process is defined to change the relation to 1:M type. This is in line with the condition that, one or more processes might be required to complete a Service. A Business Process in itself is meant to deliver value to the user, and this is why it will have to be treated as another Service, hence the Service has a cyclic relation with itself; one Service may be a combination of other Services.

One of the important outputs of the EPP Project was the ontology model of the public services inventory. This inventory might provide answers to some fundamental questions for public services in Turkey. Some answers that the inventory provided are:

1. Service to process relation (which processes are required to deliver a particular public service),
2. Information about regulation of any kind (Law, Cabinet decision, etc.)
3. System environment of public services, computerized tasks in the process,
4. Number of inputs and their types, which can also be used in calculating the bureaucracy level indicator,
5. Generated outputs and their types,
6. Total number of services used by citizens, public agencies, businesses and NGO's (non-governmental organizations)
7. The mean time of completion of each service and its activities, cross-linked to the process activities,
8. The role of the applicants,
9. The number of activities in servicing and responsible authorities of these activities,
10. The complexity of business of each service (bureaucracy level indicator) which is scored using number of documents, number of activities and the number of services given per year,
11. The number of usage of any specific type of input for all government services (the frequency of usage of any document and for the high frequency inputs a shared web service would be a fast solution to decrease bureaucracy and duplication),
12. Problems (bottlenecks, redundant activities, organizational issues, and legislative concerns) and solutions / improvements of service delivery, via performing simulations on the process models,
13. Problems and solutions / improvements of service delivery, via online measurement of processes utilizing Business Activity Monitoring,
14. Commitment to delivery (service level agreements) through measuring process performance metrics,
15. Identification of manual vs. computerized operations, and
16. Impact analysis (effect of one perspective on the others). This is basically finding answers to HOW questions, such as How to improve services through process management?; How does technology affect process performance?; How to compare different geographical and cultural approaches on the execution of service delivery processes?; How does a change in a legislation affect service delivery?; How to identify which legislative/regulative changes are required if processes are redesigned?; etc.

Questionnaires were prepared regarding the generic ontological model. As it was stated before, it didn't include all the answers to the model, since it was impossible to get some answers from the fieldwork. The questionnaires were composed of five sections:

1. First part included 8 questions about service to define the fundamental attributes of service, in terms of application and the results of it.
2. The second part was about the legislation framework of service regarding the taxonomic structure.
3. The third part was about inputs (documents in either hard or softcopy) required for application.
4. The forth part was about business flow of service, after application.
5. The last part included outputs of the service and their target users; namely the citizens, businesses, or other public agencies.

3 Business Modeling and Integration

For the pilot implementation of the ontology based process models, three services were chosen, namely Green Card, Retirement, and Traffic Fine Payments.

The Green Card public service is for the citizens who have no social security and inadequate income to personally finance their health expenditures. These citizens in need are issued green cards after 14 step verification through 10 different agencies, entitling them for free medical care. All medical expenses are then charged to the green card, and covered by the government. These citizens constitute 20% of the total population of Turkey. The total health expenditures financed through Green Card system is 3.5 billion USD per annum. Currently, the appraisal of the applicants for the Green Card is a long process which includes collecting information about from 10 different systems by means of paper documentation. It's a time consuming and costly process both for citizens and for the government. Public institutions and application services included in the realization of green service is depicted in Fig 3:

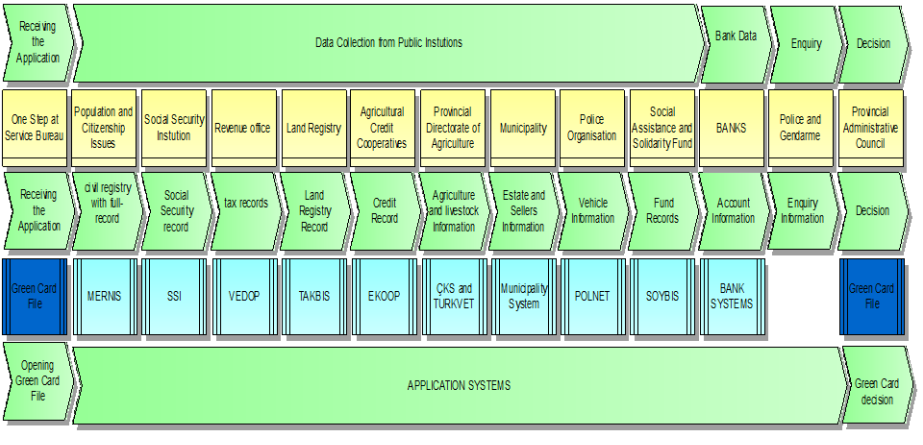

Fig. 3. Value Added Diagram of Green Card Service

Process centricity and continuous process improvement was targeted for the entire service processes covered as part of the project, where Business Process Management (BPM) was used as a tool for the management of the business processes.

BPM Suite used enabled the project team to automate and control processes as they are executed. Process modeling was done to facilitate the use of this suite.

For implementation, WebMethods programming environment was used as the BPM Suite to manage and integrate Green Card Service to electronic servicing environment.

4 Lessons Learnt

EPP project was planned to respond the needs of global modeling of public services. During the modeling efforts, the main problem was about the definition of the service and the process. A clear answer was needed to service and process classes of the model in order to determine the elements of service inventory correctly.

The following answers were developed for the controlled vocabulary:

Service: All individual business processes, combined together to respond a specific needs of the citizen, business or public entities. A service might be started either by the application of user or spontaneously by the bodies of service provider. A value should be delivered by the end of the service which serves a specific need of the user. The value delivered should be for some entity which is out of the body of the service provider. A service can be used by another service.

Process: Complete business process or its subset which is carried out in compliance with a legislation framework. A process can be used by another process.

The main difference between service and process is that, in the service case a value or benefit should be delivered for any entity which is out of the body of the service provider. However in the process case, this is not a must.

Another key issue in the development of the ontological model was the role and relationship concept in the determination of classes, relations and attributes. For example, a public service unit that executes service is a class or an attribute of the service?

In ontological modeling, John Sowa [5] introduces the *firstness* and the *secondness* of concepts. The former is roughly defined as a concept which can be defined without mentioning other concepts. Examples include ion, a man, a tree, etc. The latter is roughly defined as a concept which cannot be defined without mentioning other concepts. Examples include wife, husband, student, child, etc. [6] Since, a public service unit can be defined as an independent concept it should be treated as firstness group. A concept in the firstness group is a class and a concept in secondness group should be an attribute of a class. For example, date of issue of a law is a secondness concept and it should be an attribute of regulation class.

5 Conclusion and Future Work

In this paper, firstly a generic ontological model of the public services was discussed. Then an application method was discussed for a fieldwork study which was realized in order to build business inventory of public services. The application method includes

all the steps from building theoretical ontological model to integration to e- servicing environment.

Our study provides extensive theoretical information and application experience for public modeling analysis and integration to e-government.

Our generic ontological model combines and harmonizes various proven techniques such as qualitative analysis, ontology development, process management including modeling via process chain diagrams, execution and activity monitoring via software support. The model completes a streamlined and integrated cycle from conceptual design through to continuous monitoring and evaluation based on ontology and process approach.

We have also clearly identified the relations and differences between the foundational concepts such as service vs. process, and entity vs. attribute within the scope of government e-servicing.

Finally, we have developed a field study method applicable to almost all government agencies, taking into account management and human resources social and psychological success factors, applying empirical data collection to the theoretical model developed as instances.

Hence, our generic ontological model and the streamlined management process were extensively tested, using sample services and revised into a version that is applicable for all public services.

The methodology developed added to the experience of the team members in the use of the methodology in related areas.

This project was one of the first in Turkey combining multiple disciplines, resulting in an applicable model at government service delivery. We also believe that, our approach will also be useful to other countries as well. However, there is still more work to do, as follows:

- Extension of the model by adding a service life cycle and document (paper or electronic) taxonomy
- Extension of the model by adding instances of missing customs and maritime services
- Extension of the model to cover whole of the country, and establishment of a related governance model, including establishment of dynamic management structure involving major stakeholders
- Detailed application of the model to specific service domains such as education, health and public financial management.
- Possible revisions after wide-spread application, which is possible as Turkey now has a legislation for the usage and population of the model to keep it as a live system.

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