A MODEL FOR STRUCTURING INFORMATION RESOURCES IN E-GOVERNMENT

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Abstract

In the past years, the interaction level between citizens and government has significantly risen. Due to the growing number of services provided by e-governments, the information resources in e-government systems are becoming increasingly complex and vast.As a result, structuring information, so it can easily be understood and further used, has become a vital topic. This paper gives an overview of the situation of e-government in Serbia, with a special emphasis ontwo main aspects of using the information resources:analyzing current situation and decision-making. This paper deliberates the application of a model for structuring e-government information resources using faceted taxonomy.Faceted taxonomy represents a set of taxonomies, each one describing the domain of interest from a different, preferably orthogonal, point of view. This model would facilitate the understanding of relationships between different pieces of information in the system and therefore, improve the efficiency of use of the information resources in the system. The paper clarifies the guidelines for practical implementation of the model and deals with the transition process. The work also depicts the possible benefits of applying the faceted taxonomy model to the e-government system.

Keywords/Key phrases: faceted taxonomy, faceted navigation, e-government, information modeling

1 Introduction

Many governments all over the world are trying to change their traditional profile to an electric one. The work of these e-governments is generally oriented towards providing services, hence one of the most overlooked topics in the recent debate on e-government is the structure of e-government information resources.Scholl(2005)states that many e-government initiatives are subject to an iceberg phenomenon. The top of the iceberg is the government's interaction with citizen and business, which is quite noticeable. The government's internal efficiency and effectiveness, on the contrary, is largely overlooked because it is buried below the surface and therefore, much less visible. This paper

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proposes a model that will aid the employees in government in the processes of searching information, analyzing information and decision-making. The model relies on the concept of faceted taxonomy.

1.1 Information resources in e-government systems

The security aspect of information resources has been discussed in the literature by several authors, including Zhao & Zhao(2010) and Lambrinoudakis, Gritzalis, Dridi& Pernul(2003).One other aspect of information, that has not been researched sufficiently, is analyzing the information in e-government systems. Understanding and analyzinginformation resources in the system is one of the key prerequisites for further development of e-government services.Browsing and querying databases that consist of thousands of information items is quite challenging for an average user. Due to a great number of information items in governmental databases, examining the information in the system represents one of the key issues in the internal work of e-government.Sacco(2000)definesphases of access for the user of a complex information database. First phase is the locator phase, when the user tries to pinpoint the needed information. Key points in this phase are query formulation and the review of the result list. The second phase is called the navigation phase. In the navigation phase, the user uses the result list from the previous phase as a basis for further examination of relationships between items. If the user is not certain what he/she is looking for, or what the contents of the database are, a problem emerges. This situation can often result in imprecise queries that lead to thousands of information items or no items at all.

1.2 Information resources in e-government in Serbia

[E-government strategy in Republic Serbia, for the period 2009-2013] (2008)states that e-government system in Serbia is characterized by insufficient development of common ICT network and standardization protocols. The document also states that one of the main goals of e-government is to increase the efficiency of government, by using modern ICT. Republički zavod za informatiku i Internet (2009) proposes guidelines for implementing ICT, specifically guidelines for building a web portal of the local authority.The document proposes the use of a Content Management System, that could facilitate the process of maintenace. There are no further guidelines that suggest the necessary characteristics of the information system of the local authority. Therefore, every local authority has the possibility to choose an information system that suits the needs of that local authority.

1.3 Taxonomies

Simple taxonomy represents a process of organizing and grouping entities into classes, arranging classes into groups, and naming these groups. The result of a simple taxonomy is usually a tree-like classification with named leaves. The process of creating taxonomy begins by defining the *taxonomy universe*. Taxonomy universe represents all the entities that need to be classified.For example, if we want to classify cars, we will observe the universe of cars. Next, we need to choose one attribute, according to which we will group these entities. If two entities share one attribute equally in measure, intensity or extent, we can say that these entities are like, with reference to the mentioned attribute. If we choose the “size” attribute, we can then say that all cars with the size attribute value “small” are like, with reference to the size attribute. We can also group these cars into class “small cars”. Simple taxonomy allows us to classify the universe according to one attribute, but real-life information usually demands classification according to multiple criteria. Figure 1 shows how analyzing different criteria helps us pin point the entity we need.

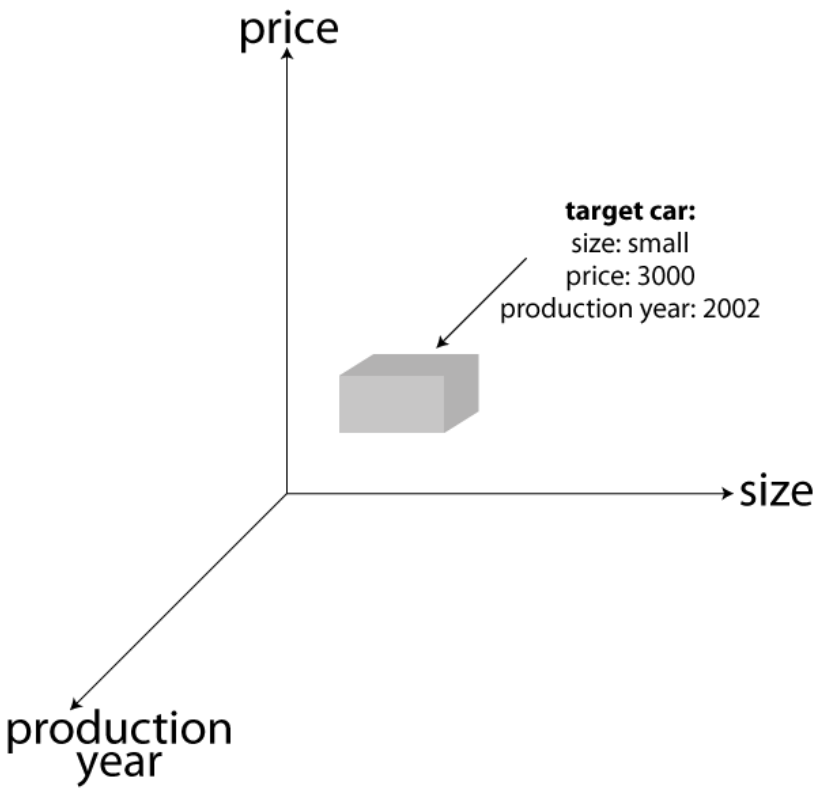
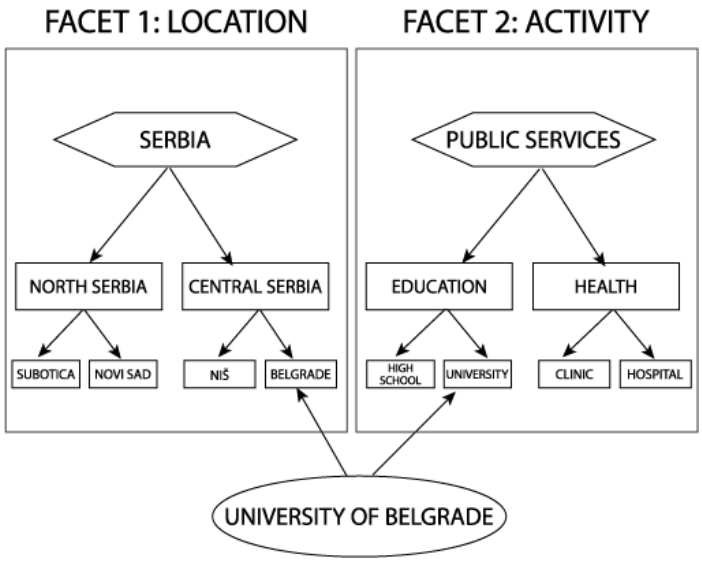


Figure - Pinpoint an entity by analyzing multiple criteria

In the previous example, we would want to classify the universe of cars according to attributes “size”, “price”, “production year” etc. This is possible only when using faceted taxonomy. Ranganathan (1965) defined faceted taxonomy as a set of taxonomies, each one describing one domain of interest, from a different, preferably orthogonal point of view. To put it simply, faceted taxonomy alows us to classify one universe of entities according to several criteria. Tzitzikas & Analyti (2007) also define materialized faceted taxonomy as a faceted taxonomy accompanied by indexes of objects. Figure 2 shows a simplified example of a materialized faceted taxonomy with two facets. In the given example, one object (University of Belgrade) belongs to two different facets, and is categorized according to two different criteria.



Depending on the implementation, browsing and searching can be performed in several different ways in faceted taxonomy. Faceted navigation is a term used to describe one way of browsing information in faceted taxonomy. This process begins with a representation of all the entities in the universe, along with the representation of the faceted taxonomy.The user then performs the zoom operation - selects one node in the taxonomy, and as a result sees the subset of the original universe along with the adjusted representation of the taxonomy. Sacco (2007) defines the term zoom operation as well as the term dynamic taxonomy.Dynamic taxonomy is a taxonomy that is able to dynamically adapt to a certain subset of the universe, according to the user’s choice.

Ranganathan (1965) developed the colon classification system that was the first classification to apply the principles of faceted taxonomy. According to Ranganathan there are five fundamental categories: Time, Space, Energy, Matter and Personality.

There can be several facets in one category. Besides fundamental categories, every entity belongs to one Basic Facet. Time represents the common meanings of the word time, including seasons and meteorological qualities, such as wet, dry, stormy. Space represents geographical terms, physiographical terms and areas occupied by people (e.g. city). Energy embodies actions of various kinds: conceptual, intellectual, animate etc. Manifestations of the category Matter can be of two kinds: Material and Property. Defining category Personality presents a great difficulty. Besides representing manifestations of personality in wide range of meanings, other manifestations that are easily determined not to be one of the four previously mentioned categories, belong to category Personality. This is the Method of Residues.

2 Related work

Faceted taxonomy is very convenient because it can be applied to various domains: e-business, multimedia databases, geo-hydrological matters, etc. (Sacco, et al., 2011) Commercial web shops were the first ones to start the intensive usage of faceted taxonomy. Examples can be seen on bestbuy.com or shopping.com. Faceted navigation feels very natural to human navigators because people tend to think about things from different perspectives. Hence, faceted taxonomies and faceted navigation became very widespread in recent years.Faceted taxonomy is also very compatible with different innovative technologies.Vandic, van Dam, & Frasincar (2012)propose a faceted taxonomy search platform that uses semantic web technology, and is available on-line at http://www.xploreproducts.com. In the field of e-government, some solutions based on faceted taxonomy have been proposed. Proposed solutions focused mostly on e-government portals. Results of these solutions were usually increased usability and navigability for the users of government portals. Modern architectural concepts based on faceted taxonomy have also been proposed (Gupta et al., 2009).

3 Model for structuring information resources

3.1 Definitions and explanations

Level 1 facets can be divided into level 2 facets and so on. Final facet is a facet that can contain only labels. The notation is following: Final facet = {Label1, Label2...}. Labels can contain sub-labels. One document can be associated with maximum one label in one final facet, and with maximum n different facets where n is the number of final facets. Figure 3 illustrates previous definitions. In the example, Location is the level 1 facet that

is further divided into level 2 facets. Both of these level 2 facets are final level facet since they contain a hierarchy of labels. A book “Hello world, A novel by Mr. Smith” can be associated with only one label per final facet. From the figure we can see that the book was published in USA, Seattle, while the author’s hometown is UK, Brighton.

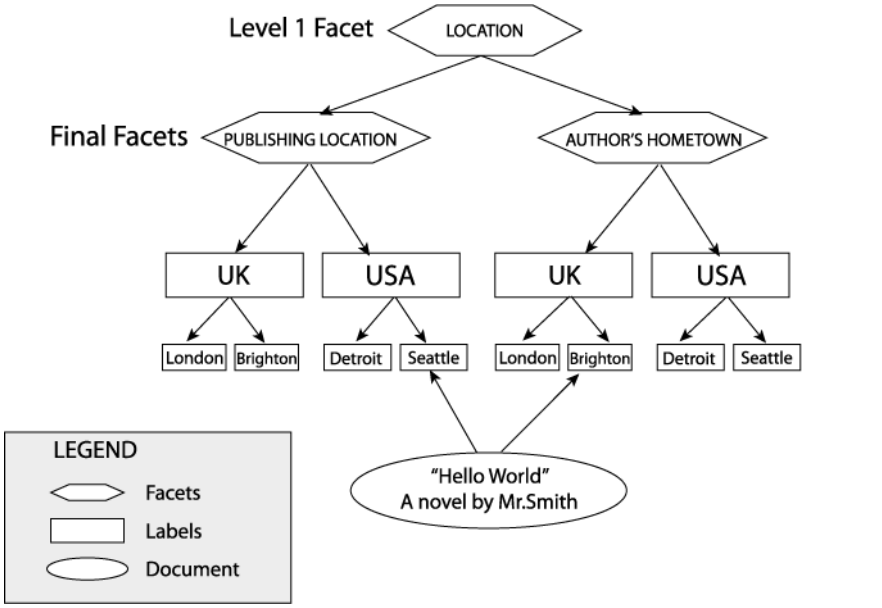


Figure - An example illustrating the terms facet, final facet and labels

3.2 Model proposition

In the case of e-government, we consider a universe of information resources in the system, specifically a universe of documents in the system. We can say that this is a growing universe, due to the fact that entities (i.e. documents) will be added to it from time to time. The proposed model (specified in Table 1) was created by analyzing all the services provided by e-government in Serbia. Analysis was performed according to the official information (Republički zavod za informatiku i internet, 2010). The model is, therefore suitable for documents related to services.

Table - Faceted taxonomy model

CATEGORY	FACETS (LEVEL1)	FACETS (LEVEL 2)
Basic facet	By service	Service type = {Services to citizens, Services to business}

	type	
Time	By document time	Year
Space	By request location	Region
Energy	By status	Status = {Request, Confirmation, Object}
	By operation	Operation = {Issuing documents, Providing information, Scheduling appointments, Registering documents (or requests)}
Matter	By immobility	Housing, Transportation
Personality	By user group	Age group, Sex group, Vulnerable group
	By institution in charge	National level institutions, Regional level institutions, Local institutions
	By topic	Topic = {Health, Education, Employment, Environment, Tax, Human rights, Social welfare, Personal documents, Business documents, Law, Security, Manifestations, Sport}

Thorough explanation for the model is following.

- Basic facet
    - By service type: All services in e-government system in Serbia can be divided by the type of service users, into two main categories: services to citizens and services to business, hence the Basic facet of the model is

By service type that has two labels {Services to citizens, Services to business}.

- Time
    - By document time: Meaning differs for different document statuses (see below Energy- By status). This facet is of great importance when searching and analyzing the information in the system. Classic classification of Time should be applied (i.e. Years should be divided into Months, Months into Days).
- Space
    - By request location: Classic classification of Space should be applied (i.e. Regions should be divided into Municipalities, etc.).
    - (This category can be expanded with additional facets, such as By user's location or similar)
- Energy
    - By status: Documents related to services can be either Request for a service, or Confirmation for the service provided (or service declined or operation performed). Document included in the service are Object documents (e.g. A birth certificate requested by the user, that is yet to be handed to the user). This facet should be mandatory.
    - By operation: Documents can relate to several types of operations. Issuing documents is self-explanatory. Providing information stands for providing simple pieces of information, for which no formal paper is needed (e.g. list of available medications). Scheduling appointments can be described as scheduling appointments with officials, appointments for a certain service or similar. Registering documents refers to registering user's documents (e.g. birth certificate issued by the hospital) or registering user's request (e.g. request for tax relief).
- Matter

- By immobility: Housing represents all types of housing facilities, building and construction material, and can further be divided into groups, according to specific needs of the system. Transportation represents all types of transportation and transportation related materials.

- Personality

  - By user group: User groups facet includes level 2 facets Age groups, Sex groups and Vulnerable groups, but additional level 2 facets based on demographic criteria should be defined.

  - By institution in charge: This usually refers to an institution that will provide the service itself or will participate in the provision of the service (e.g. National tax service will participate in the service: Income tax registration). This facet contains three level 2 facets.

  - By topic: All topics can further be specified. Health can be divided in Health insurance, Biomedicine, Medications. Education can be divided into Libraries, High education, Professional development. Employment can be divided into Inspections, Unemployment. Environment can be divided into Ecology, Construction, Architecture. Tax can be divided into groups of existing taxes. Personal documents and Business documents can be divided into groups of explicit document types (e.g. Personal documents: ID Card, Passport, Birth, Marriage and Death certificate, Work permit etc.; Business documents: Company registration, Earnings testimonial, etc.)

Figure 4 shows the example of the model with two example documents in the system. In the third column, cells containing labels are filled with light gray color. The example illustrates associations of each document with labels in the facets. Document ‘ID Card Request #123’ is a document related to Services to citizens. The request was made 1st January 2012 in Belgrade. The status is Request, since this document describes the user’s request for a certain service. The operation of this service is Issuing documents, while the topic of the service is Personal documents. The user who made this request belongs to the user age group Senior. This user can further be associated with labels in other final facets (e.g. with a label Male in the final facet Sex group).

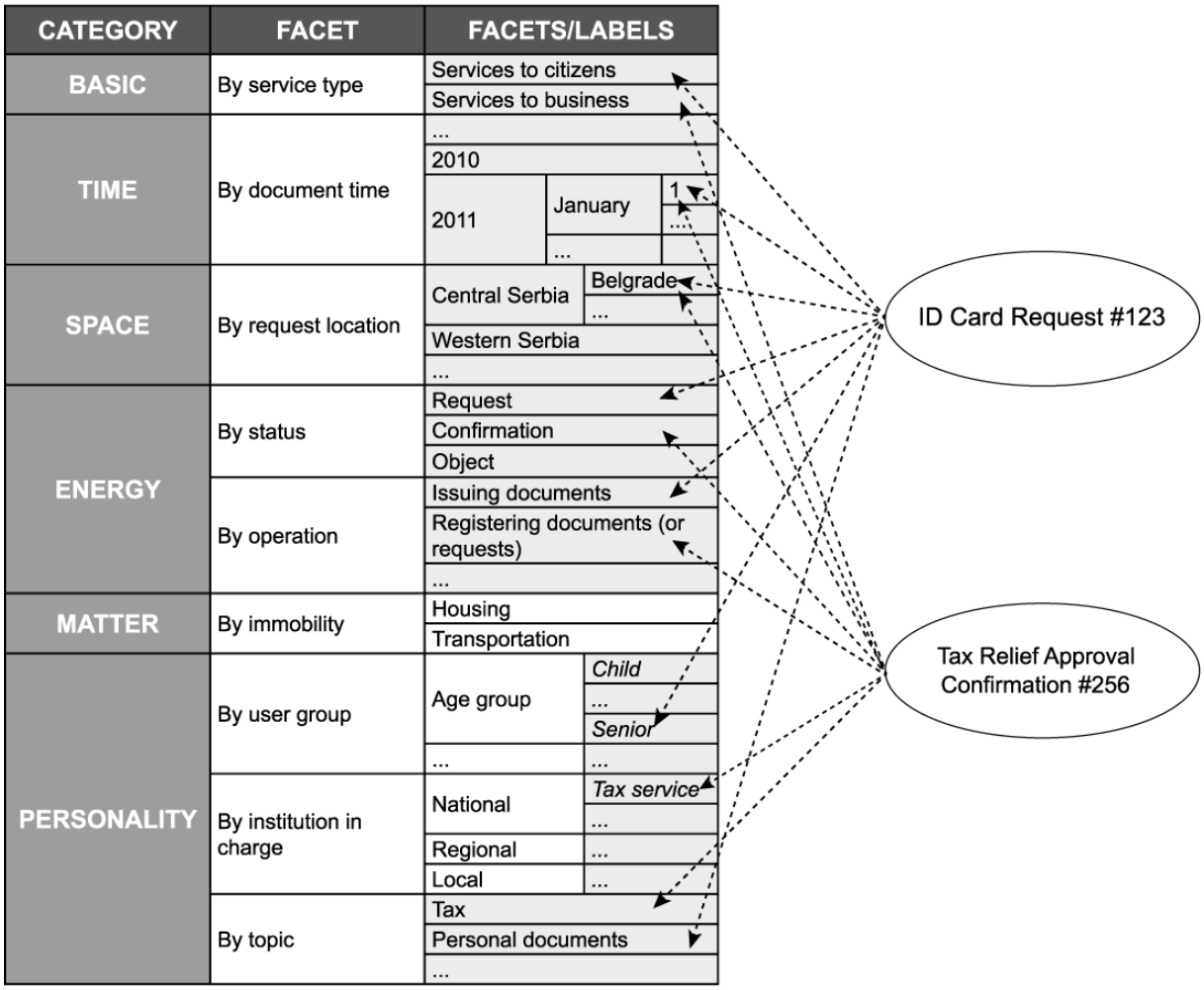


Figure - Example of the model with two documents classified

4 Model architecture

All the service related documents should be tagged with terms from the taxonomy. These tags can be generated automatically since all the relevant information is contained within the document itself. Many classification theories that focus on library science state that there can be difficulties with determining the attributes for some entities. Attributes can be explicit, implicit in the context or hidden within a derived composite term. In e-government information resources, this dilemma is reduced to the minimum. The attributes of the documents in e-government will almost always be hidden within the subject of the document or the fields in the document. Hence, it will be possible to automatically generate the tags needed for the classification. This model is an information model that does not include implementation specific details. The model can be mapped to an actual implementation in several ways. The proposed architecture of the information system is represented on Figure 5.

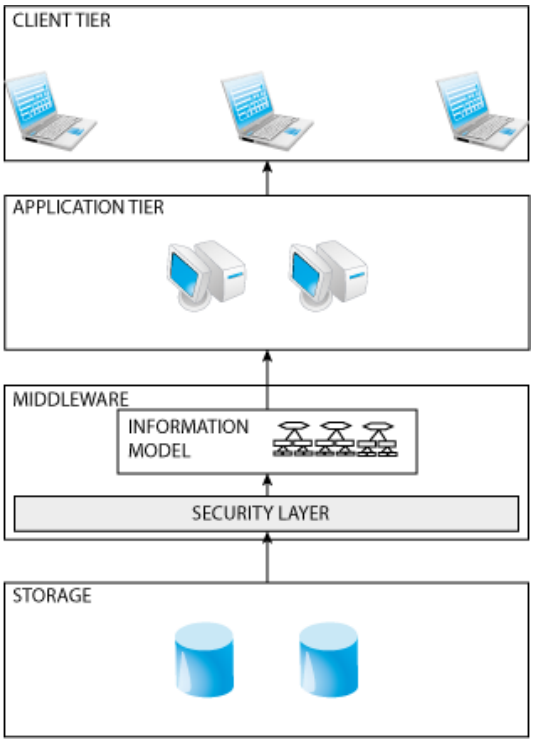


Figure - Proposed architecture of the system

5 Benefits of the model

One of the first benefits of the model that emerges is the power that faceted navigation allows. Papa (2006) states Busch's golden law of facets: "Four facets of 10 nodes each have the same discriminatory power as one taxonomy of 10,000 nodes."Thereafter, it is also obligatory to examine the user-friendliness and success of faceted navigaion in application. Several authors studied this issue. Pratt, Hearst, & Fagan (1999) conducted a study to examine whether faceted browsing was better than clustering and relevancy-ranked results. Study showed that users found more answers with faceted interface, than with other browsing methods. Users' satisfaction with the faceted browsing process was also much higher than with either ranking tool or the cluster tool.Research by Uddin & Janecek (2007) that focused on academic staff and students, also showed that the success in finding relevant results was higher with faceted system than with traditional list system. This research points that most useful features of the faceted systems, in the opinion of the participants, are: possibility to switch from one facet to another, possibility to combine facets, preview the result set and navigate via breadcrumbs.

When faceted taxonomy is applied to the specific domain of e-government, several benefits are recognized:

- Automatic creation of summaries for the documents. The summary can be created according to document's associations with the taxonomies. In the example in section 3 (shown on Figure 4), summary of the document 'ID Card Request #123' would look like:

Service type – to citizen; Document time – 2011.Jan.10; Request location – Central Serbia.Belgrade; Status – Request; Operation – Issuing documents; User group – Age group.Senior; Topic – Personal documents.

- Locating documents by an attribute that was not explicitly stated in the document, but its value is uniquely defined by the laws of the taxonomy. In the example shown on Figure 4, user could search for all documents with request location in Central Serbia, even if region is not explicitly stated in the documents. This possibility is provided by the structure of the information model.

- Detailed analysis of the documents by exploring the relationships in the taxonomy. For example, user could select the label 2011 in the taxonomy, and by performing the zoom operation, see all the documents dating from 2011, as well as the adjusted focus of the original taxonomies. The true benefit of the adjusted focus lies in the fact that the user can see the quantitative aspect of the relationships (e.g. the number of documents related to 'services to citizen' dating from 2011).

6 Conclusion

In this paper we presented a model that can simplify the process of querying and browsing, and thus improve understanding of information and the relationships between different pieces of information in e-government. Taking into consideration the stated benefits of the model, we can conclude that this model would allows users to browse information in a clear and simple way. The model would also facilitate the understanding of the relationships in the model. It is particularly convenient that the proposed architecture of the system demands for no bigger changes or adjustments in other parts of the system. This leads to lower costs of implementation as well as cost of maintenance.

It would be crucial to perform further research in this area. Our main research task in the future include analyzing documents in the system together with a domain expert,

building a pilot model and using the pilot model on a set of information and evaluating the effectiveness of the pilot model.

7 Acknowledgements

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